JOURNAL OF THE TENNESSEE ACADEMY OF SCIENCE 84(1–2):13–35 JANUARY–APRIL 2009

ABSTRACTS OF PRESENTATIONS AT THE 2008 (118th) ANNUAL MEETING OF THE TENNESSEE ACADEMY OF SCIENCE

Nashville, Tennessee

21 NOVEMBER 2008

SYMPOSIUM ON ADVANCES IN TEACHING EVOLUTION

MICHAEL A. GIBSON, PRESIDING

TEACHING EVOLUTION. ***Frances A. Hamilton and Patricia M. Royle***, *Blanche School, Taft, Tennessee, and Camden Junior High School, Camden, Tennessee*. Evolution is controversial to teach. Teacher preparation programs mostly examine teaching methods for general topics, show how to create your materials, and discuss research behind using hands-on experiences. Students need to understand the importance of evolution to understand biological processes, such as adaptations, and it is imperative that they understand how things change over time to see the relationship in fossils and the geologic time scale, but evolution education should include geologic and other evolution. Many teachers struggle with teaching this evolution because they are not aware of its importance in integrating science and have poor backgrounds in pre-service training outside of biology exposure, believing it is isolated to biology. We are not taught how to teach evolution, often relying on years of trial-and-error and poor self-education. Because of its importance in understanding the fundamentals of science, it should be more of a focus for teacher preparation programs.

ADDRESSING THE STANDARDS FOR TEACHING THE CONCEPTS OF EVOLUTION IN K-12. ***Linda K. Jordan***, *State Department of Education, Nashville, Tennessee*. The State Board of Education revised K-12 science curriculum standards in 2007–08 with new features to greatly enhance teaching evolution. Framework components include *Conceptual Strands* that express "big ideas" of science. *Guiding Questions* provide clearly defined targets to sharpen and inform instructional articulation. *Learning Progressions* cluster interrelated ideas which become increasingly complex across grade levels and guide the development of *Grade and Course Level Expectations*. *Checks for Understanding* assess student progress toward meeting grade level or course level expectations. For example, the Conceptual Strand Standard 5.0 (Biodiversity and Change) is: *A rich variety of complex organisms have developed in response to a continually changing environment*. The Guiding Question in that standard is: *How does natural selection explain how organisms have changed over time?* Checks for Understanding then provide "suggestions" or starting points for assessing student learning and include formative assessments embedded within a lesson or a smaller unit of instruction.

HOW SCIENCE WORKS: THE NATIONAL ACADEMY OF SCIENCES, THE TENNESSEE SCIENCE FRAMEWORK, AND THE TEACHING OF EVOLUTION IN THE PUBLIC SCHOOLS. ***George E. Webb***, *Tennessee Technological University, Cookeville, Tennessee*. In the nearly quarter century since the publication of *Science and Creationism: A View from the National Academy of Sciences* (1984), the status and place of the teaching of evolution in the K-12 curriculum has remained a contentious issue. A comparison of the Academy's three publications addressing these issues (published in 1984, 1998, and 2008) provides a valuable overview of the changing environment facing teachers and policymakers. When examined within the context of the Tennessee Science Framework (1995), further, the Academy's efforts reveal the centrality of the underlying theme of the state's four science education components, namely, "how science works" (although this phrase does not appear in the Framework). This theme is essential for the education of future scientists, but it is equally crucial for the education of the well-informed citizens that have long been defined as the primary goal of public education.

CAN ASTRONOMY HELP WITH THE TEACHING OF EVOLUTION? ***Lionel Crews***, *University of Tennessee at Martin, Martin, Tennessee*. When discussing evolution, issues pertaining to astrophysics and cosmology such as the origins of the Earth, solar system, and universe invariably arise. One of the strengths of such a discussion can be how the models of astronomy are consistent with those of geology and biology. Recent measurements of the cosmic microwave background produce ages for the universe that are consistent with the geologic timeline. Primordial and stellar nucleosynthesis models yield a plausible method for the observed abundance of the elements. Stellar evolution models yield an age for the Sun that is also consistent with the geologic timeline. Examining properties such as surface cratering of other solar system objects like the Moon, Mercury, Venus, and Mars also reveals consistency in age. The discoveries of astronomy can therefore be used to support biological evolution indirectly through a consistent historical timeline and consistent physical models.

SOCIAL INFLUENCE AND THE TEACHING OF EVOLUTION. ***Brian Johnson, Angie MacKewn, Lionel Crews, and Michael Gibson***, *University of Tennessee at Martin, Martin, Tennessee*. The coverage of controversial topics, especially those that are only perceived as controversial by students, creates a different learning context than do innocuous topics. Evolution is a prime example of a concept that creates demonstrable negative

reactions from students. Social psychology, specifically the topic of social influence, helps explain why these and other negative reactions occur. Attitude accessibility and strength, persuasion and resistance to persuasion, as well as group polarization serve as social constraints that, in part, control and direct student behaviors regarding the topic of evolution. This resistance to evolution derives not only from student's negative attitudes but through social interactions with others who support and reinforce their perspective. Better understanding of how social forces help create and maintain student resistance can assist college professors in better preparing tomorrow's K–12 science educators.

TRAINING TEACHERS TO TEACH EVOLUTION: DO WE NEED A NEW APPROACH? ***Michael A. Gibson***, *University of Tennessee at Martin, Martin, Tennessee*. Evolution (cosmic, geologic, organic) is central to science, easily recognized, but explaining mechanisms of change remain challenging. Processes of evolution are generally treated as subtopics within biology, geology, ecology, or astronomy courses with emphasis placed on evidence demonstrating evolutionary change occurs. This apologetic approach, held over from the early days of trying to document the reality of change, is archaic and reflects lack of re-evaluation of how modern concepts of evolution should be integrated into science. Rather than a module or topic within courses, evolution should be THE central theme tying content together, thus forming the implicit backbone of course content. Science education curricula should include a course that is multidisciplinary, focused on the explanatory power of the science of evolutionary change, and emphasizing grade-appropriate concepts and methods of conveying evolutionary science through each vertical grade level and across lateral boundaries that separate individual sciences.

BOTANY

JOEY SHAW, CHAIR

THE COMPLETE CHLOROPLAST GENOME OF TALL FESCUE (*FESTUCA ARUNDINACEA*) AND THE COMPARISON OF WHOLE PLASTOMES FROM THE FAMILY POACEAE. ***A. Bruce Cahoon, Anhua Linn, Chansemone Mysayponh, Richard M. Sharpe, Elizabeth J. Thompson, and Andrea D. Ward****, *Middle Tennessee State University, Murfreesboro, Tennessee*. Chloroplast genomes (plastomes) are circular remnants of an ancient prokaryotic genome found in the current semi-autonomous organelle. Chloroplast plastomes are typically sequenced and analyzed for phylogenetic or genetic engineering purposes. In this presentation we describe the complete chloroplast plastome sequence of *Festuca arundinacea*; an economically important cool season grass used extensively for forage and landscaping. The fescue plastome is 136,219 bp with a quadripartite structure and a gene order similar to other grasses. 56% of the plastome is coding region comprised of 75 protein coding genes, 31 tRNAs, 4 rRNAs, and 5 hypothetical coding regions (ycf's). A comparison of Poaceae plastomes reveals a cladistic genome size split between PACC and BOP. Alignment analysis suggests several large deletions in intergenic polymorphic regions are responsible for the majority of the size discrepancy. Phylogenetic analysis using whole plastome data shows that Fescue closely aligns with *Lollium* which agrees with breeding and molecular data.

