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Abstracts of the Eighty-Fifth Annual Session

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ORAL PRESENTATIONS

Astronomy, Geology, & Physics

E. RAY GARTON, WV Geological Survey, Morgantown, WV 26508, ROBERT L. PYLE, Prehistoric Planet, Morgantown, WV 26505, and DAVE PHILLIPS, Sunset Fossils, Morgantown, WV 26505. **A new vertebrate fossil assemblage from the Ewing Limestone, Conemaugh, Pennsylvanian of West Virginia.**

A few scraps of fossil bone were discovered in the fall of 2008 along a drainage ditch from a coal strip mine. The ditch was being prepared for highway construction. Highway construction progressed at a fast pace and could not be diverted or delayed. The authors spent considerable time prospecting the area and located a large deposit that contained several vertebrate forms, including teeth and spines of the shark *Orthacanthus,* teeth, spines, vertebra and skull plates from the lungfish *Sagenodus,* and other fishes. Several jaws and teeth from labyrinthodonts (amphibians), possibly a temnospondyl or anthracosaur have also been identified. At least one tooth of a pelycosaur has been identified along with several vertebra of the amphibian *Megamolgophis.* In addition, many vertebra centrum elements of an embolomere form were found. Hundreds of cranial and postcranial elements were found. Although some bones were found in close association, no articulated specimens were found. The deposit originally covered about one acre and has been removed and distributed as fill for the new highway. The bone horizon is a few feet below what is tentatively identified as the Harlem Coal at what would be the level of the Ewing Limestone. The Ewing is reported in the literature as a fresh or brackish water deposit and the vertebrate forms confirm this hypothesis. No invertebrate or plant fossils were found in the deposit.

DOMINIC A. LUDOVICI and DANIEL J. PISANO, Dept. of Physics, West Virginia University, Morgantown, WV 26506. **A survey for neutral hydrogen in the loose group LGG140.**

The majority of galaxies are contained in loose groups. Loose groups are collections of galaxies containing a few large galaxies, as well as tens of smaller galaxies spread out over approximately three million light years. These loose groups may also contain gaseous remnants of galaxy formation in the form of neutral hydrogen (H I) clouds that are devoid of stars. These clouds are analogous to those found around the Milky Way. To date, no free-floating H I clouds have been found away from bright galaxies, though many gas-rich dwarf galaxies have been found. We conducted a survey of the loose group LGG 140 with the Westerbork Synthesis Radio Telescope (WSRT) for neutral hydrogen H I emission from dwarf galaxies, H I clouds, and extended low column density structures. LGG 140 is a loose group that is rich in spiral galaxies and is located at a distance of 208 million light years away. This cluster contains a total of eight known members. The survey has sensitivity to detect diffuse H I clouds, dwarf galaxies, and extended H I structures. Thus far in the survey, we have detected four previously known members of the group, as well as four new H I-rich objects in the group. We examine the properties of the new H I detections in the group and characterize them. The detections in this survey show that there are more signatures of ongoing galaxy interaction than seen in previous observations of this group.

CLARISSA R. MATHEWS, EDWARD M. SNYDER, and JOHN J. SMITH, Institute for Environmental Studies, Shepherd University, Shepherdstown, WV 25443. **Comparison of solar photovoltaic technology performance at the Shepherd University Renewable Energy Demonstration Site.**

Performances of two polycrystalline silicon solar photovoltaic modules (BP and Mitsubishi) were compared in a ground-mount configuration in Shepherdstown, WV, holding the following parameters constant: PV collection area, module orientation (39°), circuit resistance, shading, ambient temperature, and solar irradiance. Preliminary work characterizing climatic variation and module responses at 5-min intervals (11:00 to 14:00 hrs, July, 2009) showed a range in solar irradiance across three d (94.0 - 995.0 W/m^2). Although module performance (mA/m^2) and ambient temperature (°C) were correlated ($N = 106$; BP: $\rho = -0.558$, $P < 0.0001$; Mitsubishi: $\rho = -0.530$, $P < 0.0001$), module performance and solar irradiance (W/m^2) were not correlated. A second study tested manufacturers' claims regarding sub-optimal

conditions, measuring module performance (mA), solar irradiance (W/m^2), and ambient temperature (°C) at 30-min intervals (8:00 to 16:00 hrs; 5 d, July – August, 2009). Manufacturer significantly affected performance at solar noon (12:00 to 12:30 hr: $F = 3831.97$; $P < 0.0001$; $ndf = 1$; $ddf = 4$), high temperatures (35 °C or >: $F = 6178.97$; $P < 0.0001$; $ndf = 1$; $ddf = 22$), and low solar irradiance (< 100 W/m^2: $F = 2845.57$; $P < 0.0001$; $ndf = 1$; $ddf = 11$), with BP significantly out-performing Mitsubishi under all climatic conditions (LSD; $\alpha = 0.05$). These findings suggest that PV production at Shepherd University could be optimized by utilizing BP's manufacturing process. This research was funded in part through support from the West Virginia EPSCOR program and a NASA West Virginia Space Grant Consortium award.

MAURA MCLAUGHLIN, Dept. of Physics, West Virginia University, Morgantown, WV, 26506.
Detecting ripples in space-time using radio pulsars.

Gravitational waves are ripples in the fabric of space-time caused by accelerating massive objects. Einstein predicted the existence of these waves in 1915 but they have never been directly observed. Radio pulsars are rapidly rotating, highly magnetized neutron stars, which can act as extremely precise celestial clocks. I will describe how we can use a network of radio pulsars distributed throughout the sky to detect gravitational waves. I will discuss the telescopes we use for this effort and in particular our work with the Green Bank Telescope in Green Bank, WV. I will show that a detection of gravitational waves through radio pulsar timing is possible within the next 5-10 years. This detection will transform astronomy and allow us to study the most extreme and exotic objects in the universe.

KAREN O'NEIL, Green Bank Observatory, National Radio Astronomy Observatory, Green Bank, WV, 24944. **Faint fuzzy stuff – examining star formation and evolution in diffuse environments.**

Low surface-brightness galaxies are diffuse spiral galaxies whose gas content is often at or below the density required to form stars. Yet low surface-brightness galaxies cover a wide range of morphological types, from galaxies with bright central bulges and well defined spiral arms to amorphous blobs. I will describe the general properties of these galaxies and look at the possible evolutionary scenarios for these systems.

D J. PISANO, Dept. of Physics, West Virginia University, Morgantown, WV, 26506.
Constraining galaxy evolution through radio observations.

Eight billion years ago, luminous compact blue galaxies were relatively common with high rates of star formation. Today, they are exceedingly rare. What are these galaxies and what have they become? While we cannot study the distant luminous compact blue galaxies directly in high detail, we can study their local analogs. Using radio telescopes in West Virginia and around the world, we are able to learn about their star-formation rates, their fuel for future star formation and their masses. I will present the initial results from our study of local luminous compact blue galaxies, and what it implies for the current nature and future evolution of these galaxies.

CALEB RICE and JASON BEST, Shepherd University Observatory, Institute for Environmental Studies, Shepherd University, Shepherdstown, WV 25443.
The study of the skyglow around the Shepherd University Observatory.

The Shepherd University Observatory is centrally located on campus in order to provide easy access to the campus community. However, recent construction has added additional skyglow, which has dimmed the visibility of celestial objects. This research examines the skyglow in the night sky over the observatory. Data from prior research and the findings of this project will be incorporated into future studies to understand better the impact of the skyglow on images taken from the observatory. We acquired overlapping images at numerous elevations and orientations covering the entire observable sky as seen from the observatory. We took sections from these images and analyzed them for various qualitative and quantitative comparisons. Qualitatively, we find little difference in the brightness once elevation has exceeded 60 degrees. Surprisingly, however, nonparametric tests reveal statistical differences even at the higher, qualitatively similar, elevations.

Biology & Ecology

NATHAN R. BEANE and JAMES S. RENTCH, Division of Forestry and Natural Resources, West Virginia University, Morgantown, WV 26506. **Using maximum entropy to model current red spruce forest habitat in West Virginia.**

Red spruce (*Picea rubens* Sarg.) characterizes niche communities at higher elevations throughout the Appalachian Mountain Region (AMR) and is a relic species of the central and southern Appalachians. The reduction of approximately 90% of spruce habitat in West Virginia due to exploitative logging has led to the listing of the federally endangered cheat mountain salamander (*Plethodon nettingi* Green) and the recently delisted Virginia northern flying squirrel (*Glaucomys sabrinus fuscus* Miller). This loss of habitat is crucial for these species, as well as many other species of conservation concern, and serves as an indicator of an ecosystem in need of restoration. The objective of our research was to use a maximum entropy (MAXENT) modeling approach to construct a habitat suitability map for red spruce. A total of 43 variables were incorporated into our model, with 19 bioclimatic variables examined. Preliminary analyses indicated maximum temperature of the warmest month, slope position, mean temperature of the coldest quarter, and soil type to be important factors for predicting suitable habitat. The habitat suitability maps created from this modeling effort will help guide future restoration efforts as well as aid with identifying areas in need of conservation management.

R. DALE BILLER and DEWEY D. SANDERSON, Department of Geology, Marshall University, Huntington, WV 25755. **Water budget of the Coal River Basin 2009.**

In 2009 a study of the 890-square-mile Coal River watershed in West Virginia, a tributary of the Kanawha River, was conducted in an effort to characterize the water budget of the basin. A total of 13 rain-gauging stations provided data on input precipitation to the basin. A USGS stream-gauging station at Tornado provided outflow data for 863 square miles upstream. Three rainfall interception sites were established in the basin and were revisited around 50 times during the course of the year. Relative leaf cover was estimated throughout the year.

The effective yearly rainfall across the basin as calculated by the Thiessen polygon method was 42 inches, of which 20 inches, or 48%, left the basin through the Coal River, 33% was intercepted by foliage, and 19% reached the ground and was lost by evapotranspiration.

Stream discharge was separated into overland and base flow components by both manual and digital filtering techniques. The base flow index (BFI), which is the ratio of the base flow to the total stream flow, was calculated on a daily basis and averaged on a monthly basis. For a month of a two-inch rainfall, the BFI was around 80% and dropped to 40% when the rainfall topped 8 inches. The BFI was also calculated for daily flow data from 1961 to 2009 and was found to have no trend over nearly 50 years.

ELIZABETH A. BYERS, JAMES P. VANDERHORST, and BRIAN P. STREETS, West Virginia Division of Natural Resources, Elkins, WV 26241. **Natural Heritage assessment of upland red spruce communities in West Virginia.**

Upland red spruce communities in the Allegheny Mountains of West Virginia provide unique habitats for wildlife and plant species. As part of a statewide vegetation classification effort, West Virginia Division of Natural Resources personnel used Natural Heritage methodology to assess the upland red spruce ecosystem. Five associations were classified, peer-reviewed, and published in the U. S. National Vegetation Classification (USNVC). The five red spruce forest and woodland associations are all ranked as high state and global conservation priorities. Documented species occurrences in the study area include 850 animal species and 373 plant species. Rare taxa include 15 mammals, 16 breeding birds, two reptiles, four amphibians, seven land snails, two crayfish, 17 butterflies, 10 moths, and nine vascular plants. This report complements a recently completed assessment of 41 high-elevation wetland communities within the Allegheny Mountains of West Virginia, and together these two reports complete the USNVC classification of red spruce ecosystems in West Virginia.

ELIZABETH A. BYERS, West Virginia Division of Natural Resources, Elkins, WV 26241. **Assessing the climate change vulnerability of West Virginia's rare species.**

Resource managers are increasingly asked to identify which of the species on the lands and waters they oversee are most vulnerable to climate change-induced declines. Comparing vulnerabilities across species is difficult, however, because species respond differently to change and because climate change is likely to impact species through direct and indirect pathways, many of which could influence the success of potential management strategies. The West Virginia Division of Natural Resources is currently assessing rare species in the state using NatureServe's newly developed Climate Change Vulnerability Index, which provides a rapid, scientifically defensible assessment of species' vulnerability to climate change. The index is based on down-scaled climate exposure predictions combined with natural history and distribution factors that are associated with sensitivity to climate change. The list of target species is drawn from those identified in the West Virginia Wildlife Conservation Action Plan as being in greatest need of conservation, in addition to species that are considered imperiled throughout their range. Results of the assessment will include ranking of taxa and taxonomic groups, identification of geographic regions of the state most vulnerable to climate change extinctions, and identification of common risk factors. Based on these data, recommendations for monitoring, conservation, and/or management of vulnerable species and their habitats will be prepared for the West Virginia Wildlife Conservation Action Plan. Taxonomic experts interested in contributing to this on-going assessment are encouraged to contact the author.

DAN CINCOTTA, WV Division of Natural Resources, Wildlife Resources Section, Elkins WV 26241, and STUART A. WELSH, US Geologic Survey, WV Cooperative Fish and Wildlife Research Unit, Morgantown, WV 26506. **Conservation status of imperiled West Virginia fishes.**

West Virginia waters contain a fairly rich and unique ichthyofauna. Of the approximately 180 species among 24 families found within the state, no fishes are listed as endangered and threatened pursuant to the federal Endangered Species Act of 1973 (ESA). In 1996 the US Fish and Wildlife Service (FWS) discontinued the use of the ESA designation of Category 2, which was the list of "candidate" species. Fishes and other biota within this former group are now regarded as "species of concern" and to list species via the Act became more comprehensive and difficult. Partly in response to the changes in ESA, fish conservation groups compile independent lists to supplement the law, and to keep data current in the event of a potential ESA listing. Species of concern in West Virginia, formerly listed via Category 2, are the lake sturgeon (*Acipenser fulvescens*), paddlefish (*Polydon spathula*), Kanawha minnow (*Phenacobius teretulus*), Cheat minnow (*Rhinichthys bowersi*), blue sucker (*Cycleptus elongatus*), crystal darter (*Crystallaria asprella*), spotted darter (*Ethesostoma maculatum*), candy darter (*E. osburni*), eastern sand darter (*E. pellucidum*), longhead darter (*Percina macrocephla*), and the Bluestone sculpin (*Cottus* sp.). The American Fisheries Society Endangered Species Committee (AFS) recently reviewed the status of the North American fauna. In doing so they updated former AFS conservation lists and attempted to clarify the population status of all fish species on the continent by utilizing the terms *endangered, threatened, vulnerable, extinct, possibly extinct, extirpated in nature,* and *delisted.* Relative to West Virginia, this documentation maintained that all "species of concern" mentioned above were still in potential jeopardy, except the Kanawha and Cheat minnows (i.e., delisted); moreover, several species were added to their checklist. This presentation will discuss: 1. historical and current status of the all AFS listed species for West Virginia; 2. the merit of maintaining independent state rare species checklists; and 3. the potential problems associated with the recent AFS effort.

JESSICA CURTIS and PETER VILA, Institute for Environmental Studies, Shepherd University, Shepherdstown, WV 25443. **Survey of herpetofauna in three West Virginia counties: Berkeley, Jefferson, and Morgan.**

An updated qualitative herpetological survey of the Eastern Panhandle was conducted from spring to late-summer 2009 at 274 sites. The survey objective was to provide basic information about the current distribution of native reptiles and amphibians. Sampling was opportunistic and habitats were grouped into (1) on or next to roads and (2) other habitats. "Other habitats" included riparian areas, mature deciduous forest, ephemeral pools, and edge habitats, such as residential edges. Species were observed and identified as live or dead animals (road mortality) or by audible calls.

A total of 15 species of reptiles and 17 species of amphibians were identified. This is a marked increase from a 2005 study of fifty-nine sites that identified 12 species of reptiles and seven species of amphibians. All species except one are native to the region and none is listed as threatened/endangered. However, five species are considered Species of Concern by the state of West Virginia. Approximately 26 species of amphibians and 35 species of reptiles are expected in the survey area. High rates of development and a long history of heavy agricultural use in the area have fragmented suitable habitats for many species. Most expected species likely still occur in the Eastern Panhandle, but in Jefferson and Berkeley counties, many species may occur in disjunct habitats that are difficult to sample.

RODNEY DEVER and DONNA FORD-WERNTZ, Dept. of Biology, West Virginia University, Morgantown, WV 26506. **Taxonomy of the *Allium cernuum* complex in Appalachia**.