SURVEY AND DNA BARCODING OF GRASS SPECIES IN FLAT ROCK CEDAR GLADES AND BARRENS STATE NATURAL AREA, MURFREESBORO, TENNESSEE. ***Abby M. Drumwright, Brian W. Allen, and A. Bruce Cahoon***, *Middle Tennessee State University, Murfreesboro, Tennessee*. Flat Rock Cedar Glades and Barrens State Natural is an endangered cedar glade ecosystem. Cedar glades, found primarily in Middle Tennessee, are typified by very thin soil layers and often uncovered limestone. Plants living in this ecosystem are adapted to withstand hot, desiccating summers and cold, sodden winters. As a result, cedar glades are home to several rare plant species. The purpose of the study is to survey grass species found in this environment and create a DNA barcode for each one. Approximately twenty seven unique species were collected from May until October 2008. For each one, two chloroplast DNA regions were sequenced - the *trnH-psbA* spacer region and the *matk* gene. Phylogenetic analysis based on the sequenced regions and habitat distribution will be presented.

GENETIC VARIABILITY WITHIN AND AMONG POPULATIONS OF THE RARE PLANT SPECIES *ARABIS PERSTELLATA*. ***Nacole C. Jinks and Carol J. Baskauf***, *Austin Peay State University, Clarksville, Tennessee*. Potential for adaptation and evolutionary change depends on the degree of genetic variation present within a species. We estimated the genetic variability of *Arabis perstellata*, a rare plant species federally listed as endangered, by using starch gel and cellulose acetate gel electrophoresis to assay 23 isozymes. *A. perstellata* exhibits a disjunct distribution, occurring only in Tennessee and Kentucky. We sampled four populations in Tennessee and three populations in Kentucky, and our results showed no variability within these populations. However at the species level, 4% (1/23) of the loci were polymorphic, with a mean number of alleles per locus at 1.043%. This was due to a fixed difference between Tennessee and Kentucky populations for one isozyme (IDH).

CLEMATIS FREMONTII S. WATS. (PLANT FAMILY RANUNCULACEAE): ARE THE NEWLY DISCOVERED POPULATIONS OF THIS SPECIES THE RESULT OF RECENT INTRODUCTION OR ARE THESE NATURAL AND RELICTUAL POPULATIONS? ***Meredith Montgomery and Joey Shaw***, *University of Tennessee at Chattanooga, Chattanooga, Tennessee*. Cedar glades are unique habitats characterized by a high number of endemic plant species. One such species is *Clematis fremontii*, which is normally restricted to alkaline glades of the Midwest. However, two disjunct populations of *C. fremontii* have recently been rediscovered in cedar glades located in Chattanooga, TN, and Rome, GA. Interestingly, both eastern populations have a similar history in that in each case (TN and GA) a single herbarium specimen from before the 1930's was later found to be misidentified as *C. ochroleuca*, indicating that *C. fremontii* has been in the east for at least 75 years. The existence of these populations outside the Midwest is an anomaly. We have used tools from molecular genetics to determine whether the two southeastern populations are recent introductions to the east or are relict populations. Analysis of molecular data from the Southeastern populations and ten Midwestern populations has yielded support for the phylogeo-

graphic hypothesis that these southeastern populations are indeed native ancestral relict populations.

THE PHYLOGEOGRAPHY OF NORTH AMERICAN *CASTANEA*. ***Meagan Binkley, Hill Craddock, and Joey Shaw**, University of Tennessee at Chattanooga, Chattanooga, Tennessee.* North American *Castanea* L. (Fagaceae) consists of three morphologically variable species. Taxonomy of these species has been complicated by intermediate morphology, similarity in growth habit, and putative naturally occurring hybridization where species' ranges overlap in the southeast. The main goals of the present study were to: 1) determine if genetics reflect the morphological variation observed in southeastern populations of North American *Castanea*, 2) explore the extent of DNA sharing in North American *Castanea*, and 3) map the geographic distribution of the genetics in relation to morphotaxa. Finally, we wanted to use the information obtained from these analyses to gain insight into southeastern populations, where intermediate morphologies and putative hybridization are confounding taxonomy. We sequenced the *trn*V-*ndh*C intergenic spacer region (~380 bp) of the chloroplast for 233 *Castanea* accessions collected throughout the range of the genus, with a focus on southern Appalachian populations from Georgia, Tennessee and North Carolina. We identified four main genetic types and found that for three of these the leaf morphology is a good indicator of genetic identity. We found that the fourth genetic type was shared among accessions of *C. dentata*, *C. pumila*, and also in trees with intermediate morphology. The geographic mapping of these genetic types revealed that each one is found in a separate geographic range, which allowed us to compare current distributions with locations of historical glacial refugia.

THE WOODY FLORA OF LAND BETWEEN THE LAKES, KENTUCKY AND TENNESSEE—A REVISED CHECKLIST. ***Edward W. Chester**, Austin Peay State University, Clarksville, Tennessee.* Land Between The Lakes (LBL), a 69,000-ha National Recreation Area (NRA) in southwestern Kentucky and northwestern central Tennessee, was established in 1964 and administered by the Tennessee Valley Authority until 1999 when the USDA Forest Service assumed control. The NRA is managed for outdoor recreation, environmental education, and historic interpretation, receiving more than two million visitors yearly. Prior to NRA development, LBL consisted of small farms, communities, and a National Wildlife Refuge. The area is surrounded by water on three sides and is now about 80 percent forested. A 1976 checklist of woody taxa listed 178 species in 99 genera and 49 families. The current list increases the numbers to 247 taxa within 116 genera and 56 families. State-listed, introduced, and excluded taxa are discussed.

LONG-TERM FOREST CHANGE IN RADNOR LAKE NATURAL AREA. ***Jesse Germeraad*, Paige Griffin*, Robert Loeb, and Steven Ward**, Lipscomb University, Nashville, Tennessee (JG, PG), Pennsylvania State University, DuBois Campus, DuBois, Pennsylvania (RL), and Radnor Lake Natural Area, Nashville, Tennessee (SW).* Long-term forest change was determined for Radnor Lake Natural Area through resampling in 2008 of 95 plots placed during 1974 in the lakeshore, mesic, ravine, ridge, and xeric forests. Comparing 1974 to 2008, the importance value (IV) for the dominant species *Acer saccharum* more than doubled in every forest type except lakeshore, which instead had a >75% increase in IV for *Acer saccharinum*. *Quercus rubra* IV rose in the mesic forest, but the species was not found in the xeric forest plots in 2008. In contrast, *Quercus prinus* had a lower IV in the xeric forest but remained the dominant species in the ridge forest with a >35% gain in IV. Tree reproduction is limited by invasive *Lonicera* species.