The *Allium cernuum* complex in Appalachia potentially consists of three taxa: *A. cernuum* Roth (nodding onion), *A. allegheniense* Small (Allegheny onion) and *A. oxyphilum* Wherry (acid-loving onion). Some botanists have held that these onions are three distinct species, whereas others regarded the putative taxa as synonyms of *Allium cernuum*. This issue presents a conservation concern as *A. oxyphilum* and *A. allegheniense* are both considered rare and possibly threatened in West Virginia and Virginia. This research is clarifying the ambiguous classification of these onions by assessing variation in their morphology, ecology, anatomy, and cytology. A survey of 852 specimens from 18 eastern U.S. herbaria is being conducted to reveal locations of populations. Characters such as the size of leaves, scapes, pedicels, tepals and capsules are being examined in addition to shapes and colors of the perianth. Morphological variation will be evaluated using a multivariate statistical analysis. The vascular anatomy can be useful diagnostically in *Allium*. Scape and leaf sections from field collections are being investigated for bundle number and pattern. To detect cytological variation among localities, somatic chromosomes are being examined in root tip cells. A common garden experiment, done in the summer of 2009, established that the observed morphological variation is primarily genotypic.

R. TRISTAN GINGERICH and JAMES T. ANDERSON, Div. of Forestry and Natural Resources, Wildlife and Fisheries Resources Program, West Virginia University, Morgantown, WV 26506. **Decomposition rates in created and natural wetlands of West Virginia.**

Wetland decomposition is influenced by numerous wetland functions and, in turn, is an important component of nutrient cycling. This makes wetland decomposition a good means of assessing wetland function. From 2008 to 2009 we measured plant litter decomposition rates using leaf litter bags in eight created and eight reference wetlands in West Virginia,. A subset of those wetlands, three mitigated and three reference, were part of a more in-depth study that occurred from 2007 to 2009. Four common wetland litter species were used: broadleaf cattail (*Typha latifolia*), common rush (*Juncus effusus*), brookside alder (*Alnus serrulata*), and reed canary grass (*Phalaris arundinacea*). A fifth litter type was created from a mix of common rush, brookside alder, and reed canary grass. Percent mass remaining and mean decomposition rates (k) were similar between mitigated (n=3, 38.1%, $k = 0.646$ yr $^{-1}$) and reference (n=3, 32.2%, $k. = 0.710$ yr $^{-1}$) wetlands ($P > 0.05$) after 728 days; they were also similar between created (n=8, 55.9%, k= 0.526 yr $^{-1}$) and reference (n=8, 54.6%, $k = 0.517$ yr -1) wetlands after a year. Percent of mass remaining for reed canary grass (26.5%, $k = 0.92$ yr $^{-1}$), the mixed litter (28.3%, $k = 0.77$ yr $^{-1}$), and common rush (30.8%, $k = 0.61$ yr $^{-1}$) were similar, but were significantly less than brookside alder (44.3%, $k = 0.673$ yr $^{-1}$) and broadleaf cattail (45.8%, $k = 0.40$ yr $^{-1}$). Our study indicates that mitigated wetlands had similar function with regard to decomposition as the reference wetlands.

JOE GREATHOUSE, Curator of Animals, Oglebay's Good Zoo, Wheeling, WV 26003. **Conservation of the Eastern Hellbender (*Cryptobranchus alleganiensis alleganiensis*) in the northern panhandle of West Virginia.**

The Eastern Hellbender (*Cryptobranchus alleganiensis alleganiensis*), the largest salamander in the Western Hemisphere is considered a rare or endangered species in each state that it inhabits. Surveys of this species have been conducted in the

Northern Panhandle of West Virginia since 2005. These surveys have resulted in the capture of 112 hellbenders from eight geographically isolated populations in four Ohio River tributary streams. These surveys have yielded the first documented occurrence of the amphibian chytrid fungus (*Batrachochytridium dendrobatidis*) in West Virginia, the documentation of the first larvae of this species in West Virginia, and the first eight documented nests of this species in West Virginia. One of these nests was discovered with a portion of the clutch infected with *Saprolegnia* spp. in September, 2007. These eggs were taken to Oglebay's Good Zoo where the infected eggs were removed and discarded, and the remaining eggs were separated and cared for individually until the hatching of over 120 larvae. This was the first hatching of this species at any zoo or aquarium in the world. These individuals will be used in reintroduction efforts to determine if head-starting hellbenders would be an effective conservation strategy for this species. The majority of the support for this project has been provided by the West Virginia Division of Wildlife's Diversity Grants Program, and additional disease surveillance and captive husbandry support have been provided by Oglebay's Good Zoo, The Wilds, the Columbus Zoo and Aquarium, the Fort Worth Zoo, and Omaha's Henry Doorly Zoo.

JOE GREATHOUSE, Curator of Animals, Oglebay's Good Zoo, Wheeling, WV 26003, and THOMAS K. PAULEY, Dept of Biology, Marshall University, Huntington, WV 25755. **Surveillance of the amphibian chytrid fungus (*Batrachochytridium dendrobatidis*) in West Virginia amphibians.**

The amphibian chytrid fungus (*Batrachochytridium dendrobatidis*) is a fungal pathogen that has decimated amphibian populations throughout the world and is considered to be the worst disease in recorded history in terms of its ability to drive a species or populations of species to extinction. From 2008 to 2009 researchers from Marshall University and Oglebay's Good Zoo conducted surveys for this pathogen to determine its distribution in West Virginia. During this project, samples were collected from 483 individuals of 19 species from 31 sites in 17 different counties. Positive samples occurred in seven of the 19 different species and at six of the 31 sites. When analyzing the presence of the pathogen geographically in West Virginia, five out of seven sites north of U.S. Route 50 (71.4%) had positive test results, and five out of nine sites near the Ohio River (55.6%) had positive test results. Conversely, only one out of 22 sites south of U.S. Route 50 in the montane region of the state (4.6%) had positive test results. This data should be used to develop appropriate hygiene protocols for amphibian researchers in West Virginia in order to attempt to prevent the movement of this pathogen within the state. Funding for this project was provided by the West Virginia Division of Wildlife's Diversity Grants Program.

ERIC HEITZMAN, SEAN DOUGHERTY, and JAMES RENTCH, Division of Forestry and Natural Resources, West Virginia University, Morgantown, WV 26506, STEVE STEPHENSON, Dept. of Biology, University of Arkansas, Fayetteville, AR, and STEVE ADAMS (ret.), Dabney Lancaster Community College, Clifton Forge, VA. **Long-term changes in stand structure and tree ring patterns in old-growth red spruce (*Picea rubens*) forests in West Virginia.**

In the early 1980s, the stand structure and radial growth patterns of three, old-growth red spruce (*Picea rubens*) forests in West Virginia were documented. In 2007, we re-measured these stands to describe changes that occurred over 25+ years. The three case studies indicate that standing dead trees are a common feature of old-growth spruce stands. Spruce regeneration occurs naturally under small- and large-scale disturbances, but can be inhibited by dense thickets of rhododendron. Declining radial growth trends characteristic of the 1980s were not always observed among current spruce trees.

TRACY LEE and KENNETH CUSHMAN, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074, and ERIN KELLEY, RYAN C. KENNEDY, and HEATHER N. CUSHMAN, Dept. of Biology, Washington and Jefferson College, Washington, PA 15301. **Effects of intramuscular acid injections on ASIC3 and NaV1.9 expression.**

When acid is injected into the gastrocnemius of mice it causes long lasting hyperalgesia. We injected acidic solutions of varying pH into mice to determine the behavioral and transcriptional effects. RNA

was extracted from dorsal root ganglia (DRG) and converted to cDNA using reverse transcription. We analyzed the mRNA levels of acid-sensing ion channel 3 (ASIC3), voltage-gated sodium channel 1.9 ($Na_v1.9$), and cyclooxygenase-2 (COX2) with quantitative real-time PCR. The data analyzed from the q-PCR from the cDNA of these proteins showed an up-regulation of ASIC3 in mice that were injected with acid compared to control mice and a decreased expression of $Na_v1.9$, in mice injected with acid compared to control mice. Q-PCR data showed very little COX-2 transcription in the DRG.

R. SCOTT LEMONS, JOHN WIRTS, and PAT CAMPBELL, Dept. of Environmental Protection, Division of Waste and Water Management, Charleston, WV 25304. **Dunkard Creek fish kill: Golden algae and water chemistry.**

This presentation will discuss the events of a major fish kill in the Dunkard Creek Watershed in northern West Virginia during the early fall of 2009. It will include data from several years of water chemistry, macro-invertebrate sampling, and continuous monitoring data from before and after the event. Also included will be a brief histology of golden algae, *Prymnesium parvum*, which has been concluded to be the cause of the fish death.

ZACHARY LOUGHMAN, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074 and Biology Graduate Program, Indiana State University, Terre Haute, IN 47801, DAVID FOLTZ, EVAN HEWITT, MATTHEW MCKINNEY, and NICOLE GARRISON, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074, and STUART WELSH, West Virginia Cooperative Fish and Wildlife Research Unit, West Virginia University, Morgantown WV 26506-6125. **Rediscovery and discussion for future conservation efforts of *Cambarus (P.) veteranus* (Big Sandy crayfish) in West Virginia.**

The crayfish fauna of West Virginia has received a resurgence of attention, with the majority of this work focusing on determining the conservation and taxonomic status of the 24 species that occur within the state. *Cambarus veteranus* (Big Sandy crayfish) has been a focal species of this work due to its rarity when the state received its initial statewide census in the mid 1980's. Jezerinac et al. determined that *C. veteranus* likely would be extirpated due to land use practices and stream degradation in the West Virginia coal fields. Several investigators have focused on determining the conservation status of *C. veteranus* in the last decade in West Virginia; during these efforts zero *C. veteranus* were observed. In the summer of 2009, all historic locations (n = 17) and several additional locations, determined through a probabilistic site selection design, were surveyed in the Guyandotte, Bluestone, and Tug Fork river basins to determine if the West Virginia population had been extirpated. One result of this effort is that *C. veteranus* was discovered at one historic station for the species, in Pinnacle Creek, Wyoming County. In addition to the rediscovery of the Pinnacle Creek population, a previously unknown population was discovered in Dry Fork, a tributary to the Tug Fork River. This population represents a new basin record for the species in West Virginia and appears to be more stable than the Pinnacle Creek population. Potential causes of decline are evaluated, and future conservation efforts for the species are discussed.

BEN LOWMAN, West Virginia Dept. of Environmental Protection, Charleston, WV 25304. **Impacts of selenium bioaccumulation on freshwater fishes in West Virginia.**

In respect to the USEPA's draft whole-fish tissue body burden criterion for selenium, the West Virginia Department of Environmental Protection (WVDEP) has studied selenium bioaccumulation among fishes residing in the state's lakes and streams since 2005. Additionally, due to concern regarding fish population health at locations subjected to elevated selenium inputs, the WVDEP has collected and examined bluegill sunfish, *Lepomis macrochirus*, larvae (ichthyoplankton) from selected waterbodies since 2007. Also, in 2009, WVDEP began acquiring data about selenium concentrations within fish eggs, which is often used as a predictor of larval deformity rates. Average whole-fish tissue concentrations of selenium in fishes collected from study locations ranged from 1.03 ppm (mg/L) at Elk Fork Lake, a reference impoundment, to 40.43 ppm at Little Scary Creek, which is influenced by upstream fly

ash deposition. Larval deformity rates were variable throughout the study duration but were nonetheless associated with waterborne selenium exposure; reference locations produced larval bluegill with deformity rates between 0% and 1.27%, whereas locations with elevated selenium inputs exhibited bluegill ichthyoplankton deformity rates ranging from 0% to 47.56%. Concentrations of selenium within fish eggs also varied according to study location and ranged from <0.8 mg/kg dry weight among bluegill eggs at the control site to 64.62 mg/kg dry weight among largemouth bass, *Micropterus salmoides,* eggs collected from selenium-enriched waters.

KATHRYN R. P. McCOARD and JAMES T. ANDERSON, Division of Forestry and Natural Resources, West Virginia University, Morgantown, WV 26506. **A year in the lives of West Virginia's wood turtles.**

Wood turtles (*Glyptemys insculpta*) were listed in 2008 by the Endangered Species Coalition as one of 10 threatened/endangered species in the United States most in need of Endangered Species Act protection. This species is considered to be very rare and imperiled (S2) in West Virginia. Wood turtle ecological studies have largely occurred in the northern portions of the species' geographic range, which extends from eastern West Virginia and northern Virginia north to Nova Scotia, Canada and west to eastern Minnesota. Consequently, little is known about wood turtle ecology in West Virginia at the southern portion of the range. The study objective was to track adult and juvenile wood turtles with radio telemetry to determine activity and habitat preferences depending on season. Date, time, GPS coordinates, gender, observed activity, and local vegetation were recorded for each capture. Twenty-nine turtles were fitted with transmitters, epoxied to the back right of the carapace, and tracked once a month to twice a week, depending on season. Home ranges (95% MCP) ranged from 0.48-12 ha. Turtles were predominantly terrestrial (97%) in late spring, but entirely aquatic (100%) by winter. Activity varied by season, including sitting in vegetation (wingstem [*Verbesina alternifolia*] was the dominant vegetation type) in the spring and burrowing under surface litter or mating in the fall. Mating males were significantly larger than mating females in four morphological characteristics (p-value < 0.5). This information is important for filling in geographical data gaps for wood turtles in order to better manage and conserve their declining populations.

THOMAS K. PAULEY, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. **Conservation issues of amphibians and reptiles in West Virginia.**

Forty-four years of field research on amphibians and reptiles in West Virginia reveal that some species may have declined in numbers, some ranges have expanded, and some species have changed little in numbers and distribution. Climate changes, habitat destruction, habitat degradation, and habitat fragmentation may have contributed to alterations in population sizes and ranges. Data were collected by on-site surveys and road mortalities. Results of road mortality data will be the major emphasis of this presentation.

CARA SCHILDTKNECHT, Institute of Environmental Studies, Shepherd University, Shepherdstown, WV 25443. **Developing new methodology for trapping upstream migrating adult Pacific lamprey (*Lampetra tridentata*) and western brook lamprey (*Lampetra richardsoni*) to estimate species abundance.**

Survival of Pacific lamprey, *Lampetra tridentata*, and western brook lamprey, *L. richarsoni*, are major concerns for the Pacific Northwest, as these two native species are an important component of the ecological system. Due to the invasive species of lamprey in the Great Lakes area, the focus and status of development of methodologies for lamprey sampling has been on capture and destruction. Moreover, traps for estimating abundance are typically concerned with juvenile lamprey. Thus, these designs are not desirable to complete abundance sampling in the Pacific Northwest and new methodologies for capturing adult lamprey are necessary to evaluate adult abundance. The purpose of this study was to develop a trap to sample for adult lamprey abundance. This study adapted a weir used by the Maori to capture lamprey during their upstream migration. The Maori used the trap to capture lamprey as a major food source. The trap utilizes knowledge of the life cycle of lamprey in order to anticipate movements and trap adults as they complete their upstream migration prior to spawning. The design

was modernized for this study, utilizing a fyke net, live cart, and weir fences constructed from wood and hardware cloth. The trap was placed at two different rivers in Washington State. Sites were sampled thirteen and nine times, respectively, between 9 July and 31 July 2009. Preliminary data tested the usefulness of the trap design and collected 11 adult individuals and 12 juveniles. Collections indicated a successful trap design that efficiently sampled adult abundance of upstream migrating lamprey.

CRAIG W. STIHLER, WV Div. of Natural Resources, Elkins, WV 26241. **White-Nose Syndrome: A new threat to the West Virginia's cave-dwelling bats.**

White-nose Syndrome (WNS), a condition that appears to be caused by the fungus *Geomyces destructans*, has killed many thousands of cave-dwelling bats in the Northeast since it was first observed near Albany, NY, in 2006. The fungus was first documented in West Virginia in 2009 when it was seen in four caves in Pendleton County and bat mortality was observed at one of these caves. In 2010, WNS was found in additional caves in Pendleton County, including the state's most important bat hibernaculum, Hellhole. Samples collected from a Pocahontas County cave in 2010 tested positive for *G. destructans*. At this time, samples from additional counties are being examined. The bat species most affected have been *Myotis lucifugus* and *Perimyotis subflavus*, but affected specimens of *M. septentrionalis* and the endangered *M. sodalis* have also been observed. To date, no affected *Corynorhinus townsendii virginianus* have been observed even though this bat hibernates in caves that are positive for this fungus. *C.t. virginianus* is an endangered species with the largest concentration in the world occurring in Pendleton County. The caving community is helping to monitor the spread of WNS by monitoring cave entrances for unusual bat behavior often associated with this WNS (e.g. bats flying out of the cave in winter even during the daytime and dead bats found outside the cave entrance). It appears likely that WNS will spread throughout the karst areas of West Virginia, and populations of cave-dwelling bats may be severely impacted.

CRAIG W. STIHLER, WV Div. of Natural Resources, Elkins, WV 26241. **The conservation of Virginia big-eared bats (*Corynorhinus townsendii virginianus*) in West Virginia.**

The Virginia big-eared bat (*Corynorhinus townsendii virginianus*), an eastern subspecies of Townsend's big-eared bat, was listed as federally endangered in 1979. The largest concentration of *C.t. virginianus* is found in the Pendleton County area of West Virginia. A major factor in the listing of this bat was disturbance of cave roosts from increased recreational entry into caves by humans. Beginning in the early 1980s, disturbance in important caves was reduced through seasonal cave closures, including the fencing and gating of cave entrances. Summer maternity colonies have been monitored annually using infrared lights and night-vision equipment to enumerate bats as they leave the caves in the evening to forage. The number of bats in the seven maternity colonies known in 1983 increased 76.7 % from 1983 to 2009; three maternity colonies found after 1983 contained 1,816 bats in 2009. The total number of *C.t. virginianus* in maternity colonies in West Virginia is estimated at 7,245 bats. *C.t. virginianus* hibernacula are monitored biennially by entering the caves and counting the hibernating bats. The number of bats hibernating in caves in West Virginia in 2010 was estimated at 12,059 individuals. Although the numbers of *C.t. virginianus* in West Virginia caves have increased over the past decades, a new threat, White-nose Syndrome (WNS), a condition associated with the fungus *Geomyces destructans*, threatens the continued existence of this bat. To date, no *C.t. virginianus* have been seen exhibiting the signs of WNS, even in caves where the presence of the fungus has been confirmed.

SAMANTHA TAYLOR, Dept. of Integrated Science & Technology, Marshall University, Huntington, WV 25755. **Mitochondrial DNA phylogeography of *Rhinichthys* species in West Virginia.**

Blacknose dace are an abundant cyprinid minnow distributed widely in West Virginia and throughout North America. For more than 25 years the taxonomy of the blacknose dace species complex (*Rhinichthys*) has been an area of disagreement. Recently a reclassification of the members of this species complex has taken place. The objective of our study is to

analyze mitochondrial and genomic DNA variation to try to resolve relationships within the species complex. Samples: Ninety-two fish (33 *R. atratalus*, 26 *R.obtusus obtusus,* 33 *R. obtusus meleagris*) were electrofished from streams within three watersheds (Atlantic, Upper Ohio R., and Lower Ohio R.) throughout central West Virginia. Methods: DNA was purified from individual fish. Conserved PCR primers were used to amplify the mitochondrial cytochrome *b* gene. Primers were redesigned based on sequence analysis of these fish. DNA sequences were analyzed using Sequencher® software. CLUSTAL W was used for developing a phylogram tree. The conserved primers only amplified half the fish DNA. Redesigned primers amplified the remaining fish DNA. The resulting tree has three distinct branches within the species complex, corresponding to the three species. All three species were found in one stream and two species were found in several other streams. We are currently analyzing RAG2 genomic sequences to determine if the three different species may be interbreeding in streams where mixed populations occur.

CHENJIE WU and LIAN-SHIN LIN, Dept. of Civil and Environmental Engineering, West Virginia University, Morgantown, WV 26506. **Long-term climate trend in Mid-Atlantic Highlands Region and its correlation with regional landscape attributes.**

This study focused on detecting climate changes and effects in Mid-Atlantic Highlands Region, an important ecological system in the US and the world. Climate data from 25 stations with daily measurements for more than 100 years from the National Climate Data Center were analyzed. The primary aim of this study was to examine the trends of the air temperature and precipitation time series for all the available stations in the region using the Mann-Kendall statistical test. The Z statistic for each season as well as for the whole period was calculated. The median slope of trends was estimated by Sen's method. Regional trends were formed by statistically combining the results of the Mann-Kendall test for each individual trend. Extreme events were defined and analyzed as well. The secondary objective of this study was to detect relations between landscape attributes (e.g., elevation, altitude, forestry) and the long-term trend using correlation analysis. The analyses are expected to provide information that can help answer questions related to regional climate changes, such as elevation-dependent climate changes in this Highlands Region. All statistical analyses were conducted using SAS software 9.1 and SYSTAT 12. Results indicated variations between stations. Both negative and positive trends for all parameters were detected. Magnitude and direction of the trends were also found relative to elevation.

Chemistry

SONG CHEN and XUEYAN SONG, Dept. of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506, YUN CHEN and HARRY FINKLEA, Dept. of Chemistry, West Virginia University, Morgantown, WV 26506, and GREG HACKETT and KIRK GERDES, National Energy Technology Laboratory, DOE, 3610 Collins Ferry Road, Morgantown, WV 26507. **Microstructure and chemistry of the anode active layers in the anode-supported solid oxide fuel cell.**

In order to examine the microstructure and chemistry of the anode-supported solid oxide fuel cell (SOFC), the SOFC was operated in coal syngas containing H_2, CO, CO_2, H_2O, N_2, and CH_4 at a current load of 0.25 A/cm^2 at 800 °C for 45 h. After operation, transmission electron microscopy (TEM) was employed to examine the microstructure and chemistry of the anode active layer. In this study, we focused on the region that is about 5 μm away from the interface of the anode and the electrolyte. The TEM results showed that a surface bi-layer is present and that this layer covers the interface between the pores and the Ni and yttria-stabilized zirconia (YSZ) grains and separates the original triple-phase boundary (TPB) site from gas phase. The select area diffraction (SAD) patterns associated with energy dispersive spectroscopy (EDS) reveal that this bi-layer structure is composed of an amorphous layer and a polycrystalline layer with fine NiO nano grains. A long ribbon phase was also observed between Ni and YSZ grains. The SAD confirmed this ribbon phase is a NiO phase.

WESTLEY MULLINS, JANE OOSTHUIZEN, KAITLYN BOWMAN, Dept. of Science and Mathematics, Glenville State College, Glenville WV 26351, HOWARD WHITE, Dept. of Physiological

Sciences, Eastern Virginia Medical School, Norfolk VA 23510, and GARY Z. MORRIS, Dept. of Science and Mathematics, Glenville State College, Glenville WV 26351. **Synthesis of 3′-(7-diethylaminocoumarin-3-ester)-3′-adenosine 5′-triphosphate (or DeacesterATP).**

Hydrolysis of adenosine triphosphate (ATP) produces chemical energy that can be used by a cell to do work. The kinetics involving ATP hydrolysis in muscle cells is studied using fluorescent ATP analogs and actin and myosin proteins. Actin and myosin are proteins found in muscle fibers that do the mechanical work of muscle contraction. A very efficient fluorescent ATP analog for studying myosin-actin kinetics is 3′-(7-diethylaminocoumarin-3-carbonylamino)-3′-deoxy-ATP (deac-aminoATP or DeacATP), which undergoes a 20-fold increase in fluorescence emission intensity when bound to the active site of myosin. This fluorescent ATP analogue is composed of a coumarin tag attached to ATP at the 3′ position thorough an amino group. DeacATP has to be made in its entirety from scratch through seven different reactions. Here we propose an alternative to DeacATP, which is to attach the coumarin tag to ATP through an ester. Because ATP already has an alcohol at the 3′position, this process should require fewer steps and be less expensive; instead of seven reactions, only two reactions are necessary. Coumarin is first activated through mixing with tributylamine (solvent) and isobutyl chloroformate (leaving group). ATP is then added to the activated coumarin, producing the new fluorescent ATP molecule (DeacesterATP), carbon dioxide, and the isobutyl chloroformate leaving group. This specific fluorescent ATP analog has not been synthesized before. TLC, NMR, FTIR, HPLC, and UV-Vis are being used to monitor synthesis of the new compound, and the effects of temperature and light on product yield are being determined.

JANE R. OOSTHUIZEN, PHILIP HOFFMAN, and KEVIN L. EVANS, Dept. of Mathematics and Science, Glenville State College, Glenville, WV 26351. **Synthesis of triacid and triamide amphiphiles.**

Amphiphiles are compounds that possess both hydrophilic and hydrophobic properties. Amphiphiles have practical applications in both industry and medicine. Industry is particularly interested in amphiphiles for their ability to inhibit corrosion and as flotation collectors, which is especially useful in mining. From a medical standpoint, amphiphiles are being investigated as a new type of antibiotic. Two series of amphiphiles were synthesized during this research – the triamide and the triacid. Each synthesis involved the condensation of a secondary amine with an isocyanate. Four triamide amphiphiles were synthesized by the condensation of triamide isocyanate with *N*-methylalkylamines of different alkyl chain lengths (12, 14, 16, and 18 carbons). The triacid amphiphile was synthesized with *N*-methyloctadecylamine and weisocyanate. Attempted purification of the compounds included recrystallization and thin layer column chromatography. Characterization of the triacid and triamide amphiphiles included ^{1}H and ^{13}C NMR, FTIR, and melting point.

Engineering & Computer

BRIAN J. ANDERSON, National Energy Technology Laboratory, Dept of Chemical Engineering, West Virginia University, Morgantown, WV 26506. **Multiscale modeling: molecular, thermodynamic, reservoir, and economic modeling of energy systems.**

Although for decades researchers have been able to model and simulate systems of different scales independent of each other, the ability to bridge multiple time and length scales between such models is still at the cutting edge of modeling capabilities. The ability to establish a direct connection between the models that are used to simulate the different scales can provide insight into the important parameters between scales in real systems. Current methods of modeling generally focus on one time- or length-scale, and any step change in dimension typically necessitates the introduction of new governing equations. Modeling of many dimensions in space is a challenge in and of itself. Not only are we attempting to model all spatial dimensions, but spatial dimensions over varying length and time scales with added complexities, such as molecular interactions and economics. National-scale economic models of Geothermal Systems and their potential for U.S. electricity production, as well as the coupling of molecular, thermodynamic, reservoir, and economic modeling in the area of natural gas hydrates will be presented. Enabled by the incorporation of

ab initio calculations on the interactions of guest gas and host water molecules, molecular dynamic simulations are being used to predict the dissolution of hydrates in the presence of small driving forces. Thermodynamic models of natural gas hydrate phase equilibria have been improved upon, and economic modeling techniques for studying infant technology diffusion have been developed. Finally, the connection to nature's heterogeneity and production rates from arctic gas hydrate reservoirs will be discussed.

CHRIS ATKINSON, Director, Center for Alternative Fuels, Engines and Emissions, and Professor, Dept. of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506. **Future automotive technologies and trends.**

The automotive industry has recently been subjected to the confluence of a number of powerful and conflicting forces, including adverse economic effects, the consequences of globalization, the existence of significant production overcapacity, stringent emissions and safety legislation, increasing calls for energy independence, and requirements for further fuel economy and vehicle fuel efficiency improvements. There have been, and will continue to be, profound shifts in vehicle technologies including the introduction of hybrid electric vehicles, the increased use of renewable fuels, and added vehicle electronic content. The electrification of passenger vehicles represents one of a series of inexorable trends that will play out over the foreseeable future. The future of the light-duty passenger car and truck, the heavy-duty vehicle, and fuel industries will be discussed against this backdrop.

LISA BLICKENSTAFF, Dept. of Education Mathematics (5-Adult), Shepherd University, Shepherdstown, WV 25443, and KARA CRESS, Dept of Mathematics, Shepherd University, Shepherdstown, WV 25443. **Unstable wobble mode.**

Through research and experimentation in bicycle dynamics, we determined what causes a wobble oscillation in the front wheel of a bicycle. During our research, we looked at various equations to calculate wobble and its relationship to speed. We also used programs such as MATLAB to confirm our results. Our research is ongoing and will eventually consider the combination of both wobble and weave. We thank Dr. Elmer and NASA for their continuing support to our research.

KIRAN CHAUDHARI and RICHARD TURTON, Dept. of Chemical Engineering, West Virginia University, Morgantown, WV 26505, and CHRIS GUENTHER and RONALD BREAULT, National Energy Technology Laboratory, Morgantown, WV 26505. **Development of advanced coal gasification kinetics models for CFD (and process simulation) codes.**

The objective of this research is to implement detailed kinetic expressions for the gasification of a wide variety of coals in existing CFD codes such as MFIX. These expressions describe the fundamental steps taking place in the gasification of coal, namely, coal devolatilization, tar-gas chemistry, soot formation, and the heterogeneous and homogeneous gasification reactions along with combustion reactions. For this purpose, the data generated by PC Coal Lab, licensed by Niksa Energy Associates LLC, will be used to simulate the gasification of various coals in CFD codes. The CFD code of most interest is MFIX, which is used to describe the hydrodynamics, heat transfer, and chemical reactions in the reacting fluid-solids systems comprising the contents of a gasifier. The implementation of coal gasification kinetics in MFIX is currently done through a set of subroutines making up the module Carbonaceous Chemistry for Continuum Modeling (C_3M) code. C_3M has default gasification kinetics for only a few coals. On the other hand, PC Coal lab can predict the gasification kinetics for over 2000 coal species. Therefore this project focuses on the development of a seamless connection between PC Coal Lab and the C_3M. The interface will be designed to allow MFIX to transfer information through C_3M to PC Coal Lab, run PC Coal Lab with the input data from MFIX, and send kinetic information back to C_3M in a form that allows C_3M to update and continue the MFIX simulation using updated parameters from PC Coal Lab. The project is funded by department of energy.

PINGEN CHEN, HAILIN LI, W. SCOTT WAYNE, and NIGEL N. CLARK, Center for Alternative Fuels, Engines and Emissions, West Virginia University, Morgantown, WV 26506, and XIAOHUA ZENG, College of Automotive Engineering, Jilin University, Changchun, Jilin, P. R. of China. **Optimization of a heavy-duty hybrid bus operated under transient cycles.**

Hybrid vehicles have been recognized as a viable technology having the potential to improve fuel economy substantially and to reduce exhaust emissions in urban areas. In principle, the success of hybrid technology relies on the efficient recovery of the vehicle's kinetic energy during the braking process and energy management between the battery system and engine. The optimization of the power control strategy makes it possible to run the engine with best fuel economy while complying with emissions regulations, although the engine may not operate in the same way as in a conventional bus. The main objective of this research was to simulate and optimize the operation of a heavy-duty hybrid bus operated under typical transient bus cycles. Component data and operation maps of a prototype parallel hybrid bus were employed in the Powertrain Systems Analysis Toolkit (PSAT) developed by Argonne National Laboratory. The model was validated against preliminary experimental data measured using the China bus driving cycles. The validated model was then used to simulate the performance of its operation under many US transient bus emission cycles. The simulation results indicated the potential of hybrid bus control strategy optimization in reducing the fuel consumption and greenhouse gas emissions. Compared to the fuel consumption obtained with the original control strategy, the optimized strategy had the potential to reduce the fuel consumption by 5.3%, 7.7%, and 3.37% when operated through the Manhattan Bus Cycle, the Central Business District Cycle, and the New York Bus Cycle, respectively.

KARA CRESS, Dept. of Mathematics, Shepherd University, Shepherdstown, WV 25443, and LISA BLICKENSTAFF, Dept. of Education Mathematics (5–Adult), Shepherd University, Shepherdstown, WV 25443. **Weave's effect on the stability of a bicycle.**

Have you ever wondered how a bicycle stays upright when you ride it? One effect that keeps the bicycle upright is called weave, an oscillation of the rear end of the bicycle around the steering head axis. As part of this research, we experimented with bicycles and solved the differential equations dealing with weave and its effect on the stability of the bicycle. We found the eigenvalues of the underlying equations and used these to make conclusions about the stability of the bicycle. We thank NASA and Dr. Chris Elmer for their help and support throughout the project.