HABITAT MAPPING OF *CASTANEA DENTATA* AT MAMMOTH CAVE NATIONAL PARK. ***Songlin Fei, Joe Schibig, and Mark Vance***, University of Kentucky, Lexington, Kentucky (SF), Volunteer State Community College, Gallatin, Tennessee (JS), and Tennessee Technological University, Cookeville, Tennessee (MV).* From 2003 to 2006, 2156 native American chestnut (*Castanea dentata*) trees were recorded at Mammoth Cave National Park. Ecological niche factor analysis was used to determine the site affinities of American chestnut trees and to produce a chestnut habitat suitability map for Mammoth Cave National Park. Chestnut trees were strongly associated with geological formation, slope steepness, elevation, and topographic position. Chestnut was nearly absent on the abandoned agricultural lands, but occurred most frequently in less disturbed forests on steep mid to upper slopes near the boundary of limestone and sandstone formations; overall, it was more frequent on the sandstone formations. The habitat suitability map predicts likely areas in the park for locating additional chestnut trees and identifying potential restoration sites within the park and in other areas with similar site conditions. Excluding the abandoned agricultural lands, the model predicts favorable chestnut habitat for 19 percent of the park's area.

PRODUCING MARKETABLE ZINNIAS (*ZINNIA ELEGANS*) USING SALINE WASTEWATER. ***Christy T. Carter and Catherine M. Grieve**, Tennessee Technological University, Cookeville, Tennessee, and U. S. Salinity Laboratory, Riverside, California.* Increasing soil salinity has become problematic in agricultural fields throughout California. Our goal was to determine whether marketable cut flowers of *Zinnia elegans* ('Golden Yellow' and 'Salmon Rose') could be produced under increasing salinity. Irrigation water mimicked ionic compositions of sea water and the Colorado River. For each water type, a control and four salinities (EC = 2.0, 4.0, 6.0, 8.0, and 10.0 dS m^{-1}) were tested on three replicates of ten plants for each cultivar under greenhouse conditions. A two-way ANOVA was used to assess effects of water type and salinity on leaf nutrient concentrations (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-}, total-S, and total-P) and final growth parameters for each cultivar. Concentrations of Ca^{2+}, K^{+}, and total-P decreased whereas Mg^{2+}, Na^{+}, Cl^{-}, and total-S increased as salinity increased. Even though all growth parameters decreased as salinity increased, all treatments produced marketable cut flowers based on a minimum stem length of 41 cm.

THE EFFECTS OF SHOOT HARVEST DATE AND AUXIN CONCENTRATIONS IN THE PROPAGATION OF 'CYNTHIANA / NORTON' GRAPES (*VITIS AESTIVALIS*). ***Nathan C. Phillips, Benjamin J. Kelly*, and Tony Johnston**, Middle Tennessee State University, Murfreesboro, Tennessee.* The 'Cynthia/Norton' grape cultivar is native to the United States, and is used as a wine grape, partly due to its inherent disease resistance traits. Propagation success for this cultivar has been erratic. We examined propagation success in relation to the timing of shoot harvest and auxin treatments. Dormant cuttings were taken in December cold stored for ten weeks, before being subjected to treatments. Cuttings were also taken in June and August. The

summer cuttings were treated and placed in the rooting environment on the same day they were harvested. All cuttings were stuck in a standard media mix and placed on a bottom-heated propagation table with intermittent misting. After three weeks, cuttings were examined for the presence of callous, and roots. Significant differences existed in rooting vigor and percentage in relation to the timing of shoot harvest. June-harvested shoots exhibited higher rooting percentages and root number. Auxin treatments had minimal effects in increasing rooting vigor and percentages.

EVALUATING THE EFFECTS OF AN ASIAN ORIGINATED BIO-EXTRACT ON TWO VEGETABLE CROPS (*BRASSICA OLERACEA* AND *PHASEOLUS VULGARIS*) IN MIDDLE TENNESSEE. ***Aaron Shew* and Nathan C. Phillips***, *Middle Tennessee State University, Murfreesboro, Tennessee.* We evaluated an East Asian method of fertilization and its effects on the yields of broccoli and bush beans. Both species were subjected to five different treatments with three replications each. Treatments consisted of a control, a standard fertilizer, and three concentrations of a bio-extract derived from decomposed whole oranges and brown sugar. The three concentrations of bio-extract used as treatments, were 4, 8, and 12 tablespoons per gallon of water. Both the broccoli and the bush beans were harvested at three intervals during the growing season and total plant fresh weight was measured after the final harvest. The bio-extract treatments did not positively affect growth or yield in both species. The data further suggests that the addition of the bio-extract may be detrimental. Overall, the results suggest that further study is needed before recommending the use of bio-extract in Middle Tennessee broccoli and bush bean production.

TAXONOMY AND ECOLOGY OF A NEW SPECIES OF *LYSIMACHIA*. ***Tianita D. Duke* and Dwayne Estes***, *Austin Peay State University, Clarksville, Tennessee.* The genus *Lysimachia* (Myrsinaceae) is a large genus of cosmopolitan distribution, with 13 species in eastern North America. Of these, six are members of section *Seleucia*: *L. ciliata*, *L. hybrida*, *L. lanceolata*, *L. quadriflora*, *L. radicans*, *L. tonsa*. During the past decade, numerous populations of a putative new species of *Lysimachia* have been discovered in a small area of Lewis and Maury counties, Tennessee. Observations of 20 populations in the field as well as preliminary morphological comparisons support the distinctiveness of this new species as compared to the other members of the section.

THE VASCULAR FLORA OF TENNESSEE PROJECT. ***Dwayne Estes, Joey Shaw, Edward W. Chester, B. Eugene Wofford, and Claude Bailey, Jr.***, *Austin Peay State University, Clarksville, Tennessee (DE, EWC), University of Tennessee at Chattanooga, Chattanooga, Tennessee (JS), University of Tennessee at Knoxville, Knoxville, Tennessee (BEW), and Jackson State Community College, Jackson, Tennessee (CB).* Tennessee is the most floristically diverse landlocked state in the US east of the Mississippi River. Tennessee has been explored and studied by botanists since the late 1700s and since then much has been written about its flora. There have been four major checklists of the vascular plants of Tennessee, and a fifth list is in press. The county-level distribution of the state's flora has been mapped. Books have been published concerning the ferns and woody plants of Tennessee and the flora of the Blue Ridge Mountains. In 2007, we began working on producing the first complete guide to the vascular flora of the state. This book will include an overview of Tennessee botany, both past and present, as well as dichotomous keys and notes on habitat, distribution, abundance, and phenology for the state's 2,866 species and infraspecific taxa. We anticipate having the first draft completed by the end of 2010.