JUSTIN EBERSOLE, SCOTT FRAZIER, JR., and RAINA ROMERO, Dept. of Mathematics, Shepherd University, Shepherdstown, WV 25443. **Gyroscopic effects on a bicycle.**

The objective of this study was to determine if gyroscopic forces stabilize a bicycle while it is in motion. By measuring the distribution of the masses of a bicycle wheel, we determined both its center of gravity and its angular momentum. We obtained values for gyroscopic forces and observed their effect on the stability of a moving bicycle. We will also be creating a computer model to compare our findings with expected values derived from accepted equations. Do gyroscopic forces hold up a bicycle? Come and see. Special thanks to Dr. Christopher Elmer and NASA for their support in this project.

RAJ GONDLE and HEMA SIRIWARDANE, Dept. of Civil and Environmental Engineering, West Virginia University, Morgantown, WV 26506. **Geologic storage of carbon in coal seams.**

Geologic sequestration is one of the options for storage of carbon to reduce current levels of carbon dioxide emissions. The potential of CO_2 sequestration in a deep, unmineable coal seam was evaluated based on a field injection and numerical modeling of overburden response. The field site was instrumented with high precision tiltmeters that can measure surface displacements in the sub-millimeter range. Three-dimensional, coupled flow-deformation, finite element analyses were performed to determine expected surface deformations during fluid injection. Numerical methods were also developed to simulate fault activation and its influence on overburden response. Results from this study are presented in this paper. Those results can be used in developing monitoring technologies for geologic sequestration.

DUSTIN JONES, DEBANGSU BHATTACHARYYA, and RICHARD TURTON, Dept. of Chemical Engineering, West Virginia University, Morgantown, WV 26506, and STEPHEN E. ZITNEY, Collaboratory for Process & Dynamic Systems Research, National Energy Technology Laboratory, Morgantown, WV 26507. **Analysis of an air separation unit as part of an integrated gasification combined-cycle power plant.**

Efficient design of a cryogenic air separation unit (ASU) and its optimal integration with the gas turbine (GT) can help to improve the overall efficiency of an integrated gasification combined-cycle (IGCC) power plant. Because of the integration between the ASU and the GT, an elevated pressure ASU (EP ASU) is usually considered to be a better option than the conventional low pressure ASU (LP ASU) because O_2 to the gasifier and N_2 to the GT become available at higher pressures. However, because of an increase in the operating pressure, the relative volatilities among O_2, N_2, and Ar decrease along with a decrease in the differences between the liquid and vapor densities. This gives rise to a very challenging separation problem. In this study, the focus is on maximizing the overall process efficiency by investigating various configurations of an EP ASU, optimal integration of the ASU with the GT, and the effect of power cycle selection on the choice of the ASU cycle. The study has also investigated the possibility of an LP ASU with a pumped liquid oxygen cycle that can decrease the power requirement of the oxygen compressors significantly. For a steam-injected GT, the study shows that an LP ASU is a better option compared to an EP ASU because no nitrogen injection is required. In addition, more air is available for extraction due to limitations in the mass and volumetric flow of the gas turbine. This work was funded by the NETL.

S. J. KASULE, D. BHATTACHARYYA, and R. TURTON, Dept. of Chemical Engineering, West Virginia University, Morgantown, WV 26506, and Collaboratory for Process and Dynamic Systems Research, U.S. Department of Energy, National Energy Technology Laboratory, Morgantown, WV 26507, and S. ZITNEY, Collaboratory for Process and Dynamic Systems Research, U.S. Department of Energy, National Energy Technology Laboratory, Morgantown, WV 26507. **On the modeling of a single-stage, downward-firing, entrained-flow gasifier using Aspen Custom Modeler.**

Coal-fired gasifiers are the centerpieces of integrated gasification combined-cycle (IGCC) power plants. The gasifier produces synthesis gas that is subsequently converted into electricity through combustion in a gas turbine. Several mathematical models have been developed to study the physical and chemical processes taking place inside the gasifier. Such models range from simple one-dimensional (1D) steady-state models to sophisticated dynamic 3D computational fluid dynamics (CFD) models that incorporate turbulence effects in the reactor. The practical operation of the gasifier is dynamic in nature, but most 1D and some higher-dimensional models are often steady-state. On the other hand, many higher order, CFD-based models are dynamic in nature but are too computationally expensive to be used directly in operability and controllability studies. Thus lower-dimensional dynamic models are still useful in these types of studies. In the current study, a 1D dynamic model for a single-stage, downward-firing, entrained-flow gasifier is developed using Aspen Custom Modeler® (ACM), which is a commercial equation-based simulator for creating, editing, and re-using models of process units. The gasifier model is based on mass, momentum, and energy balances for the solid and gas phases. The chemical reactions considered in the model are devolatilization/pyrolysis, gasification, combustion, and the homogeneous gas-phase reactions. In this presentation, preliminary results from the steady-state, non-isothermal gasifier model will be presented. Sensitivity studies will be presented for different types of coal and validation of the model with experimental data will be shown. This project is supported by NETL.

PAUL J. KREITZER and JOHN M. KUHLMAN, Dept. of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506. **Spray-cooling simulation implementing time-scale analysis and the Monte Carlo Method.**

Simulation capability for complex physical systems is expected to increase as computational power increases, with computational fluid dynamics (CFD) leading the way. However, the complicated, multiphysics nature of spray-cooling has resulted in recent 3-D CFD simulations of single droplet

impingement using a serial PC that can take in excess of 30 days to solve (Selvam, 2009). Parallel processing shortened this time dramatically, but still requires over half a day. Therefore, there is a clear need for a comprehensive spray-impingement simulation with adequate physical complexity to yield accurate results within a relatively short run time. The present work combines experimental and computational results with numerical correlations representing the physics that occurs on a heated impingement surface. The current simulation models the spray behavior of a Spraying Systems FullJet® 1/8-g spray nozzle. Spray characteristics are indicated as follows: flow rate of 1.05×10^{-5} m^3/s, normal droplet velocity of 12 m/s, and Sauter mean diameter of 48 μm. This produces the following non-dimensional number ranges: We 300–1350, Re 750–3500, Oh 0.01–0.025. Numerical and experimental correlations have been identified that represent crater formation, splashing, film thickness, droplet size, and spatial flux distributions. A combination of these methods has resulted in a spray-impingement simulation capable of simulating hundreds of thousands of drops. This represents approximately one millisecond and takes several hours to complete. A comparison of results from this code to experimental results shows similar trends in surface behavior and heat transfer. Partial support from the NASA WVSGC is appreciated.

RAY LIANG, HOTA GANGARAO, and DANIEL STANISLAWSKI, Constructed Facilities Center, West Virginia University, Morgantown, WV 26506, and YING LEI, YANHAO LI, and YONGQIANG JIANG, School of Architecture and Civil Engineering, Xiamen University, Xiamen, China, 361005. **Material and structural response of historic Hakka rammed-earth structures.**

Rammed-earth is a sustainable construction material with many positive attributes to the environment compared to concrete and steel. The in-service World Heritage Hakka rammed-earth structures, e.g. Fujian Tulou of China, are historic and unique in design and performance. This presentation reports our findings from the studies of these buildings sponsored by National Science Foundation. The material and structural responses of five rammed-earth buildings have been field-investigated. All field studies were conducted in a nondestructive manner using techniques such as infrared thermography, rebound hammer, ultrasonic testing, strain data from load tests on roof trusses and floors, and thermal data from thermocouples. The data collected from the field trip were processed further for their implications and the samples collected are being tested further at WVU for thermal, mechanical, and morphological properties, including carbon dating for the age of buildings. Those material and structural responses are also being simulated through FE modeling for better understanding. The sustainability of Hakka village dwellings built hundreds of years ago and still in use today might provide us with exemplary lessons with reference to the green building movement, including the Leadership in Energy and Environmental Design (LEED) program. Upon completion of the research we wish to emulate the Hakka Tulou Technologies, with appropriate modifications, for implementation in modern construction leading to: 1. energy-efficient and green buildings with thermal comfort; 2. disaster-resistant structural configurations; 3. innovations of affordable housing and multi-story buildings; and 4. development of durable rammed-earth material systems and construction techniques.

SHIYU LIU, HAILIN LI, CHET-MUN LIEW, TIMOTHY GATTS, SCOTT WAYNE, BENJAMIN SHADE, and NIGEL CLARK, Dept. of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506. **An investigation of NO_2 emission of a H_2-enriched, heavy-duty diesel engine.**

This paper investigates the effect of H_2 addition on the nitrogen dioxide (NO_2) emission of a 1999 Cummins ISM370 diesel engine. The preliminary data measured using the 13-mode European Stationary Cycle (ESC) demonstrated the significant effect of H_2 addition on the emissions of NO_2. The detailed effect of H_2 addition on NO_2 emissions was investigated at 10-70% of maximum load at 1200 RPM. The addition of a small amount of H_2 was shown to substantially increase the emissions of NO_2 but slightly reduce the NO emissions, especially at low load. A portion of the NO formed in combustion process was converted to NO_2. When operated at 10% load, the maximum NO_2/NO_x ratio of 60% was observed with the addition of 4% H_2. Further increasing the addition of H_2 beyond the point at which maximum NO_2 emissions occurred still produced more NO_2 than diesel operation.

Increasing the engine load inhibited the enhancing effect of H_2 on the conversion of NO to NO_2, with the maximum NO_2/NO_x ratio observed with the addition of less H_2. The maximum NO_2 emissions obtained under H_2–diesel, dual-fuel operation were 3 times (70% load) to 5 times (10% load) that of diesel operation. It was concluded that the engine load and combustion temperature were not the main factors dominating the formation of NO_2 in the dual-fuel engine. The preliminary analysis demonstrated the dependence of the NO_2/NO_x ratio of the H_2–diesel, dual-fuel engine on the emissions of the unburned H_2 and its combustion efficiency.

STEVEN McCLELLAND and JOHN ZANIEWSKI, Dept. of Civil and Environmental Engineering, West Virginia University, Morgantown, WV 26506. **A history of the Fuller curve.**

The gradation (size distribution of aggregate particles) in Portland cement and hot mix aggregate concrete is important to their strength, performance, and economy. Fuller developed mathematical functions, based on empirical evidence, for determining maximum density gradation blends of aggregates. Over the subsequent century, Fuller's methodology is cited as the seminal research that has lead to the current state of the practice. Fuller's original research reports were consulted in an attempt to better understand the methodology. Fuller actually proposed two different but similar curves and a physical test procedure in order to produce workable, dense Portland cement concrete using the most widely available aggregates in the turn-of-the-20th Century New York City area. In the 1920s Richard Grün, a German Portland cement researcher, accepted Fuller's curve based on a trade journal summary of Fuller's research. Fuller's caveat of fitting the curve to each aggregate or combination of aggregates seems to have been dropped. In the early 1940s, L.W. Nijboer, a Dutch asphalt researcher, adopted the Fuller curve from Grün's work and tested asphaltic mixes using triaxial testing. Based on his research he proposed changing the curve to a different power and plotting it logarithmically. This gave rise to a different ideal form (a straight line instead of a parabola). In the early 1960s American researchers Goode and Lufsey proposed adopting Nijboer's results. This form of the Fuller curve has remained unchanged for over 45 years. The Fuller curve is now far enough from its origins that it needs to be revalidated for its present use or be replaced.

MAYURI MUKKA, EDWIN L. KUGLER, and DADY B. DADYBURJOR, Dept. of Chemical Engineering, West Virginia University, Morgantown, WV 26505. **Parametric study of the partial oxidation of propane over Ni- and Pt-based catalysts.**

Hydrogen production through the partial oxidation of propane over CeO_2-supported Pt and Ni catalysts was studied. The aim of the study was to investigate the sequence of different reactions during propane oxidation over two catalysts. The reaction runs were performed in a fixed-bed reactor at a reaction temperature of 600 °C and a feed ratio (O_2: C_3H_8) of 1.78. The effect of space velocity on the reaction rates was evaluated by varying total inlet flow (100 to 400 SCCM) and catalyst weights. The outlet gases from the reactor were analyzed by an online gas chromatograph (GC). At 600 °C, six species (C_3H_8, O_2, H_2, CO, CO_2, and C_3H_6) were detected at the reactor outlet. Ten reaction sets containing four independent reactions each (which would yield the six species) were found by the Gaussian elimination process. For each set, a material balance on the six outlet compositions measured the extents of each of the four reactions in the set. The rate of each reaction in all the ten sets was calculated using MATLAB least-square regression technique. Sets with negative reaction rates were eliminated. To confirm the validity of sets, reactions representing dry reforming, steam reforming, and water gas shift were further carried out over the catalysts. Finally, the effect of weight hourly space velocity on the reaction rates for each of the catalyst was evaluated.

JORDAN MUSSER, Dept. of Mathematics, West Virginia University, Morgantown, WV 26506, MARY ANN DRUMRIGHT-CLARKE, West Virginia University, Morgantown, WV 26506, and JANINE GALVIN, National Energy Technology Laboratory, Albany, OR 97321. **Development of a discrete mass inflow boundary condition for MFIX.**

MFIX (Multiphase Flow with Interphase eXchanges) is an open source software package developed by the National Energy Technology Laboratory (NETL) used for modeling the chemical

reactions, heat transfer, and hydrodynamics of fluid-solid systems. Currently, the stable, publically available release of MFIX does not include a discrete mass inflow boundary condition (DMIBC) for its discrete element method (DEM) package. Inflow boundary conditions are useful for simulating systems where particles are consumed through chemical reactions and an incoming feed is necessary to sustain the reaction. To implement the DMIBC, an inlet staging area is designated outside the computational domain and particles are passed through the wall region associated with the inlet. Forces incurred on entering particles, generated from collisions with particles already in the system, are ignored, whereas particles already in the system respond to contact forces and react accordingly, moving away from the inlet. This approach prevents any unphysical overlap between new and existing particles. It also ensures that particles entering the system will enter the computational domain regardless of opposing forces. Once an incoming particle is fully within the domain, it reacts appropriately to any and all contact forces. This approach for a DMIBC has been implemented and is available within the current development version of MFIX.

KYLE PHILLIPS, EMILY CALANDRELLI, MIKE NUSSBAUM, and JOHN M. KUHLMAN, Dept. of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506. **West Virginia University (WVU) Short Microgravity Research Facility (SMiRF) drop-tower development.**

West Virginia University (WVU) has committed itself to developing the Short Microgravity Research Facility (SMiRF) drop tower on its campus to increase direct access to inexpensive and repeatable microgravity research. A drop tower is essentially a tall structure from which experimental payloads are dropped and experience microgravity, or "weightlessness," during free fall. There are several ways to conduct scientific research in microgravity, including drop towers, parabolic flights, sounding rockets, suborbital flights, NanoSats, CubeSats, full-sized satellites, and the International Space Station (ISS). However, none of the aforementioned techniques is more inexpensive or has the capability of frequent experimentation repeatability as drop-tower research. These advantages can allow a wide variety of experiments to become inexpensively certified through repeated, reliable research that permits experiment modification and re-testing. Therefore, WVU has begun to develop the SMiRF drop tower through a WVU Research Corporation Program to Stimulate Competitive Research (PSCoR) grant. Development of SMiRF, or any drop tower, includes the design of several main components, namely the payload release mechanism, the payload deceleration system, the payload hoisting and transfer system, the drop-tower structure, and the drop-tower instrumentation and controls system, as well as a standardized drop-tower payload frame for use by those researchers who cannot afford to spend money on a frame. After design and construction of the WVU SMiRF is complete, an initial calibration payload and experimentation will prove the accuracy of the drop tower, so that open operation will begin in the Fall of 2010.

SOHEIL RAZMYAR, KATARZYNA SABOLSKY, and EDWARD M. SABOLSKY, Dept. of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506. **Microstructural control and characterization of BICUVOX ceramics.**

The widespread commercialization of solid-oxide fuel cells (SOFCs) and solid-oxide electrolyte cells (SOECs) is primarily limited by materials degradation issues related to the required high-temperature operation (>800 °C). Research is required to develop the next generation of solid ionic electrolytes for those applications that display ionic conductivities exceeding 10^{-2} S/cm at temperatures <800 °C. The typical approach is through the doping of various fluorite-, perovskite-, and pyrochlore-structured materials to alter ionic vacancy concentration and order. Relatively few researchers have explored methods of manipulating the microstructure of bulk ceramic oxides to control diffusional kinetics. The proposed approach may lead to electrolyte ceramics with enhanced ionic conduction and mechanical strength. Research on controlling grain orientation and grain growth kinetics of $Bi_2Cu_xV_{1-x}O_{5.5-z}$ (BICUVOX) will be presented. Discussions will focus on the effect of processing variables,such as liquid phase content, powder characteristics, and thermal conditions on density, grain growth, orientation, and mechanical strength.

JAMES M. STILES, Limestone Engineering, 1766 Limestone Road, Parsons, WV 26287. **AMD remediation options for large-scale watershed remediation.**

Monday Creek of the Hocking River has a 116 square-mile drainage basin in southeastern Ohio, and since the middle of the 19th century, extensive portions of the watershed have been subjected to underground and surface coal mining. A recent survey of the watershed has identified over 4,300 point sources of acid mine drainage that have rendered a number of stream reaches within the watershed sterile and unable to support diverse, aquatic life. In 2003, the author developed a computer model of those aspects of water quality related to acid mine drainage (AMD) for the watershed using the TAMDL computer program developed by the author at West Virginia University. TAMDL was designed to model stream water quality in watersheds affected by AMD and its treatment by simulating the evolution of stream pH, net acidity, and the concentrations of aluminum, iron, and manganese. The model was then employed by the author to develop strategies for the treatment of AMD in the watershed. The objective of this new project was to recalibrate the TAMDL model created in 2003 for the new conditions in the watershed and use this recalibrated model to design a revised, cost-effective treatment strategy to bring the water quality conditions from their current level up to the remediation target conditions. This research was funded by the Huntington District of the U.S. Army Corps of Engineers.

JEREMY THOMPSON, Dept. of Mathematics, Shepherd University, Shepherdstown, WV 25443, and JACOB HACKETT and DANIEL RIZER, Dept. of Education/Mathematics Shepherd University, Shepherdstown, WV 25443. **Torques in the golf swing.**

Have you ever wondered how professional golfers make the golf swing look so effortless while still hitting the ball incredibly far? The answer: they have trained their bodies to apply the various torques involved in the golf swing in the most efficient manner possible. There are numerous torques involved in the golf swing, including two applied torques, as well as several other torques produced by diverse means, such as gravity; however, all of these torques may be combined into two general torques, the torque in the arms and the torque on the club. Throughout this project we have been studying how these various torques, mostly the applied torques, affect other aspects of the golf swing, such as velocities and accelerations associated with the club and arms. After much research and experimentation, we were able to produce quantitative results to demonstrate to what degree these torques influence the other quantities in the golf swing. We thank Dr. Chris Elmer and NASA for their continuing support throughout this project.

TU H. TRAN, Dept. of Physical Science, Marshall University, Huntington, WV 25755, and SEUNGJIN LIM, Dept of Integrated Science and Technology, Marshall University, Huntington, WV 25755. **Bridging the digital divide in WV GIS systems.**

Many government agencies in WV such as the Raleigh County Assessor's office, Dept. of Revenue, and Rahall Transportation Institute, have difficulties in sharing and reusing information across their GIS systems due to the lack of interoperability both at the application and the database layers. This study focuses on developing an efficient and cost-effective solution to the aforementioned problem by which the agencies can share data easily and henceforth provide the public access to information at convenient locations. As a result, we present a data management solution based on the OpenGIS standard at the database layer and a middleware-based application development. This approach enables us to save time and storage space. Based on our study, Raleigh County launched a new distributed, replicated Metro GIS system in Beckley in 2009 that allowed the EMS Center, the Raleigh County Assessor's office, and the County Commission Board to share GIS information efficiently. As a result, the employees at these agencies can access any shared GIS data at their locations. In addition, we will migrate the backend platform to open source technologies to save the ownership cost of the system, provide a GIS web-based application layer to allow the public to access and process information at home through the internet, and add customizable middleware for developers. Developers will then have greater flexibility in developing user interfaces and applications using open source libraries, such as Proj4, GEOS, and PostGIS, while securing a high degree of interoperability and information sharing.

HENRY WARE, MedQuist, Inc. 235 High Street. Morgantown, WV 26505, and JOHN ATKINS, Dept. of Computer Science and Electrical Engineering, West Virginia University, Morgantown, WV 26506. **A note on Second Normal Form**

Third Normal Form has been considered the de facto standard in the design of relational databases. Bernstein showed that any relation schema not in Third Normal Form can be losslessly decomposed to subschemas in Third Normal Form while preserving functional dependencies. Furthermore, any relational schema can be evaluated for conformance to Third Normal Form in polynomial time (given that the keys are known). Since every relation schema in Third Normal Form is in Second Normal Form and since Third Normal Form is the generally accepted goal in database design, the study of Second Normal Form has been somewhat neglected. Exacerbating this neglect has been the absence of a convenient method to determine conformance to Second Normal Form (given that the keys are known). This paper attempts to rectify that deficiency. Given the keys for the relation schema, we explore a polynomial time algorithm to decide definitively if a relation schema is or is not in Second Normal Form.

YA-MEI YANG and MITCHELL J. SMALL, Dept. of Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, PA 15213, EGEMEN O. OGRETIM and DONALD D. GRAY, Dept. of Civil and Environmental Engineering, West Virginia University, Morgantown, WV 26506, and GRANT S. BROMHAL, National Energy Technology Lab, Department of Energy, Morgantown, WV 26507. **Probability of leak detection for soil CO_2 flux measurement under different geologic carbon-sequestration site conditions.**

Near-surface monitoring is an essential component of leak detection at geologic sequestration sites, and soil CO_2 flux monitoring provides a simple and direct estimate of CO_2 exchange between the soil and the atmosphere. This paper presents a methodology for integrating soil CO_2 flux monitoring data with modeling of CO_2 migration to infer the probability that a CO_2 leak has occurred at a sequestration site under different site conditions. Possible near-surface flux rates for CO_2 as a function of distance from the leakage point are generated by TOUGH2, a multiphase groundwater flow model, given different leakage rates and permeabilities. The natural near-surface CO_2 flux measured at the ZERT demonstration site in Montana is used to determine critical values for leak inference and to calculate the probabilities that a leak of a given size will be detected by the monitoring network. Detection maps for detecting CO_2 leakage given different permeabilities and leakage rates are generated by combining simulations from the TOUGH2 model and soil flux monitoring data at the ZERT site. The results show that the probability of detecting a leak increases for larger leakage rates but not necessarily with larger permeability. We also show how increasing the monitoring density increases the probability of detection for a leak of a given size with different site conditions. The detection maps for different permeability and leakage rates at a given location clarify the likelihood of leak detection and the necessary monitoring density for a given monitoring technique. We thank the U.S. Department of Energy, National Energy Technology Laboratory, for funding this research under Contract No. TSK.41817.606.04.03.

STEPHEN E. ZITNEY, U.S. Department of Energy, National Energy Technology Laboratory, Collaboratory for Process & Dynamic Systems Research, Morgantown, WV 26507, and DEBANGSU BHATTACHARYYA and RICHARD TURTON, Dept. of Chemical Engineering, West Virginia University, Morgantown, WV 26506. **Immersive 3D virtual training systems for advanced energy plant operations and control.**

In today's business environment, the process and energy industries are pushing their operating plants to their limits, while at the same time both processes and control systems are becoming increasingly more complex. Operator training systems (OTS) provide one of the best ways to train plant operators and engineers. Immersive 3D virtual reality adds another dimension of realism to real-time dynamic OTS systems and extends the training scope to both control room and outside operators, allowing them to work as a team. The benefits of a high-fidelity immersive training system (ITS) go beyond those of traditional simulation and include more realistic scenarios for plant startup, shutdown, and power-load-following; improved communication and collaboration among work crews;

off-line evaluations of procedures; and training for safety-critical tasks and rare abnormal situations. The U.S. Department of Energy's (DOE's) National Energy Technology Laboratory (NETL) and West Virginia University (WVU) are collaborating with software, industry, and research partners to develop a state-of-the-art dynamic simulator and immersive 3D virtual training system for a next-generation, zero-emission integrated gasification combined-cycle (IGCC) power plant with carbon-capture. The combined IGCC OTS/ITS solution will be deployed and operated at NETL's Dynamic Simulator Research and Training (DSR&T) Center and at WVU's National Research Center for Coal and Energy, both in Morgantown, WV. The world-class DSR&T Centers will offer unique R&D, training, and education opportunities for the operation and control of advanced energy plants with carbon-capture.

Mathematics

ROBERT AULD, Dept. of Computer Science and Mathematics, Shepherd University, Shepherdstown, WV 25443. **Mathematically modeling high-altitude balloons.**

The purpose of this project is to allow insight into the dynamics of high-altitude flight in order to predict a high-altitude balloon's position at any given time during the duration of its flight. The model created in this project takes into account near-current wind velocities at different altitudes based on previous data recovered, temperature and pressure values at these altitudes, maximum balloon fill capacity/starting volume of gas, weight of payloads, and many other factors. The program created for this project allows relevant parameters to be defined and, with the help of a previous National Weather Service high-altitude weather balloon, will create a depiction of exactly what will go on during the flight of a future balloon. This model should allow a user to know where he or she will be going for retrieval of his or her high-altitude balloon. Although more testing needs to be done, I believe this program provides a working model for actual high-altitude balloon flight. This project is supported by NASA.

MARY ANN DRUMRIGHT-CLARKE, Dept. of Mathematics, West Virginia University, Morgantown, WV 26506.

A review of partial differential equation, weak-solution formulation used in finite element software construction.

Finite element methodology is a classic applied mathematics technique used to manage the solution of partial differential equations (pde). One foundational means to construct a finite element framework for any pde is through the analysis and formulation of a weak solution. In the field of fluid dynamics, there are several publically available software packages that utilize finite element methodologies (such as Fluent®) to solve the Reynolds- averaged Navier-Stokes (RANS) equations. While these packages are phenomenally useful as predictive tools, it is an unfortunate truth that most package-users are unaware of how or why the software works. While the material is not new, the presenter will review the basic tenets of weak formulation for the Stokes equation, and demonstrate the construction of a finite element solution methodology on a simple grid system. The methodology will be generalized to the extent that other pde of engineering interest that are not available in commercial solvers can similarly be investigated.

YOONJA MORTENSEN and RAINA ROMERO, Dept. of Education, Shepherd University, Shepherdstown, WV 25443. **Mathematical analysis of the bistable equation for modeling electric potential propagation along the axon of a neuron.**

Much research exists to model the voltage propagation along the axon of a neuron. That research aids in our understanding of the nervous system. The model used for electric potential propagation along the axon of a neuron is the bistable equation. However, the bistable equation is resistant to solving using an analytic approach. The transformation of variables is introduced to make this partial differential equation a solvable ordinary differential equation. It is assumed that the voltage along the axon travels at a constant speed. The MATLAB package is used to find the solution numerically since this transformed ordinary differential equation is not solvable analytically. The solution of the voltage along the axon behaves differently depending on the magnitude of the speed of propagation. For example, with high propagation speeds, the waveform does not oscillate but with low propagation speeds the waveform shows an oscillating behavior. The solutions of the bistable equation show the voltage wave propagation phenomena along the axon of a neuron clearly. This project was an experience in transforming partial differential equations into ordinary differential equations and exposed us to mathematical modeling.

Medicine & Health Sciences

CHASE DOWLING, QING WANG, and ZHIJUN WANG, Shepherd University, Dept of Computer Science, Mathematics, and Engineering, Shepherdstown, WV 25443. **The reproductive ratio of pandemic H1N1/09 influenza virus in active-duty military personnel.**

Influenza A (H1N1), a virus of much academic scrutiny, was declared a pandemic flu by the World Health Organization in 2009. Here we analyze the reproductive ratio of the virus as of February/ March 2010. The basic reproductive ratio, R_0, is defined as the number of secondary cases generated by a typical infected individual in a completely susceptible population. Essentially, the reproductive ratio describes the rate at which the virus spreads, if at all. This value provides us with valuable insight into the behavior of the virus; with this value, we can predict the longevity and magnitude of the pandemic and effectively determine courses of action to control it. In this study, we use comprehensive data regarding influenza-like symptoms and confirmed H1N1 cases arising in active-duty military personnel to determine a reproductive ratio with a special system of differential equations: an SIR model (Susceptible/ Infected/Recovered). We compare this experimentally derived value of the reproductive ratio to previously forecasted and more recently derived values of the reproductive ratio. We also forecast the ratio into the coming months as the pandemic comes to a close. We determine if this Defense Intelligence Agency data set effectively models influenza virus on a national scale, given the skewed characteristics of the active duty military population the ratio is based on. Given the virus' known behavior, we also determine whether or not we can use our results to forecast the virus' future behavior outside of the data set's population.

LUCAS A. DVORACEK, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074, HUEY MIIN LEE, Dept. of Statistics, West Virginia University, Morgantown, WV 26506, MELINDA S. DETRICK, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074, and ROBERT KREISBERG, College of Sciences, West Liberty University, West Liberty, WV 26074. **Statins may be beneficial in reducing heart disease by inhibiting the inflammatory response that causes atherosclerosis.**

Coronary heart disease is the leading cause of death in the United States. The principal cause of heart disease is atherosclerosis, the accumulation of plaque on arterial walls. In the past, low-density lipoprotein (LDL) has been villainized as the immediate cause of this disease, but recent findings have linked atherosclerosis with a chronic inflammatory response at the arterial endothelial cell level.The apparent initiator of this response is minimally modified LDL (mm-LDL), a partially oxidized form of LDL. In our laboratory, human aortic endothelial cells (HAECs) treated with oxidized 1-palmitoyl-2-arachidonoyl-*sn*-phosphatidylcholine (oxPAPC, a principal bioactive component of mm-LDL) demonstrated increased message for IL-6 and IL-8, two pro-inflammatory cytokines with roles in atherosclerosis. This effect was reversed by lovastatin. Statins are prescribed as inhibitors of cholesterol biosynthesis, thus diminishing serum LDL and ultimately retarding atherosclerosis. The work presented illustrates statins may also function at the endothelial cell level, down-regulating pro-inflammatory cytokines in cells affected by mm-LDL/ oxPAPC. Furthermore, lovastatin-mediated reversal of oxPAPC effects was abolished with mevalonate (in both cytokines) or geranylgeranyl pyrophosphate (in IL-8). This evidence suggests lovastatin has an anti-inflammatory effect on endothelial cells through which inhibition of mevalonate production and subsequent reduction of geranylgeranyl pools available for IL-8 and potentially IL-6 up-regulation signaling is accomplished. The reported effects strengthen evidence for prophylactic statin use in decreasing the incidence of atherosclerosis through a two-pronged approach: limiting the availability of LDL for oxidation by reducing biosynthesis and down-regulating production of pro-inflammatory cytokines within arterial endothelium, ultimately lessening inflammation underlying atherosclerotic plaque formation.

MICHAEL HENDRYX and KEITH J. ZULLIG, Dept. of Community Medicine, West Virginia University, Morgantown, WV 26506. **Population health disparities in central Appalachian mountaintop coal-mining counties.**

Previous research has identified significant population health disparities within Appalachian coal-mining areas associated with socioeconomic and environmental risks. The objectives of the current research were to identify whether health disparities were unique to areas of central Appalachia where mountaintop mining (MTM) takes place.

Secondary data covering the four central Appalachian states with MTM (KY, TN, VA, and WV) were collected and merged from many existing sources. Data included records of all live births in the years 1996-2004, CDC self-report survey data from 2006 on adult cardiovascular health and health-related quality of life, demographic variables from the US Census and other sources, and mining data from the Department of Energy and US Army Corp of Engineers. Counties were categorized into three groups: counties in MTM permit areas, other coal-mining counties outside of MTM areas, and non-mining counties. Analyses included multilevel logistic regression modeling to examine associations between county group and health outcomes, controlling for other health risks. Results for all outcomes (babies born with congenital anomalies, adult cardiovascular health, and quality of life) showed significant health impairment in MTM counties. For example, the adjusted odds ratio for a congenital anomaly in 2004 in MTM areas was 2.68 (95% CI = 2.24-3.20) compared to non-mining counties. Health disparities in non-MTM mining counties were intermediate and significantly impaired compared to non-mining counties for some but not all outcomes. Previously identified health disparities in Appalachian coal-mining areas are concentrated in areas where MTM takes place. Limitations and future directions are briefly discussed.