VIBURNUM BRACTEATUM (ADOXACEAE) EXPANDED TO INCLUDE *V. OZARKENSE*. ***Dwayne Estes***, *Austin Peay State University, Clarksville, Tennessee. Viburnum ozarkense* was recently resurrected as a distinct species after having been synonymized with the related and partially sympatric *Viburnum molle* for much of the latter half of the 20th century. Presently, *V. ozarkense* is considered to be endemic to the Interior Highlands physiographic region of western Arkansas, southern Missouri, and eastern Oklahoma. However, this research indicates that although *V. ozarkense* is morphologically distinct from *V. molle*, it cannot be distinguished from *V. bracteatum*, a rare species found more than 500 km away in southeastern Tennessee, northeastern Alabama, and northwestern Georgia. Based on morphological and phytogeographical evidence, *V. ozarkense* is here considered to be conspecific with *V. bracteatum*. An overview of the expanded taxonomic concept, distribution, ecology and rarity of *V. bracteatum* is provided.

COMPARISON OF PHOTOSYNTHESIS AND TRANSPIRATION RATES IN *LONICERA MAACKII* AND *SYMPHORICARPOS ORBICULATUS* IN RESPONSE TO ENVIRONMENTAL FACTORS. ***April L. Tummins* and A. Darlene Panvini***, *Belmont University, Nashville, Tennessee.* Invasive exotic species appear to be more prevalent in urban environments than rural settings. The disturbance and fragmentation on wooded sites due to developing urban areas could provide favorable settings for exotic species. CO_2 and light levels are two major environmental factors that can change as a result of disturbance and fragmentation. An invasive exotic species, *Lonicera maackii*, and a native species, *Symphoricarpos orbiculatus*, were exposed to varying levels of CO_2 and PAR to compare the species' responses in photosynthesis, transpiration, and water use efficiency using a LI-6400. The exotic species had higher rates of photosynthesis but comparable rates of transpiration at all levels of CO_2 and PAR compared to the native species, resulting in an overall greater water use efficiency in *Lonicera*. The data suggest that exotic species respond favorably to the increasing CO_2 and light levels that accompany urbanization.

DIURNAL DIFFERENCES IN PHOTOSYNTHESIS IN *LONICERA MAACKII* AND *LONICERA JAPONICA* IN SUN AND SHADE ENVIRONMENTS. ***Alex Hughes and A. Darlene Panvini***, *Belmont University, Nashville, Tennessee.*

DEVELOPMENT OF INTER-SIMPLE SEQUENCE REPEAT MARKERS (ISSR) FOR DETERMINATION OF GENETIC DIVERSITY IN *DALEA* SPECIES. ***Jacob Wadlington*, Benjamin Bailey*, and Mary Sledge***, *Lipscomb University, Nashville, Tennessee.* Purple prairie clover (*Dalea purpurea*) and white prairie clover (*Dalea candida*) are declining throughout the cedar glades and other areas of Tennessee. Inter simple sequence repeat (ISSR) primers were developed to assess the genetic diversity of these species. The clover plant cells were opened by crushing and heating/cooling methods. Using the Qiagen PlantDNeasy protocol the DNA was isolated and suspended in solution for further

manipulation. The DNA was then introduced to one of 19 ISSR primers and amplified in a PCR machine using a touchdown protocol. After the DNA was amplified, polymorphic DNA markers were identified by visual comparisons. The longterm goal of this project is to select a genetically diverse population of *D. purpurea* or *D. candida* and start a breeding for program to develop germplasm that could be used to reintroduce these species to their natural habitats in Tennessee.

PRELIMINARY FLORA OF SEQUATCHIE VALLEY IN SEQUATCHIE COUNTY, TENNESSEE. ***John Evans and Joey Shaw***, *University of Tennessee at Chattanooga, Chattanooga, Tennessee.*

CELL AND MOLECULAR BIOLOGY

MICHAEL W. THOMPSON, CHAIR

OPTIMIZATION OF AN ENZYME IMMUNOASSAY FOR THE DETECTION OF GONADOTROPIN-RELEASING HORMONE. ***Maryam Farsian and Gilbert R. Pitts***, *Austin Peay State University, Clarksville, Tennessee.* Gonadotropin-releasing hormone (GnRH) secretion by hypothalamic cells is responsible for the synthesis and release of gonadotropins from the anterior pituitary. In order to study the secretion of GnRH, an enzyme immunoassay (EIA) that is capable of detecting low levels of GnRH secretion is required. While GnRH EIAs have been reported in the literature, we needed to optimize a GnRH EIA in order to increase assay sensitivity and decrease variability. Standard curves were constructed using three different concentrations of rabbit anti-GnRH primary antibody (R1245), donkey anti-rabbit secondary antibody, and biotinylated-GnRH. Optimal assay conditions were chosen based upon the slope of the standard curve and the minimum detectable GnRH concentration. Based upon these criteria, the optimum concentrations of EIA reagents were: a 1:10,000 dilution of R1245, 5 µg/ml donkey anti-rabbit secondary antibody, and a 1:5000 dilution of bt-GnRH. Additionally, a number of methods to decrease both inter- and intra-assay variability were explored.

ACRIDONES CIRCUMVENT P-GLYCOPROTEIN-ASSOCIATED MULTIDRUG RESISTANCE (MDR) IN CANCER CELLS. ***Kuntebommanahalli Thimmaiah, Larry Sylvester, Paul Grisham, Ray Cox, Harold Simmons, Augustinus Rinaldy and Peter Houghton***, *Northwest Mississippi Community College, Southaven, Mississippi (KT, LS, PG, RC, HS, AR), and St. Jude Children's Research Hospital, Memphis, Tennessee (KT, PH).* Multidrug resistance (MDR) mediated by over-expression of *MDR1* P-glycoprotein (Pgp) is one of the best characterized transporter-mediated barriers to successful chemotherapy in cancer patients. Chemosensitizers are the agents that increase the sensitivity of multidrug-resistant cells to the toxic influence of previously less effective drugs. A series of N^{10}-substituted-2-chloroacridone analogues has been synthesized and were examined for their ability to increase the uptake of vinblastine (VLB) in MDR $KBCh^R$-8-5 cells and the results showed that eight compounds caused a 2-fold greater accumulation of VLB than did a similar concentration of verapamil. Results of the efflux experiment showed that verapamil and each of the modulators inhibited the efflux of VLB, suggesting that they may be competitors for P-gp. Compounds were evaluated for their efficacy to modulate the cytotoxicity of VLB and the results showed that five modulators were able to completely reverse the 25-fold resistance of $KBCh^R$-8-5 cells to VLB.

MAIZE BS & MSC CHLOROPLASTS: SAME GENES DIFFERENT BS. ***Richard M. Sharpe and A. Bruce Cahoon***, *Middle Tennessee State University, Murfreesboro, Tennessee.* C4 photosynthesis was first recognized as a process distinct from C3 in the 1970's. It has become clear that C4 represents a more efficient form of carbon sequestration and may give C4 plants a competitive advantage over C3. Developing *Zea mays*, corn, plant leaves are an ideal model to study temporal and spatial genetic expression of the divergent development of mesophyll (MSC) and bundle-sheath (BSC) chloroplasts indicative of C4 (a.k.a Kranz anatomy). Relative q2(RT)PCR assays have been completed on the major subunits of both types of electron transport mechanisms (ETM) exhibited in C3 and C4 photosynthesis. Our results suggest that transcript production is up-regulated in early chloroplast development of genes producing subunits of the major complexes of the MSC linear ETM. As chloroplasts mature more BSC ETM gene expression occurs. This suggests that mesophyll cells may utilize C3 type photosynthesis before BSC comes on-line and takes over the dark reactions.