SUMANTH MANOHAR, Biotechnology Graduate Program, West Virginia State University, Institute, WV 25112, MATTHEW HARLOW and CHRISTOPHER RYAN MACKIE, Dept. of Biochemistry, Marshall University, Huntington, WV 25755, GERALD R. HANKINS, Biotechnology Graduate Program, West Virginia State University, Institute, WV 25112, and MAIYON PARK, Dept. of Biochemistry, Marshall University, Huntington, WV 25755. **Nuclear-mediated function of Chmp1A in the regulation of ATM signaling activity for the control of human pancreatic tumor cell growth.**

Chromatin modifying protein 1A/Charged multivesicular body protein (Chmp1A) is a member of the endosomal sorting complex required for transport (ESCRT)-III family that functions in the sorting of membrane proteins. Chmp1A was shown to regulate cell cycle progression and chromatin condensation. Our reports indicate that Chmp1A over-expression leads to inhibition of cell and xenograft tumor growth, and that nuclear localization of Chmp1A is required for the mediation of the inhibitory effects of all-*trans* retinoic acid (ATRA) on human pancreatic tumor cells. Chmp1A appears to regulate tumor cell growth through the stabilization of P53. P53 is a substrate of ataxia-telangiectasia mutated (ATM) kinase, and the dynamics of ATM activation are closely related to chromatin condensation. Thus we hypothesize that Chmp1A, through its nuclear localization, regulates ATM signaling activity and subsequently pancreatic tumor growth. Our preliminary data indicates that Chmp1A over-expression led to an increase in phospho-ATM. Immunostaining identified the co-localization of ectopically induced Chmp1A with phospho-ATM and P53, whose intensity closely reflected that of Chmp1A expression. ATM kinase assay indicates that Chmp1A over-expression increased ATM kinase activity as shown by an increase in the level of phospho-P53 compared to the control. In addition, ATM inhibitor-treatment partly abolished Chmp1A mediated-growth inhibition and P53 stabilization. We are testing the significance of nuclear localization signal (NLS) of Chmp1A by using various deletion constructs. We will discuss the significance of the NLS domain of Chmp1A on ATM, P53, and tumor cell growth. This research is supported by NIH 5P20RR016477, WV-INBRE, and RR020180-02, COBRE.

Science & Math. Education

AMY ELLIS and BETH PAULEY, Dept. of Natural Science and Mathematics, University of Charleston, Charleston, WV 25304. **Helping students overcome math anxiety.**

A brief overview of practical techniques shown to be helpful for students of all ages in overcoming their anxiety toward mathematics will be presented. Mathematics is a discipline often met with much anxiety. Many students enter the classroom with self-defeating thoughts that, if not managed successfuly, can

lower academic performance. Helping students change how they think about mathematics will lessen anxieties. By providing students with practical examples of how mathematics can be applied to everyday life and the use of a few simple techniques, such as preaching patience and persistence, pictures and diagrams, and lots of scrap paper, math anxiety can be greatly reduced. General information concerning math test-taking will also be covered.

MARY RUTH GRIFFIN, Dept. of Natural Science and Mathematics, University of Charleston, Charleston, WV 25304. **Student test-taking anxiety and the application of intervention learning techniques.**

This interdepartmental study examined the physiological effects of test-taking and the efficacy of a biblio-technique intervention strategy. Test-taking anxiety is a serious problem that can negatively impact student performance. Test-taking anxiety can be the result of tension, worry, distraction, or procrastination. In some cases test-taking anxiety can manifest itself as physical bodily symptoms, such as sweating, headaches, and nausea. This four-part project began with a survey to educate students about test anxiety and test-anxiety types. A pre-intervention test was developed to determine the physiological response of students during a testing situation, after which an intervention was provided. The intervention was a biblio-learning technique that provided students with information and applicable strategies needed to overcome test anxiety. A post-intervention test in Beckley was also conducted to determine if any improvement in bodily symptom reactions using physiological measurements could be detected.

DAVID O'DELL, Dept. of Science and Mathematics, Glenville State College, Glenville, WV 26351. **Predicting student success in the first semester of college chemistry.**

General chemistry completion rates may be improved by early identification of students who are in need of support services, such as tutoring or study skills counseling. The objective of this study was to develop a model to predict student success (a final grade of C or better) using data available prior to the beginning of the course. Five years of general chemistry courses taught by three different instructors were studied, yielding a data set of approximately 150 students. Multiple linear regression was used to determine the effects of ACT subject and composite scores, high school grade-point average, and high school rank on the grade received in the first semester of general chemistry. High school grade-point average and ACT science scores were not significantly correlated to course grade in the model, while high school rank and ACT math scores were significantly but weakly correlated to course grade. While the model correctly identified most of the students who received grades lower than C, the model also predicted a grade of C for many of the students who received grades of A or B. Overall the model was a poor predictor of student success and tended to predict lower grades than those assigned. Student success in the course is affected by factors other than those included in the model.

Social Sciences & Psychology

DEBRA HULL, Dept. of Psychology, Wheeling Jesuit University, Wheeling, WV 26003. **The science of assessment: assessing service serves assessment.**

Assessing the impact of service/service learning experiences on students' college development presents some unique challenges. In this session, we will discuss two approaches to assessing service learning –asking students to tell us about the impact of their experiences through the use of pre-and post-service learning surveys and looking for evidence of change in their behavior using reflection papers, journal entries, and essay-item responses. In both cases we will attend carefully to how scientific principles of measurement can make the outcomes both more legitimate, defined as more reliable and valid with fewer potential confounds, and more helpful and meaningful to assessors. We will also present an extended example of how one can involve students in the assessment of service learning, at the same time teaching them experimental methods for answering real-world questions using primarily qualitative data.

JOHN H. HULL, Dept. of Psychology, Bethany College, Bethany, WV 26032. **The science of assessment: assessing majors.**

One difficulty with assessing academic majors and programs is addressing issues of external validity: To what extent do major requirements and students' experiences generalize to "real-world" expectations and standards? Further, how can assessment of academic majors and programs ultimately improve those majors and programs? We will discuss how the Department of Psychology at Bethany College is using data from its senior comprehensive examinations to demonstrate external validity in its assessment efforts, consider other potential sources of external validity, and share ideas about effective assessment methodology.

GARY KAPPEL and ALEECE C. GRESHAM, Bethany College, Bethany, WV 26032. **Tales from the dark side: a non-scientist's adventures in the land of assessment.**

As assessment of student learning becomes increasingly critical in accreditation of institutions of higher education, more and more faculty with little or no background in statistics, test design, or survey construction are nevertheless finding themselves called upon to take a crack at those things. While most assessment activities do not require an expert knowledge of statistics, they do require a solid grounding in descriptive and inferential statistics. As for assessment instruments, critical questions include how to satisfy the expectations of accrediting agencies while maintaining control over your curriculum, i.e "To teach or not to teach to the test?" and "Just how many surveys will my students endure before they glaze over?" This presentation offers an unscientific but realistic journey of a temporarily misassigned historian masquerading as the Institutional Effectiveness Director at a small liberal arts college. In this journey he tries to bring himself up to speed in these areas and, more importantly, what he learns about drawing on the expertise of his colleagues in a number of academic disciplines for support and advice.

BETH PAULEY, Dept. of Natural Science and Mathematics, University of Charleston, Charleston, WV 25304. **Program evaluation of a departmental initiative focused on improving student learning.**

Assessment is essential to evaluate any student learning program. In order to identify strengths and weaknesses of a departmental learning initiative, a program evaluation model was developed. First, the mission of the biology department was identified and aligned with the educational mission of the university. Second, student learning outcomes were identified and assessment instruments were developed that enable collection, analysis, and reporting of data. This program evaluation model enabled the focusing of programmatic activities of the departmental learning initiative and allowed for the development of additional intervention strategies and creative assessment opportunities.

ALAN D. SMITH, Dept. of Management, Robert Morris University, Pittsburgh, PA 15219-3099. **Gender perceptions of smoking and cessation via technology, incentives, and virtual communities.**

There are many studies that have tried to evaluate some of the determining factors in smoking cessation, but with limited success. In particular, the present study deals with these concerns within the context of the current global recession and the roles of technology and social networking as moderating variables in a study of smokers. The study was the examination of smoking working professionals' relationships between people's background experiences with smoking, their self-reported perceptions about health, economic, and social aspects of smoking, and their perspectives on quitting. The empirical section examines current opinions of smoking analogues as alternatives to cessation and identifies whether these opinions were influenced by negative perspectives of smoking in general. Several hypotheses and factor analyses related to smoking cessation statistically evaluated assumptions that economic and social considerations had more effects on quitting than health concerns; that personal experience with smoking leads to less confidence in cold turkey quitting; and that technology-based solutions and virtual communities can gain wide acceptance despite the chemical addictiveness of tobacco-related products.

POSTER PRESENTATIONS

Astronomy, Geology & Physics

JASON BEST, Shepherd University Observatory, Institute for Environmental Studies, Shepherd University, Shepherdstown, WV 25443. **Structure analyses of the 2dF Galaxy Redshift Survey and 2dF Quasar Redshift Survey.**

This work presents results of an ongoing analysis of the structure of the 2dF Galaxy Redshift Survey, which contains approximately 250,000 galaxies, as well as preliminary results of an analysis of the 2dF Quasar Redshift Survey, which contains approximately 25,000 quasars. For these analyses, I have used the pointwise dimension, which has been previously used to study cluster interiors, galactic distributions, and cluster distributions. Among the most significant of the findings: I find that the 2dF galaxy catalog does not show a tendency towards homogeneity out to scales of 100 Mpc. Furthermore, the environments of early-type and late-type galaxies, as defined by spectral parameters, show significant distinction from each other in brighter magnitude ranges, but not in fainter magnitude ranges. Finally, quasar environments show significant evolution on a number of scales. This final result is consistent with the results of recent research of this author and collaborators conducted on the Sloan Digital Sky Survey Quasar Catalog.

JESSE DOLINAR and JOSEPH L. ALLEN, Dept. of Physical Sciences, Concord University, Athens, WV 24712-1000. **Micro-XRF applied to natural friction melts.**

This research utilized the Horiba XGT-5000 X-ray analytical microscope to map and compare elements in migmatitic pelitic schist and gneiss samples taken from the Homestake shear zone (HSZ), Colorado, and granitoids taken from the Long Ridge Fault (LRF) in North Carolina. The purpose was to identify and compare the bulk major-element chemistry of earthquake-generated friction melts (pseudotachylyte) and host rock using a new technique. Micro X-Ray fluorescence (XRF) offers an opportunity to examine element distributions at the hand-sample scale and has potential to be particularly useful to the analysis of fine-grained fault rocks. Samples were cut from oriented hand samples to produce slabs less than 10 x 10 cm in area and ~1 cm thick that were polished with 250 and 400 grit abrasive. Samples were manually cleaned with tap water and acetone. We used a 100-micron focused X-ray guide tube to simultaneously map 16 elements at 512-pixel resolution. Collection time varied depending on sample size but was generally 20 hours or more for optimal data collection. For our study, the XRF was most effective in mapping Fe, Si, K, Al, Ti, and Ca. Na and Mg were too light to effectively map. This device was particularly effective in mapping chemical zoning in friction melts as well as differentiating multiple generations of melt, neither of which can be consistently identified in hand samples. Analysis indicates a depletion or enrichment of major elements at the melt boundary in the samples from LRF and HSZ. If this depletion or enrichment is indicative of friction melting, we observe only one generation of melt, which contradicts previous research suggesting a few generations of melt.

JUSTIN ELLIS, Dept. of Physics, West Virginia University, Morgantown, WV 26506. **A new method for constraining the stochastic gravitational wave background.**

Einstein's general theory of relativity predicts the existence of gravitational waves (GWs) in the form of distortions in the fabric of spacetime. Sources of low-frequency GWs may include coalescing supermassive black hole (SMBH) binary systems, cosmic strings, and relic GWs from the early universe. The direct detection of GWs would both complement data provided by electromagnetic radiation and probe more deeply into areas unreachable by current methods. Despite many attempts in past decades, only an indirect detection of GWs has been made. Direct detection of GWs through the use of pulsar-timing arrays appears likely within the decade. Here we present a new method of constraining the amplitude of GWs due to a stochastic background of coalescing SMBH binary systems. This is done through a statistical comparison of timing data with simulated GWs and through published data from very long baseline interferometry (VLBI) measurements. Using two of the highest precision pulsars, J0437-4715 and J1713+0747, we obtain a 2-sigma upper limit on the dimensionless amplitude of A=9.1e-14. While these preliminary results are not as constraining as the most recently published limits, they are consistent and give an independent upper limit on the background strength.

CRISTY KING, Dept. of Atmospheric Science, University of Arizona, Tucson, AZ 85721. **Longwave and shortwave cloud radiative forcing on the spatial and temporal scale of a tropical storm or hurricane.**

Globally, net radiation on a monthly timescale in the tropics has long been concluded to be approximately 0 W/m^2, with the longwave and shortwave radiation nearly cancelling each other out. However, it has yet to be determined whether longwave or shortwave radiation dominates on the spatial and temporal scale of a tropical disturbance, such as a tropical storm or hurricane. Spatially, my domain is limited to the latitudes 5–30 degrees N and longitudes 280-340 degrees E; my dataset spans the time period between 1985 and 2004. Establishment of an acceptable anomalous threshold is determined by a simple statistical histogram test, and all values greater than this threshold are considered to be significant. It is then determined to what distance any kind of significant values occur from the core of the storm. At present, there appears to be no relationship between a disturbance's categorization and its largest longwave cloud radiative forcing (LWCRF) or shortwave cloud radiative forcing (SWCRF) values; disturbances that are tropical storms may display the same LWCRF or SWCRF as a Category 5 hurricane. Spatially, however, there appears to be a difference, with the larger categorized disturbances showing a much broader spatial impact than the smaller categorized disturbances.

DANIEL RIZER, JACOB HACKETT, and JEREMY THOMPSON, Dept. of Mathematics, Shepherd University, Shepherdstown, WV 25443. **Golf swing as a double pendulum.**

The idea of the golf swing as a double pendulum is not new; however, our approach to this problem is unique. We began our project by first designing a machine that could emulate the ideal golf swing. After our design was complete, construction of our model commenced. The first machine that was completed was the small-scale model, which we used to run tests to determine if any aspects of the design needed to be acclimatized. In order to do this, we ran a number of tests to verify the structural integrity of the device as well as to produce numerical data. Meanwhile, we derived numerous equations including kinetic energy, potential energy, and Lagrangian differential equations of motion for our rotational system. Upon completion of these derivations, we were able to use MATLAB to produce quantitative results. Our project is yet to be concluded; however, we are making progress towards our ultimate goal, which is modeling the ideal golf swing using machines, MATLAB, and differential equations of motion. Special thanks to Dr. Chris Elmer and NASA for help throughout the project.

RAINA ROMERO, SCOTT FRAZIER, JR., and JUSTIN EBERSOLE, Dept. of Mathematics, Shepherd University, Shepherdstown, WV 25443. **Understanding bicycle stability.**

For most people, learning to ride a bicycle is one of the great milestones of childhood, but how exactly does the bicycle stay up? This question has yet to be conclusively answered in the scientific community. We have attempted to solve this problem by examining known forces that act upon a bicycle in motion. We have conducted experiments on our bicycle and created computer programs in MATLAB to predict expected results. With these tools, we are continuing to discover to what extent these forces are responsible for the stability of the bicycle. Thank-you to Dr. Christopher Elmer and NASA for your support.

Biology & Ecology

STEPHANIE ANDERSON, DAVONNA DEMPSTER, ROGER SEEBER, and JARRETT S. AGUILAR, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **Extraction and quantification of hypericin and hyperforin from *Hypericum perforatum* callus.**

Saint John's wort, *Hypericum perforatum*, contains the active chemicals hypericin and hyperforin, both of which exhibit anti-depressive properties. St. John's wort has been used as an herbal supplement in the treatment for depression, a photodynamic cancer therapy treatment, an antiseptic, and an antiviral. Four different genetic varieties of St. John's wort were used to produce callus. Hypericin and hyperforin were extracted from one of these strains, New Stem 001, using methanol. These extracts were analyzed using high-pressure liquid chromatography (HPLC)

and quantified with a standard curve. This data will be used to determine if a given strain of St. John wort callus has mutated into an over-producing strain for one or both of the active compounds. Propagation of an over-producing strain will lead to future work involving explanting the callus to establish a more efficient St. John's wort plant, which would benefit both consumers and researchers.