ALTERED MEMBRANE DISTRIBUTION OF A MATING RECEPTOR (STE2P) IN EROGOSTEROL AND SPHINGOLIPID DEFICIENT MUTANTS OF BREWER'S YEAST (*SACCHAROMYCE CEREVISIAE*). ***Katherine J. Smith, Jessica L. Ward, and D. Grant Willhite***, *Tennessee Wesleyan College, Athens, Tennessee.* The activity of membrane receptors can be greatly affected by their lipid environment. This study aimed to further determine lipid effects on Ste2p, a G protein-coupled mating receptor in *Saccharomyces cerevisiae*. Ste2p has been shown to prefer different membrane microdomains in response to drug induced ergosterol depletion. In this study, yeast strains with genes disrupted in ergosterol and sphingolipid pathways were used to determine the effect of ergosterol and sphingolipid depletion on raft association of Ste2p in the presence and absence of pheromone. Membrane localization of Ste2p in mutants mimicked those previously seen in drug treated cells. Our result also indicated that pheromone induced changes in membrane localization of Ste2p is altered by depletion of ergosterol and sphingolipids.

ARGINYL AMINOPEPTIDASE-LIKE 1 (RNPEPLI) IS AN ALTERNATIVELY PRODUCED NEUTRAL AMINOPEPTIDASE WITH SPECIFICITY FOR CITRULLINE, METHIONINE, AND GLUTAMINE RESIDUES. ***Karen A. Beasley, Michael W. Thompson, and Rebecca L. Seipelt***, *Middle Tennessee State University, Murfreesboro, Tennessee.* Arginyl aminopeptidase B-like 1 (RNPEPL1) is a novel M1 metalloprotease that shares significant identity with arginyl aminopeptidase B, and to a lesser extent, other M1 zinc metalloproteases. Human RNPEPL1 was purified from both yeast and insect cell cultures which had been genetically altered to produce high levels of histidine-tagged protein. Following histidine-tag removal, K_M and k_{cat} values were investigated using numerous aminomethylcoumarin peptide substrates. This analysis revealed that this enzyme prefers methionine and citrulline residues. Other

biochemical characteristics were also examined by altering the pH and including other chemicals in the biochemical reactions. These analyses revealed that human RNPEPL1 has several unusual characteristics not found in most other M1 metalloproteases; it is insensitive to halide activation, has a broad pH profile, and is inhibited by calcium.

DEVELOPMENT OF A DNA-CAPTURE SYSTEM FOR THE ENHANCEMENT OF DNA-BASED ASSAYS. ***Marc Smith and Chad Brooks***, *Austin Peay State University, Clarksville, Tennessee*. DNA-based assays that use polymerase chain reaction (PCR) to screen for specific DNA sequences within high concentrations of background DNA are problematic. In fact, PCR reactions are limited to approximately four to five micrograms of exogenous DNA per reaction because in excess, PCR reactions are inhibited. Therefore, DNA-based assays screening within animal tissue that contains millions of DNA copies could inhibit the detection of one copy of target DNA in a PCR reaction. This study uses small magnetic beads modified with specific DNA sequences to capture specific DNAs and remove them from the background contaminating DNAs. Preliminary data indicate that the DNA-capture system is approximately 100,000 times more likely to detect DNA than conventional PCR methods.

PHOTOTAXIS IN WILD-TYPE AND MUTANT *CHLAMYDOMONAS RHEINHARDTII*. ***Lynette C. Rives and Robert T. Grammer***, *Belmont University, Nashville, Tennessee*. The goal of this project is to develop a quantitative method for measuring phototaxis in *Chlamydomonas rheinhardtii*. This alga responds to light using its eyespot, which senses light, and its flagella, which are its mechanism for swimming. Along with wild-type algae, I am testing two mutant forms, *eye1*, lacking an eyespot, and *pf18*, lacking functional flagella. The phototaxis experiment is performed inside a pipette that will have only a portion exposed to light. After some time under the light the cells are drained into test tubes in portions that isolate the sections that were in the dark and the section that was exposed to the light. The biomass of the algae is measured by absorbance at 550 nm. Preliminary experiments as a test of the method were performed on *Euglena gracilis*.

CHARACTERIZATION OF THE TNXβ GENE IN ZEBRAFISH. ***M. Reece Cofer, Jeremy Bramblett, Cymbeline Culiat, and Ethan A. Carver***, *University of Tennessee at Chattanooga, Chattanooga, Tennessee (MRC, JB, EAC), and Oak Ridge National Laboratory, Oak Ridge, Tennessee (CC)*. We have characterized and examined an ortholog of *Tnxβ* within the zebrafish genome. Previous murine assays have discovered that expression patterns of *Tnxβ* can be altered during development due to a recessive, neonatal-lethal point mutation termed Nell1^{6R}. *Tnxβ* is believed to aid in the organization and maintenance of the normal tissue structure supporting muscles, joints and organs, and it has been associated with Ehlers-Danlos syndrome. Computational methods identified closely related orthologs in zebrafish, and primers were designed specific to a portion of zebrafish cDNA. Our studies show expression of the *Tnxβ* gene at 3, 51, 75 and 123 hours into development and no expression in adult zebrafish cDNA samples. Early *in situ* hybridization experiments reported slight expression in the developing spinal cord region in 29 hour embryos.

ALTERNATIVE MRNA SPLICING IS PREVALENT IN GENES AND REGIONS OF THE BRAIN IMPLICATED IN BIPOLAR DISORDER. ***Suzanne S. Hicks and Rebecca L. Seipelt***, *Middle Tennessee State University, Murfreesboro, Tennessee*. All cells of an organism have the same genes; however, the expression of these genes is controlled differently in tissues, developmental pathways, or disease states. Alternative splicing, a common mechanism of regulated gene expression, is a process of inclusion or exclusion of regions of the pre-mRNA which create different RNAs and thus different proteins from a single gene. These proteins provide varied functions for cells in which they are produced. Because alternative splicing is prevalent and has wide ranging effects, it is of interest to examine alternative splicing in four bipolar-related genes in four brain regions implicated in moods and bipolar disorder. The genes are *DISC1*, *IMPA2*, *NRG1*, and *P2RX7* and the brain regions are amygdala, basal ganglia, hypothalamus, and substantia nigra. Reverse transcription-polymerase chain reaction combined with agarose gel electrophoresis was used to identify splicing patterns. These analyses indicate alternative splicing is prevalent in all four genes and brain regions. *DISC1* showed two alternative forms in all brain regions tested, one of which was unexpected based on database analysis. In *IMPA2*, at least four alternative events were observed, including one unexpected form found specifically in basal ganglia and hypothalamus. Analysis of *NRG1*, showed at least six alternative events in all four regions. The most extensive alternative splicing was found in *P2RX7*. Three alternative splicing patterns were observed in one region alone with four additional splicing events occurring in a tissue-specific fashion in another area of the gene. Analysis of these isoforms and the encoded proteins will be necessary to determine if the regulated expression is due to production of alternative or truncated proteins.