JESSICA BEADENKOPF and RYAN MANUEL, Dept. of Biology, Shepherd University, Shepherdstown, WV 25443, PETER VILA, Dept. of Environmental Studies, Shepherd University, Shepherdstown, WV 25443, and CAROL ZYGAR PLAUTZ, Dept. of Biology, Shepherd University, Shepherdstown, WV 25443. ***Lymnaea palustris*** **as a model organism for developmental, reproductive, and toxicological studies.**

The freshwater gastropod mollusc *Lymnaea palustris* is a useful laboratory organism since it is easily obtained, bred, and maintained year-round. We designed experiments to establish the suitability of this organism both as an experimental system and as a model for the developmental biology teaching laboratory. However, development from fertilization through hatching takes place inside an egg capsule of albuminous fluid and in order to manipulate the embryo for valuable embryological techniques, such as blastomere separation or microinjection, the capsule must be punctured or removed entirely. We have established the viability of the embryo following such disruption and tested a variety of methods to sustain and enhance survival of the embryos. *Lymnaea* can also be used as a model for toxicological studies, using both adults and embryos. Environmental contaminants are of great concern to the health of aquatic organisms. Herbicides, pesticides, and fertilizers contribute to nutrient and contaminant runoff and accumulate in streams and groundwater. We established mesocosms containing sublethal concentrations of two fertilizers, the herbicide glyphosate, the insecticide permethrin, and a fungicide. Starting concentrations were based on EPA's maximum contaminant level (MCL) for each substance if available; in parallel, animals were exposed to 5-fold higher concentrations. Adult organisms' growth, viability, and fecundity were monitored regularly. Embryos were subjected to the same or higher concentration of these substances, and their developmental abnormalities recorded. Our data demonstrate that adults and embryos respond to the contaminants tested in a dose-responsive manner and that at concentrations legally permissible in drinking water, severe abnormalities result.

VAGNER A. BENEDITO, Genetics and Developmental Biology Graduate Program, Plant and Soil Sciences Division, West Virginia University, Morgantown, WV 26506, and IGOR KRYVORUCHKO and MICHAEL UDVARDI, Plant Biology Division, Samuel Roberts Noble Foundation, Ardmore, OK 73401. **Identification and functional analyses of organ-specific membrane transporters of the S-type anion channel (SLAC) family in the model legume *Medicago truncatula***

The only member of the slow anion channel family (SLAC) that was functionally characterized in plants is the malate efflux channel *SLAC1* (At1g12480) from *Arabidopsis*, which is involved in stomatal closing, expressed in guard cells and localized in the plasma membrane. Other four additional SLAC-like (SLAH) genes are present in the *Arabidopsis* genome, but their physiological roles remain elusive. Our genome-wide studies in *Medicago truncatula*, a model legume species, revealed three members of this family, each one with an organ-specific gene expression pattern: leaves *(MtSLAC1*, probably the functional ortholog to *Arabidopsis SLAC1)*, roots *(MtSLAC2)*, and nodules *(MtSLAC3)* (Benedito et al., 2010; http://bioinfo.noble.org/gene-atlas/v2/). In our preliminary phylogenetic analyses, *MtSLAC2* and *MtSLAC3* cluster together with *SLAH1* (which is expressed in vascular cells and is able to rescue the *slac1* phenotype in *Arabidopsis*), as well as with *SLAH4*. The physiological role of *MtSLAC3* in nodules may have striking implications in the symbiotic nitrogen fixation, since plant cells feed nitrogen-fixing bacteroids with reduced carbon as C-4 dicarboxylates, such as malate and succinate, and membrane transporters are involved in delivering these substances to the symbiosomes. Transposon-tagging mutant lines have been identified for all three *Medicago* SLAC genes from the *Tnt*1 mutant population (Tadege et al., 2008), and functional analyses are underway. This project is supported by the Agriculture and Food Research Initiative competitive grant from the USDA National Institute of Food and Agriculture.

RENU BHALLA and BENOIT VAN AKEN, Dept. of Civil and Environmental Engineering, Temple University, Philadelphia, PA 19122. **Toxicity of polychlorinated biphenyls and their metabolites from bacterial transformation.**

Polychlorinated biphenyls (PCBs) are persistent toxic organic pollutants that tend to accumulate in the environment. PCBs constitute a class of 209 different congeners, with one to 10 chlorine atoms attached to the biphenyl ring. Microbial metabolism of PCBs typically converts parent compounds into hydroxylated metabolites that can be easily further transformed. The objective of this research is to determine whether microbial metabolism of PCBs, including hydroxylation, could result in an increase of toxicity. In a first phase, the toxicity of PCB-3 and its hydroxylated metabolites (2′-OH, 3′-OH, and 4′-OH) were tested using Microtox® assay. Preliminary results showed that PCB-3 (50 mg L^{-1}) does not exhibit observable toxicity, although its hydroxylated metabolites showed high levels of toxicity: EC_{50} after 5 min = 5.9 mg L^{-1} for 2′-OH, 3.1 mg L^{-1} for 3′-OH, and 4.2 mg L^{-1} for 4′-OH. In a second phase, different PCB congeners, including PCB-3, PCB-15, PCB-28, and PCB-77, and the mixtures Aroclor-1242 and Aroclor-1254 are incubated in the presence of different bacterial strains and products of the microbial metabolism of PCBs are tested for their toxicity. Bacterial strains used for biodegradation experiments include *Pseudomonas putida, Burkholderia xenovorans,* and *Acinetobacter sp.* PCB biodegradation and the metabolites produced were analyzed by GC-MS. Results obtained in the first phase of this investigation revealed that hydroxylated metabolites of PCB-3 exhibit a higher toxicity than the parent congener. Results from the second phase of this research are expected to provide further insights about the potential toxicity of microbial metabolites of PCBs, which has potential important implications for bioremediation of PCBs.

JAMES C. CAVENDER, Dept. of Environmental and Plant Biology, Ohio University, Athens, OH 45701, JOHN LANDOLT, Dept. of Biology, Shepherd University, Shepherdstown, WV 25443, and STEVE STEPHENSON, Dept. of Biological Sciences, University of Arkansas, Fayetteville, AR 72701. **Dictyostelid cellular slime molds of Africa.**

Dictyostelid cellular slime molds (dictyostelids) are an understudied group in Africa, but several recent surveys carried out in the context of a Planetary Biodiversity Inventory project funded by the National Science Foundation of the United States have added a considerable number of new records from several areas of the continent. Since Edgar Olive isolated *Polysphondylium pallidum* in Liberia at some point during the period between 1897 and 1900, at least 25 species of dictyostelids have been documented for continental Africa (30 different study sites) and about the same number for the island of Madagascar (11 different study sites). These totals include an appreciable number of forms that appear to be new to science. Most of what is now known about the dictyostelids of continental Africa has been derived from study sites in East Africa and South Africa. Only limited data exist for West Africa and Central Africa, and we are not aware of any records of dictyostelids from North Africa.

MALIA J. DESHOTEL, Dept. of Chemistry, Shepherd University, Shepherdstown, WV 25443, and BRETT E. ZIRKLE and CAROL ZYGAR PLAUTZ, Dept. of Biology, Shepherd University, Shepherdstown, WV 25443. **Establishment of a role for transcriptional cofactor Xldb1 in *Xenopus* lens development.**

Using an expression cloning strategy to isolate genes with lens-inducing activity, we isolated the previously identified transcriptional cofactor Xldb1. This, together with evidence for its nuclear dependence, suggested that its activity is due to an indirect mechanism. We thus proposed that Xldb1 mediates induction of an early lens gene in our functional assay by transcriptional activation of lens-inducing signals. Xldb1 was shown to be capable of activating genes of the presumptive lens, presumptive nose, and cement gland; however, it had not been demonstrated to be necessary for this process prior to our study. We microinjected morpholino oligonucleotides (MOs) directed against Xldb1 into zygotes to block in vivo expression and studied the role of Xldb1 in normal development. Our studies show that knocking down Xldb1 leads to decreased expression of early lens and retinal markers as assayed using in situ hybridization. We also show that their expression can be restored in MO injected embryos by rescuing with a truncated form of Xldb1 RNA that cannot be translationally

blocked by the MO. The mortality rate in MO-injected embryos was dramatically higher than in rescue RNA + MO coinjected embryos, suggesting the mortality was due to lack of Xldb1 activity and not MO toxicity. Surviving MO-injected embryos exhibited morphological abnormalities, most noticeably an enlarged cement gland. The data suggest that an Xldb1-regulated mechanism comprises the early signal for *Xenopus* lens induction.

HEATHER DOVE, CHRISTINA SMITH, and MILAN VAVREK, Dept. of Land Resources, Glenville State College, Glenville, WV 26351. **Salt tolerance of tree-of-heaven (*Ailanthus altissima*).**

Ailanthus altissima, tree-of-heaven, is an invasive species in West Virginia that rapidly colonizes and dominates disturbances in native forests. Perturbation by oil and gas exploration and production may provide an opportunity for exploitation by tree-of-heaven. However, petroleum production may also contaminate soils with produced water (brine) as a result of accidental spills. Consequently, colonization of well sites and pipeline rights-of-way by tree-of-heaven may depend, in part, on the ability to tolerate salt contaminated soils. Few tree species exhibit salt tolerance. A germination assay and assessment of seedling growth indicated that tree-of-heaven tolerates low to moderate concentrations of salt. Seeds germinated at 0, 4, 8, and 16 dS/m of salt. Germination was greatest at 0 and 4 dS/m ($p<0.05$). Seedlings transferred to pots in a greenhouse and treated with 0, 4, and 8 dS/m salt also grew in height and number of leaves at all concentrations, but the greatest growth rate occurred at 0 dS/m ($p<0.05$). Although less than ten percent of tree-of-heaven seedlings continued to grow at 8 dS/m, establishment of only one or two tree-of-heaven individuals may be required to eventually dominate a disturbance due to its rapid growth rate and root-sprouting. Therefore, oil and gas sites may promote the spread of tree-of-heaven within West Virginia forests. Washing vehicles and equipment between job sites may help control the spread of tree-of-heaven into these sites.

DAVID FOLTZ, EVAN HEWITT, MATTHEW MCKINNEY, NICOLE GARRISON, and ZACHARY LOUGHMAN, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074, and STUART WELSH, West Virginia Cooperative Fish and Wildlife Research Unit, West Virginia University, Morgantown WV 26506-6125. **Crayfishes of the West Virginia Elk River basin: conservation and natural history.**

Although crayfish of the Elk River were briefly sampled by Jezerinac in 1988, no intensive sampling of crayfishes in the Elk River has taken place before. Survey efforts were initiated over the summer of 2009 to gather voucher material and provide a more intensive look into the basin's crayfish fauna. Recent collections provide new information regarding the distribution, natural and life history, taxonomy, habitat, and conservation status of *Cambarus carinirostrus, Cambarus bartonii cavatus, Cambarus elkensis, Cambarus monogalensis, Cambarus robustus, Cambarus sciotensis, Cambarus thomai, Orconectes cristavarius, Orconectes rusticus, Orconectes sanbornii,* and *Orconectes virilis* within the basin. Sampling of the basin revealed the presence of the invasive species *O. virilis* and *O. rusticus* within the lower mainstem of the Elk River and *O. virilis* within Sutton Dam reservoir. Diversity within the Elk River basins is a result of an elevational gradient within the Elk. High, moderate, and low elevations all maintain unique crayfish faunas. *Cambarus elkensis,* an Elk River endemic, currently is stable throughout the majority of the Elk River's headwaters.

AARON C. GOOLEY, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755, JAYME L. WALDRON, Dept. of Biological Sciences, University of South Carolina, Columbia, SC 29208, and THOMAS K. PAULEY, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. **The behavioral responses of West Virginia turtles to passing vehicles on a simulated divided highway.**

Road mortality has been identified as a major threat to many turtle species; however, response to passing vehicles and general behavior while crossing roads has never been investigated in turtles. To investigate these factors, Midland painted turtles *(Chrysemys picta marginata),* Eastern box turtles (*Terrapene c. carolina)*, and stinkpots (*Sternotherus odoratus*) were collected and placed in a release box on the side of a closed road with an active road running parallel

to it, released via a pulley-operated door facing the road, and their actions videotaped by an observer in a nearby blind. A vehicle was driven past crossing turtles to simulate passing traffic in the adjoining lane. Resulting videos were used to determine the frequency of responses and length of stops due to passing vehicles. Following trials, turtles were released at the original point of capture. Results show that Eastern box turtles stop on a divided highway due to the stimulus of an opposing lane vehicle more than either stinkpots or Midland painted turtles (84.38%, 33.33%, and 22.22%, respectively). All species reacted to a passing adjoining lane vehicle by stopping on the road; however, Eastern box turtles and stinkpots averaged more time stopped than Midland painted turtles. These results indicate that Eastern box turtles spend more time stopped on the road when crossing a divided highway than stinkpots or Midland painted turtles and are thus at greater risk of mortality. Future trials to be conducted in the spring and summer of 2010 will include additional species and expand sample sizes.

L. M. HARRIS and S. J. SAWYER, Dept. Science and Mathematics, Glenville State College, Glenville, WV 26351. **The effect of temperature-shock length on integrin distribution in the tropical sea anemone, *Aiptasia pallida*.**

Temperature-induced coral bleaching results from the loss of host cells that contain the symbiotic dinoflagellate algae from the coral host. We have been investigating how temperature affects integrin distribution in the tropical symbiotic sea anemone, *Aiptasia pallida*. Integrins are cell substrate adhesion molecules that mediate signals between the extracellular matrix and the intracellular proteins and are important in regulating apoptosis. Using immunohistochemistry, we have investigated the tissue localization of integrins using the anti-integrin antibody, CNb1. To see how the temperature shock affected the integrin distribution, the anemones were heat-shocked at 30 °C for one, four, eight, 12, 24, and 48 hours. After the heat shock, the anemones were preserved, sectioned, and then stained with an anti-integrin antibody. In control anemones, the greatest density of integrin staining is in the mesoglea area. The temperature shock affects integrin distribution, disrupting the intense mesogleal band after the 12-hour temperature shock. Substantial disruption of integrin is seen between 24 and 48 hours after heat shock. Future work will focus on the timing of the disruption of integrin and how this disruption is affecting the physiology of the animal.

EVAN HEWITT, DAVID FOLTZ, MATTHEW MCKINNEY, NICOLE GARRISON, and ZACHARY LOUGHMAN, Dept of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **Conservation of West Virginia's Ohio and Kanawha River bottomland primary burrowing crayfishes: species relationship to forest community structure with an emphasis on *Fallicambarus fodiens*.**

Crayfish conservation has witnessed an upsurge in activity over the past decade. Conservation efforts have been directed toward stream forms, while burrowing crayfishes have not received the same level of conservation intensity. In West Virginia, the pre-glacial Marietta River Valley in Cabell, Mason, and Putnam counties is a center of diversity for burrowing crayfishes. Burrowing crayfish occurring in bottomland forests in the region include *Fallicambarus fodiens* and *Procambarus acutus*, two species with limited ranges within West Virginia in need of conservation efforts. Identifying crucial ecological communities needed for these species is the first step towards their conservation. In order to identify specific forest communities harboring high levels of burrowing crayfish diversity, point quarter surveys were conducted in the nine remaining bottomland forest tracts along the Ohio and Kanawha River floodplains in the previously mentioned counties. Relative density, relative cover, relative frequency, and importance values were generated for tree species in each forest. Forest communities were identified by the top two important tree species. Oak/maple forests maintained the highest diversity levels and were the only forest communities in which *Fallicambarus fodiens* occurred. *Procambarus acutus* occurred in oak/maple forests and buttonbush marshes and had a more expansive range along the Kanawha River floodplain than previously thought. *Cambarus thomai* was present at all sites surveyed. The rarest forest type was oak/maple. *Fallicambarus fodiens'* apparent dependence on oak/maple forests and the high levels of diversity found within these forests warrant immediate conservation efforts.