EFFECT OF CHOLESTEROL CONCENTRATION ON LYSOSMAL BIOGENESIS. ***Aditya P. Mahajan, Patrick W. Jennings, A. Bruce Cahoon, and Jerry W. Reagan***, *Middle Tennessee State University, Murfreesboro, Tennessee.*

BLOCKING THE EFFECTS OF 6-OHDA IN *CAENORHABDITIS ELEGANS*. ***Brittany Myers and Nick Ragsdale***, *Belmont University, Nashville, Tennessee.*

THE EFFECTS OF SULPIRIDE, SCH23390 AND DIHYDROEXIDINE HCL 6-OHDA TREATED *CAENORHABDITIS ELEGANS*. ***Robert Gibson and Nick Ragsdale***, *Belmont University, Nashville, Tennessee.*

CHEMISTRY

DANIEL J. SWARTLING, CHAIR

OPTIMIZING THE PERFORMANCE OF A WATER ASPIRATOR AT LOW WATER PRESSURES. ***Jeanell B. Riffle and Martin V. Stewart***, *Middle Tennessee State University, Murfreesboro, Tennessee*. Water aspirators are used to evacuate closed systems to the limit of the vapor pressure of water. This common laboratory apparatus has become dysfunctional at several chemistry departments including the University of Tennessee at Chattanooga and Middle Tennessee State Univer-

sity due to low and variable water pressures caused by increased demands for water by growing populations and the installation of reduced-pressure-principle backflow preventers in campus buildings; however, optimum performance from these stressed water systems is observed when using a type of polypropylene water aspirator (NALGENE Labware, no. 6140-0010) that is designed to consume less water as established by careful pressure measurements over a range of water temperatures. Data was also collected to evaluate the efficiency of this water aspirator in evacuating large systems such as rotary evaporators. Partial support from the Undergraduate Research Council of the College of Basic and Applied Sciences at Middle Tennessee State University is gratefully acknowledged.

ENCOURAGING GIRLS IN CHEMISTRY THROUGH EYH HANDS-ON WORKSHOPS. ***J. M. Iriarte-Gross, L. S. Fleming, J. Ilsley, and A. Cowart***, *Middle Tennessee State University, Murfreesboro, Tennessee.* The MTSU Expanding Your Horizons (EYH) Conference has served over 3400 middle school girls since 1997. In 2007, the first EYH for high school girls was held on the MTSU campus with 48 girls in attendance. In 2008, 58 high school girls participated. The MTSU EYH fosters awareness of career opportunities in science and math related careers. Girls are provided with opportunities to meet and interact with other girls with similar interests in STEM and with positive role models who are successful in STEM careers. Each girl attending the MTSU EYH participates in positive hands-on experiences under the direction of an EYH workshop leader. By offering scholarships, we also involve girls with limited opportunities for success with positive experiences in science and math. We will highlight the chemistry workshops that have been presented in the twelve years that we have been hosting EYH on the MTSU campus.

THE DEVELOPMENT OF AN IMPROVED ACTIVITY ASSAY FOR THE RAPID ASSESSMENT OF CONDITIONS SOUGHT TO ENHANCE CATALYTIC ACTIVITY IN THE PRODUCTION OF BIOFUELS FROM CELLULOSIC FEEDSTOCKS. ***Jessika Pinto and Jeffrey O. Boles***, *Tennessee Technological University, Cookeville, Tennessee.* Cellulosic ethanol that originates from perennial grasses is an alternative fuel that can reduce our dependency on foreign oil while at the same time provide a more environmentally friendly fuel source. Unfortunately, its commercial availability is plagued at this time by the slow hydrolysis of Cellulose. This project investigated 1) the feasibility of producing a more rapid, reproducible activity assay, and 2) increasing the rate of hydrolysis. A new variation of a colorimetric assay was developed. This assay provided a linear response for the liberation of glucose from Cellulose. Activity assays in which the enzyme was incubated in a 75°C water bath illustrated a linear observed enhanced rate. Taken together with the slope of the standard curve, this demonstrated an activity of 0.0682 micromoles glucose/min and a specific activity of 1.00 micromoles/min/mg Cellulase. The conditional effects of various temperatures on specific activity will be presented.

ANALYSIS OF PRODUCT INHIBITION AND STABILITY OF CELLULASE FROM *ASPERGILLUS NIGER*. ***Jami Couch and Jeffrey O. Boles***, *Tennessee Technological University, Cookeville, Tennessee.* Our dependency on foreign oil can be reduced through the utilization of alternative fuels. One such fuel is cellulosic ethanol, which would also provide a fuel source more environmentally friendly than fossil fuels. The commercial availability of cellulosic ethanol is hampered at this time by the slow hydrolysis of Cellulose. This project investigated 1) whether or not cellulase from *A. niger* suffers feedback (product) inhibition, and 2) the stability of *A. niger* cellulase under varying temperature conditions. Feedback (product) inhibition was tested by adding product (glucose) directly to the assay tubes. For 1, 2, and 5 mmol of glucose added, *A. niger* cellulase did not show inhibition. Temperature stability was tested by incubating cellulase stock solutions for 24 hours at 50, 55, 60, 65, or 70°C. *A. niger* cellulase showed a high degree of stability for 50, 55, and 60°C, but lost most of its activity at 65°C and showed no activity at 70°C after 24 h incubation.

THEORETICAL STUDIES ON QUINONE REACTIVITY. ***Titus Albu and Roshan Fernando***, *Tennessee Technological University, Cookeville, Tennessee.* Quinones are a class of naturally occurring compounds that are biologically very relevant due to their ability to participate in redox couples. For example, they act as electron carriers between the different components of the electron transport chain in the mitochondrion, as a redox component for the generation of pH gradients across the mitochondrial membrane, and act as electron acceptors in the initial charge separation of photosynthesis in both bacterial and higher plants. To better understand their role in biochemical processes, it is beneficial to gain insight though electronic structure calculations. A theoretical study of a series of four benzoquinones (*para*-benzoquinone, *ortho*-benzoquinone, 2-chloro-*para*-benzoquinone, and 2-methyl-*para*-benzoquinone) was carried out using the mPWB95-44 density functional theory with the 6-31+G(d,p) basis set. One aspect of this study is focused in calculating redox potentials, and we identify nine relevant redox reactions. The reversible potentials of all nine reactions and for all benzoquinone derivatives were determined, both in gas phase and aqueous phase. Whenever more than one conformation is possible, the global minimum of the potential energy profile was chosen for the calculation. The results obtained are in very good agreement with experimental and previously published data. Another aspect of the study concerns the nucleophilic additions to the quinones. Here we are focused on investigating the reactivity toward ionized, N-containing nucleophiles such as NH_2^-, NHR^-, and NR_2^-. The interesting aspects that need to be addressed are: what position is more reactive towards nucleophilic attack, whether the reactivity is influenced by the oxidation state of quinone and if so, in what way, whether the reactivity is influenced by certain substituents and why, and if the quinones are susceptible to attack from certain nucleophile and under what conditions. The study will be later extended to other quinones and some other nucleophiles.

SYNTHESIS AND CHARACTERIZATION OF NEW 2-CARBOXY QUINOLINE THIOSEMICARBAZONES. ***James R. Wilson, Erica L. Stoner, and Edward C. Lisic***, *Tennessee Technological University, Cookeville, Tennessee.* Eight quinoline-2-carboxaldehyde thiosemicarbazone derivatives have been synthesized and characterized by melting point analysis, ^1H NMR and IR spectrometry, and UV-Visible spectroscopy, for the purpose of forming complexes with transition metals. Several of these compounds were then used as tridentate ligands and reacted with palladium (K_2PdCl_4), resulting in a square planar

palladium complex. Each palladium complex synthesized was then characterized. Previous entries pertaining to thiosemicarbazones in the literature indicate potential use in a variety of biological and biomedical applications.

SEPARATION OF STRUCTURAL ISOMERS OF OLIGONUCLEOTIDES USING MATRIX-ASSISTED LASER DESORPTION IONIZATION ION MOBILITY-TIME-OF-FLIGHT MASS SPECTROMETRY. ***Ablatt Mahsut, Michal Kliman, Sophie Zhao, and John A. McLean***, *Vanderbilt University, Nashville, Tennessee.* The separation and identification of oligonucleotide isomers and post transcriptional modifications remain a considerable challenge due to the difficulty in distinguishing structural differences between isobaric (same m/z) species. Due to differences in intramolecular packing of molecules, ion mobility-mass spectrometry (IM-MS) provides rapid (μs-ms) two dimensional structural separations on the basis of molecular structure and mass-to-charge (m/z), which allow resolution of isobaric species. In this study, baseline separation of isomeric single stranded oligonucleotides by matrix-assisted laser desorption ionization ion mobility-time-of-flight mass spectrometry (MALDI-IM-TOFMS) is presented. Gas-phase ion mobility profiles of singly charged isomeric olgionucleotides with different base length were investigated using helium as a drift gas. Ion-neutral collision cross sections were calculated using arrival time values obtained experimentally. The gas-phase ions of isomeric oligonucleotides were found to have significantly distinct cross sections due to the differences in intramolecular packing efficiency. Baseline separation was achieved for ions differing by only 7.2% in their measured collision cross sections. Partial separation was observed for isomeric oligonucleotide ions exhibiting collision cross section differences as small as 2.2%. Amber 9.0 molecular dynamics protocol was used to further explain the differences among gas phase conformational populations of measured mobility profiles. The results demonstrated the capability of IM-TOFMS to resolve isobaric oligonucleotides in the gas phase and, when used in conjunction with molecular dynamics, may help expand the understanding of gas phase folding motifs of single stranded oligonucleotides.

HARTREE-FOCK STRUCTURES OF SEVERAL ORGANOSILYLMAGNESIUM FLUORIDE DIMERS AND THEIR ADDUCTS. ***W. Ilsley***, *Middle Tennessee State University, Murfreesboro, Tennessee.* The results of Hatree-Fock 6-32G** calculations, performed on several organosilylmagnesium fluoride dimers and their adducts, of the type $[R_3SiMgF]_2$ and $[R_3SiMgF{\bullet}nY]_2$, n = 1,2; R = H, Me, CMe_3, SiH_3, $SiMe_3$; Y = THF, dioxane, pyridine, DME, and TMEDA are reported. Preliminary results indicate that the $[R_3SiMgF]_2$ dimers exhibit trigonal planar geometry about the magnesium with Mg-Mg = 2.864 Å, Mg-F = 1.916 Å, Mg-Si = 2.607 Å, Mg-F-Mg = 98.89°, F-Mg-F = 81.11°, and F-Mg-Si = 139.44° on average. The $[R_3SiMgF{\bullet}dioxane]_2$ and $[R_3SiMgF{\bullet}pyridine]_2$ adducts exhibit distorted tetrahedral geometry about the magnesium with Mg-Mg = 2.890 Å, Mg-F = 1.916 Å, Mg-0 = 2.100 Å, Mg-Si = 2.663 Å, Mg-F-Mg = 97.94°, F-Mg-F = 82.08° and Mg-Mg-Si = 143.48° on average for the dioxane adduct and Mg-Mg = 2.888 Å, Mg-F = 1.918 Å, Mg-N = 2.203 Å, Mg-Si = 2.668 Å, Mg-F-Mg = 97.72°, F-Mg-F = 82.28° and Mg-Mg-Si = 142.28° on average for the pyridine adduct.

TITANIUM PHOSPHATE/PBI COMPOSITE MEMBRANES IN PROTON EXCHANGE MEMBRANE FUEL CELLS. ***Marshall McDonnell and Roy Wilcox***, *Lincoln Memorial University, Harrogate, Tennessee.* As the world's population increases, the demand for energy increases as well. Presently, a large portion of energy consumption comes from combustion engines used in automobiles and transport. Fuel cells are a promising alternative to combustion engines and address all of the current limitations of combustion engines. Fuel cells are a simple energy conversion device that, instead of using combustion to convert the fuel source, uses chemical reactions to produce an electrical current producing electrical energy. Fuel cell classification is by electrolyte membrane type. Each electrolyte membrane gives the fuel cell its properties: operating temperatures, current densities, and what fuel is used to power the cell. Inorganic fillers and composite membranes with inorganic materials are an approach that the collective body of research today is using to help membranes keep there mechanical properties intact at higher operating temperatures. This research will hope to further the body of knowledge of proton exchange membranes used in fuel cells by experimenting with the synthesis of a PBI membrane doped with TiP, of a multi-layered membrane of PBI and TiP, and a possible comparison of ZrP and TiP with respect to the mechanical retention in a membrane.

DISCOVERY CHEMISTRY BY UNDERGRADUATE & MASTER'S LEVEL STUDENTS AT TENNESSEE STATE UNIVERSITY. ***Mohammad Al-Masum***, *Tennessee State University, Nashville, Tennessee.* Several undergraduate and graduate students are involved in developing new methods of organic transformations. Application of microwave heating and water as solvent has significant impact in these processes. Some of these new results will be discussed.

ENERGY CONTENT OF HURRICANE IKE. ***Earl F. Pearson***, *Middle Tennessee State University, Murfreesboro, Tennessee.* Evaporation and condensation of water moves tremendous amounts of energy around the planet. This process far exceeds any other "global warming" contribution. "Little Boy" was the smallest of the two atomic bombs used in World War II. The energy content of Hurricane Ike was the equivalent of 7 MILLION Little Boy atomic bombs. Even a gentle 1 inch rainfall over a one square mile area moves the energy equivalent of 4 Little Boy atomic bombs. However, the power (Kilowatts) generated by Little Boy was roughly equivalent to 2000 Hurricane Ikes. Destructive potential is more closely related to power density (Kw/cm^3). The power density of Little Boy was the equivalent of about two-thirds of a mole of Hurricane Ikes! This presentation discusses these calculations and provides information that will generate interest in heat of vaporization when discussed in chemistry classes.

SOL-GEL SYNTHESIS OF PbS/SiO_2, $PbSe/SiO_2$, AND $PbTe/SiO_2$ NANOCOMPOSITES. ***Prashant Bajaj, Tiffany P. Marsh, and Joshua T. Moore***, *Tennessee State University, Nashville, Tennessee.* Lead chalcogenides, PbE where E = S, Se, or Te, are IV-VI compound semiconductors that have applications in various technologies. The narrow band gap of these materials allows them to absorb strongly in the IR region, making them especially promising materials for IR sensing. PbS/SiO_2 nanocomposites have been prepared by the thermal decomposition of lead thiolate precursors covalently incorporated into a sol-gel

derived SiO_2 matrix. Homogeneous mixed-metal oxide materials of the general formula $(Pb^{2+}/E^{n+}/Si)O_x$ (E = Se or Te) have been prepared using typical sol-gel synthesis and processing techniques. Reduction of the *in-situ* selenium or tellurium ions by hydrogen affords $PbSe/SiO_2$ or $PbTe/SiO_2$ composites containing PbSe or PbTe nanoclusters widely dispersed throughout a SiO_2 xerogel matrix. These results demonstrate a facile synthesis of PbE, nanoclusters supported throughout a convenient and easily processed matrix material. Transmission electron microscopy, and powder x-ray diffraction have been used to characterize the resulting nanocomposite materials.

THE CHEMISTRY OF GRITS (GIRLS RAISED IN TENNESSEE SCIENCE). ***J. M. Iriarte-Gross, L. S. Fleming, and C. DeSheles***, *Middle Tennessee State University, Murfreesboro, Tennessee*. In this talk, we will explain how the chemistry of GRITS (Girls Raised In Tennessee Science) and of the GRITS Collaborative Project, collectively pull resources together to build a stronger community across Tennessee in support of girls and women in STEM. Under the GRITS umbrella, information about STEM education and careers is disseminated via "GRITS Traveling Roadshows" to students, parents and teachers. We also developed a GRITS website which features Tennessee women who have successful careers in STEM in response to a call for this information from girls attending the MTSU EYH. The GRITS Collaborative Project wants Tennessee to be the premier state in the nation for women with STEM degrees and STEM careers. By providing information about STEM resources and supporting organizations, we hope that it will become the norm for girls and women in the south, and especially in Tennessee, to pursue STEM education and careers.

WISE CHEMISTRY. ***J. M. Iriarte-Gross, C. DeSheles, and A. Schaible***, *Middle Tennessee State University, Murfreesboro, Tennessee*. WISE (Women In Science and Engineering) women of Middle Tennessee State University have great chemistry! WISE is a student-run organization that was started in 2002. The focus of WISE is to encourage and help women prepare for and become involved with-science- and math-related careers. The goal of WISE is to assure women of their importance in all STEM fields, as well as to promote equal opportunity and treatment of women in STEM. WISE hosts annual events such as the WISE Chocolate Challenge, in which the campus learns about the chemistry of chocolate. Many women involved with WISE also donate their time to girl-serving organizations or events, such as the MTSU Expanding Your Horizons Conference (EYH). WISE presents chemistry workshops, including the popular *Glitter Girls*, on cosmetics chemistry. In this talk, we will discuss other WISE chemistry activities that benefit both the WISE women and the community.

CHEMISTRY ABSTRACTS PRESENTED AT THE 2007 ANNUAL MEETING OF THE TENNESSEE ACADEMY OF SCIENCE**

LIPID PEROXIDE LEVELS IN METHYL LINOLENATE FOLLOWING EXPOSURE TO LOW LEVELS OF IRON. ***William Y. Boadi and Amber Baxley****, *Tennessee State University, Nashville, Tennessee*. Oxidative stress may be a key factor in the onset of certain diseases, including cancer. It has been considered that a significant event in oxygen radical mediated carcinogenesis is the extensive oxidative damage to the nuclear membrane, which leads to DNA damage. Iron (Fe) is an environmental contaminant, and Fe^{2+} ions have been classified as tumor promoters because of its ability to generate high levels of reactive oxygen species. We have previously investigated the role of several flavonoids in the prevention of Fe^{2+} catalyzed oxidation of lipids in U937 cells using the Fenton chemistry. In those studies, two high doses of Fe^{2+} ions were tested. In this present study, we have investigated the effects of very low doses of Fe^{2+} ions (0, 10, 20, 40, 60, and 80 pM) in the generation of lipid peroxides using the fatty acid ester methyl linolenate. 10 mM of methyl linolenate was dissolved in 1 mL Tris-HCl buffer at pH 7.4 with 0.01 M KCl and 0.01% SDS. Oxidation of methyl linolenate was begun by exposing the fat to each dose of the Fe^{2+} in the presence of 5 μM H_2O_2 overnight in a water bath at 37°C. Following the exposure, oxidation was prevented by adding 50 μL BHT to prevent further oxidation. Samples were then treated with 2 mL of 0.67% TBA solution and further incubated at 80°C in the water bath for 15 minutes. Control samples without metals, but with the methyl linolenate and all other reagents, served as controls. Lipid peroxides in the samples and in the controls were extracted with *n*-butanol, and the levels of peroxides analyzed in quadruplicates and in 4 trials in a spectrophotometer at 540 nm. There were no differences in lipid peroxide levels between the controls and levels of Fe^{2+} for the 10- and 20-nM levels. Lipid peroxides increased thereafter in a-dose dependent manner as the levels of metal ion concentration increased. The studies indicate that exposure to very low physiological doses of Fe^{2+} ions could be detrimental to cells.

NICKEL AND COPPER MODULATES GLUTATHIONE LEVELS IN U937 CELLS. ***William Y. Boadi and Shalandus Harris****, *Tennessee State University, Nashville, Tennessee*. Studies were conducted on the effects of very low doses of Cu^{2+} and Ni^{2+} (0, 5, 10, 20, and 40 nM) in the presence of 10 μM H_2O_2 on GSH levels in human mononuclear progenitor cells (U937) cells. Following the treatment, cells were maintained at 37°C under 5% CO_2 tension in RPMI 1640 medium containing 10% FBS and 50 units/mL each of penicillin and streptomycin for 24 hours. Untreated cells did not contain any metals or the reagents used in the oxidative process. Thereafter, the cells were pelleted by low speed centrifugation, lysed in 5% metaphosphoric acid (MPA), and centrifuged at 3000 RPM for 10 minutes at 4°C. The resultant supernatant was used to measure the GSH levels as described by the GSH assay kit from Pierce (cat. no. 354102). GSH Levels decreased in a dose-dependent manner for each of the metal ions used. Levels of GSH were high for the untreated samples in both cases in comparison to those treated with the metal ions. Thereafter, there was a steady decline in GSH levels especially for the high doses compared to the low doses for each of the metal ions. The data demonstrates that exposure of U937 cells to low levels of Cu^{2+} and Ni^{2+} can result in significant ($p < 0.01$) losses of intracellular GSH levels in U937 cells, which may compromise the metabolic and biochemical function of the cells.

**The two above-listed abstracts were omitted from the *Journal of the Tennessee Academy of Science* 83 (1–2).