JOHN LANDOLT, Dept. of Biology, Shepherd University, Shepherdstown, WV 25443, and STEVE STEPHENSON and CARLOS ROJAS, Dept. of Biological Sciences, University of Arkansas, Fayetteville, AR 72701. **Dictyostelid cellular slime molds from aerial microhabitats.**

The leaf litter decomposition zone of forest soils is generally considered to be the primary microhabitat for dictyostelid cellular slime molds (dictyostelids), but these organisms also occur in other types of soils, including those in caves and are sometimes coprophilous (i.e., associated with dung). The occurrence of dictyostelids in some types of aerial microhabitats has received relatively little study. However, these organisms can be surprisingly abundant in the mantle of dead organic matter (literally a "canopy soil") often found at the bases of epiphytes that grow on the larger branches and, to some extent, the trunks of trees in moist temperate and tropical forests. More than 400 samples collected from the canopy soil microhabitat in 11 different regions of the world have yielded more than 40 species of dictyostelids. In some instances, these organisms were just as abundant in samples of canopy soil as they were in samples of ground soil collected at the same locality. A few of the species recovered from canopy soil have been described as new to science, and at least two of these are not yet known from ground soil. This research was supported in part by grants from the National Geographic Society and the National Science Foundation.

B. OOSTHUIZEN and S. J. SAWYER, Dept. Science and Mathematics, Glenville State College, Glenville, WV 26351. **Sampling of the Elk River to assess macroinvertebrate abundance and diversity and water quality.**

In order to assess the health of the headwaters of the Elk River, water quality and macroinvertebrate abundance and diversity were assessed at four locations over a two-mile stretch of the Elk River in Webster County. The four locations included two tributaries of the Elk River, and each location was sampled periodically in the fall of 2008 and again in the fall of 2009. Macroinvertebrate abundance and diversity, nitrate and phosphate levels, dissolved oxygen concentrations, and other water quality indicators, as well as stream embeddedness, were measured. All chemical water quality indicators remained relatively constant over the two-year sampling regime. Stream embeddedness increased at the headwater from 54% to 68% between the fall of 2008 and the fall of 2009. In addition, chironomid abundance increased from 38% to 54% over the sampling period. The numbers of other macroinvertebrates decreased slightly. This result could be explained by the opening of the trout hatchery at the surfacing springs of the river or an increase in fine-particle load, both of which could affect the reproduction of macroinvertebrates. Future sampling could determine if the changes in chironomid and embeddedness remain.

RACHEL POLING and RICO GAZAL, Dept. of Land Resources, Glenville State College, Glenville, WV 26351. **Seasonal fluctuation in leaf structure and chlorophyll of *Ailanthus* and its co-occurring native species in an Appalachian forest.**

The success of the invasive tree *Ailanthus* in invading forest areas may be attributed to its ability to exploit pulses of increased resource levels (e.g., soil moisture and light) throughout the growing season.

We determined the seasonal fluctuations in specific leaf area (SLA), relative water content (RWC), and leaf pigments (chlorophyll) of *Ailanthus* and its co-occurring native species (black walnut, American elm, white ash, and black cherry) in an Appalachian forest in Glenville, WV. *Ailanthus* had the largest leaf area among the species, which makes it efficient in capturing light. While leaf area decreased in black cherry and *Ailanthus* through the peak of the summer, SLA increased in all species from June to August. *Ailanthus* had lower RWC (70-72%) compared to other native species (except American elm). This may explain why *Ailanthus* is found in areas where it has access to water resources, so it can tolerate low RWC. Low RWC in *Ailanthus* may also demonstrate its ability to sustain excessive water loss as long as it does not reach the critical point of desiccation (RWC< 40%). Total chlorophyll (chlorophyll a+b) was higher in June than August in white ash, black cherry, and *Ailanthus*, and remained the same for black walnut and American elm. Chlorophyll a:b ratio was similar for all the species in June, but white ash and *Ailanthus* had the highest and lowest ratio among the species in August, respectively. This study reveals that leaf structure and chlorophyll concentration provide meaningful assessment of how plants compete for resources in the same environment. The ability of the plants to capture light and CO_2 efficiently and to absorb and lose

water is reflected in their leaf structure, whereas the ability of plants to absorb light that provides energy for photosynthesis and photoprotection is exhibited in the amounts of their leaf pigments.

JAMES RENTCH, Division of Forestry and Natural Resources, West Virginia University, Morgantown, WV 26506. **Do trees fall downhill? Relationship between treefall direction, slope aspect, and wind in eight old-growth oak stands in the Central Hardwood Forest.**

This study examined the relationship between direction of treefall, slope aspect, and prevailing wind in eight old-growth stands where single-tree canopy gaps characterize the dominant disturbance regime. All live and downed trees were inventoried in 0.45-ha sample plots. To determine crown asymmetry, crown sizes of live trees were measured along two perpendicular axes. Directions of fall and slope-aspect of downed trees also were recorded. Regional data on prevailing winds and wind gusts were obtained from two nearby airports. We used circular statistics to determine if directions of treefall for each study stand had a mean direction or if the directions of fall were uniformly distributed. If directions of treefall had a true mean, they were then compared to mean slope aspect and mean wind direction. Mean crown asymmetry (ratio of long to short diameters) was 1.26, and there were no significant differences in asymmetry values when current gap border trees and non-border trees were compared. At two stands, treefall directions were uniformly distributed (i.e., no mean direction). However, only one of eight stands showed a statistically significant similarity between mean slope aspect and mean direction of fall. None of the eight study stands showed significant similarities when wind directions and treefall directions were compared. While trees may fall downhill and downwind, the high variation in treefall direction and wind direction precluded establishing a significant relationship between these data sets. We suggest that crown asymmetry, resulting from differential crown growth on sloped hillsides as well as within canopy gaps, exerts a larger influence on direction of fall than either slope aspect or wind direction.

ADAM W. ROLLINS and RONALD CALDWELL, Dept. of Math and Natural Sciences, Lincoln Memorial University, Harrogate, TN 37752, JOHN C. LANDOLT, Dept. of Biology, Shepherd University, Shepherdstown, WV 25443, and STEVEN L. STEPHENSON, Dept. of Biological Sciences, University of Arkansas, Fayetteville, AR 72701. **Dictyostelid cellular slime molds of southern Belize.**

Samples for the isolation of dictyostelid cellular slime molds (dictyostelids) were collected during two periods (March 2009 and September 2009) from lowland tropical forest and savanna study sites located in the Toledo District of southern Belize. Samples were obtained from both ground soils and the "canopy soils" that occur at the bases of epiphytic plants. These samples yielded at least 11 described species of dictyostelids and an additional five or six forms that we are unable to assign to a particular taxon. Collectively, *Polysphondylium pallidum* and other "white-spored" members of this genus accounted for more than 50% of all clones. *Dictyostelium purpureum,* generally common in tropical and subtropical regions, was the most commonly recovered species of *Dictyostelium.* Dictyostelids were recovered as frequently from canopy soils as from ground soils. Moreover, the lowland tropical forest study site was characterized by greater species richness and diversity than the lowland tropical savanna study site. Interestingly, the plasmodia of myxomycetes were quite abundant, appearing in approximately 67% of the 95 samples collected for isolation of dictyostelids. This work was supported by a grant from the Lincoln Memorial University Mini-Grants Program.

JUSTIN SHELINE and DAN K. EVANS, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. **Riparian stability, vegetation, vegetative zone width, and aquatic macrophytes, Winfield and Marmet pools, Kanawha River, West Virginia.**

This study examines riparian habitat features along the Kanawha River with particular emphasis on the Winfield and Marmet pools. The study focuses on the effects that recent habitat improvements, including the installation of rock dikes at the land-water interface, have on riparian conditions and aquatic resources. Variables of canopy cover (percent shade), bank stability, bank vegetation protection, riparian zone width, and the distribution of aquatic macrophytes were evaluated numerically at 60 sites within the two pools. Data analysis suggests that canopy cover exhibited the greatest diversity in site conditions while aquatic

macrophytes were more common at sites with rock dikes. Other variables were comparable at all sites in the two pools.

ANDREW W. SMITH and SARAH M. UMPHRESS, Dept. of Biology, West Virginia University Institute of Technology, Montgomery, West Virginia 25136. **Lethal and sub-lethal effects of selenium (selenite, selenate), an environmental toxicant, on a freshwater oligochaete, *Lumbriculus variegatus*.**

Human activities, such as coal mining and coal-burning, have been contaminating the environment with toxic heavy metals such as selenium, which is readily leached into rivers by runoff. It has been reported that selenium concentrations in West Virginia rivers downstream of mountaintop mining operations are in excess of current EPA standards. Selenium is a double-edged sword for human physiology, as it is an essential trace element but extremely toxic if taken in excess. In this study, we examined lethal and sub-lethal effects of selenium in a freshwater oligochaete, *Lumbriculus variegatus*. These worms live in shallow water along edges of streams and ponds across the United States, including West Virginia. Healthy adult *Lumbriculus variegatus*, in the size range of approximately three to five cm, were chosen for use. Worms smaller or larger than three to five cm were excluded from this study as were any worms that were in the process of asexual regeneration. Stock solutions of selenium compounds in the form of selenite and selenate were individually dissolved in doubly distilled H_2O and diluted to specific testing concentrations prior to each experimental procedure. The median lethal concentration (LC_{50}) after selenium exposure was determined for both selenite and selenate. Sub-lethal endpoints for both of these compounds focused on pulse rate, swimming behavior, and asexual regeneration. Concentrations of selenium that were tested demonstrated an increase in basal pulse rate. Further, data demonstrated that at higher concentrations of selenium the swimming behavior was altered such that the individual *Lumbriculus variegatus* worms twisted and coiled with unsteady jerking motions prior to their death.

CLIFFORD E. STARLIPER and BARNABY J. WATTEN, USGS Leetown Science Center, 11649 Leetown Road, Kearneysville, WV 25430. **Control of aquatic invasive microorganisms: method development for ship ballast applications and laboratory studies on fish pathogenic and environmental bacteria.**

Ship ballast (water) is a well-recognized conveyer of non-indigenous, aquatic-borne species to the United States. The International Maritime Organization developed international legislation (D2 Standards) that specifies maximum numbers of indicator microorganisms that may be released via ballast water. Ships constructed during and after 2009 must decontaminate ballast on-board and conform to new D2 Standards. We are developing hydroxide stabilization (i.e., hydrated lime, sodium hydroxide) as a ballast decontaminant to meet the D2 Standards. We developed controlled studies to determine endpoint treatment parameters (pH 10–12 and duration up to 72 h) to achieve our target 100 % (bactericidal) killing. Pure bacterial cultures were grown in broth on a rotary shaker at their optimum incubation temperatures. Viable-cell counting determined efficacy. About 86 bacteria have been tested, including Gram-negatives, Gram-positives, coliforms, D2 Standards indicators, fish pathogens, and bacteria recovered from a ballast tank on a cargo ship used on the Great Lakes. Control cultures grew excellently, most to 1×10^9 cfu/mL or greater. Endpoints of pH and duration varied; however, we demonstrated 100 % killing to all bacteria at pH 12.0 within 72 h. Many were killed within 4 h at pH 10.0. Results for the D2 Standards bacteria were: *V. cholera* was killed within 4 h at pH 10.0; *E. coli* within 12 h at pH 10.0; and *Enterococcus faecalis* (a Gram-positive) within 72 h at pH 12.0. In addition to excellent bactericidal efficacy, increased pH offers other advantages, namely, anti-rust properties, favorable delivery and mixing processes, economics, and pH neutralization applications.

AMY WITHROW and SARAH M. UMPHRESS, Dept. of Biology, West Virginia Institute of Technology, Montgomery, WV 25136. **Prolonged exposure to sound wave frequencies – harmful to the California blackworm or not?**

People and animals encounter different sound frequencies everyday. For example, industrial mining machinery emits harmonic sounds including both low and high frequencies. We hypothesized that long term exposure to sound waves will modify *Lumbriculus variegatus,* California blackworm, behavior. California blackworms are found throughout the United States and the world in shallow, muddy water along the edges of ponds and streams. In order to produce specific sound frequencies, a function generator was used to create precise sine wave frequencies through an audio amplifier with speakers. California blackworms were exposed to these sounds for up to twenty-four hours. California blackworms, tested at the low frequency of 122 Hz and the high frequency of 12 kHz, gravitated to the center of the containers and formed a ball shape. California blackworms were then given a cool-down period to see if any would return to their stereotypical behavior. Stereotypical behavior for the California blackworms when in normal conditions is to break away from the ball formation in a corkscrew pattern of movement to explore their environment. California blackworms tested at a lower sound frequency of 122 Hz showed an increased death rate and survivors demonstrated little to no movement during their cool-down period. Low sound frequencies transmit sine waves that can travel extremely long distances. Data from this experiment highlights the possibility that these frequencies have a harmful effect on the California blackworm. Therefore the question arises: What effects might these sound frequencies have on our environment?

Chemistry & Biochemistry

VICTOR L. CARPENTER JR. and KEVIN L. EVANS, Dept of Science and Mathematics, Glenville State College, Glenville, WV 26351. **Developing an inquiry-based organic experiment to study electrophilic aromatic substitution.**

When substituted arenes undergo electrophilic substitution, the substituent(s) already attached to the aromatic ring affects the rate and the site of the substitution. The aromatic substituents are classified as either activating or deactivating. Activating substituents accelerate the rate of reaction, whereas deactivating substituents make the molecule less reactive than benzene. The substituents are also classified based on how they direct the incoming electrophile. *Ortho/para*-directing substituents direct the incoming electrophile into the *ortho* and/or *para* positions. *Meta*-allowing substituents direct the incoming electrophile to the *meta* position. This research developed a general nitration procedure for substituted arenes that is suitable for a sophomore organic chemistry laboratory experiment. The students will combine their knowledge of electrophilic aromatic substitution and spectroscopic identification (IR, ^{1}H and ^{13}C NMR) to identify the major isomer(s). The students will attempt to quantify the percentage of each isomer formed from the crude product, then fully characterize the major product after purification. The students in the class will study different molecules and share their data with each other. We will present our preliminary results in developing this laboratory experiment.

IAN DOUGLAS and LETHA J. SOOTER, Dept. of Biology, West Virginia University, Morgantown WV 26506. **In vitro selection of SPIONs.**

In labs all over the world, in vitro selection is in common use. This process can be explained in general by the filtering and copying of single-stranded DNA to find a specific molecule with a specific function. A critical part of this process happens in a polymerase chain reaction or PCR. Much optimization is needed to get the PCR to run well. These can include temperature profile (e.g., annealing temp), concentration of reagents in the buffer, changing the concentration of $MgCl_2$, the number of cycles, time period of cycles, etc. This process of in vitro selection results in molecular recognition elements (MREs). These MREs can be made of RNA, DNA, peptides, antibodies, etc. An MRE binds to a target with high affinity and specificity. This means out of 107 to 1014 different molecules and many isolation and amplification steps are done to produce one to five molecules exhibiting the desired characteristic. The target for an in vitro selection can be anything; our target is SPIONs (super paramagnetic iron oxide nanoparticles). These SPIONs were synthesized by Dr. Lloyd Carroll's lab in the WVU chemistry lab. SPIONs have biomedical applications, including drug delivery. An MRE that binds SPIONs can be combined with an MRE that will localize the SPIONs to a specific cell type or a specific location within a cell. Potentially these SPIONs can be infused

with cancer drugs, injected into the body, and brought to a localized point (e.g., cancer site) with the use of a magnet.

CHRISTOPHER J. GUERRIERO, Dept. of Biological Sciences, University of Pittsburgh, Pittsburgh, PA 15261, KUNIO NAKATSUKASA, Division of Biological Science, Nagoya University, Nagoya, Japan, and JEFFREY L. BRODKSY, Dept. of Biological Sciences, University of Pittsburgh, Pittsburgh, PA 15261. **Defining the chaperone requirements for the endoplasmic reticulum-associated degradation (ERAD) of novel substrates.**

Over one-third of all newly synthesized proteins in eukaryotes must pass through the endoplasmic reticulum (ER), where they are folded before trafficking to their final destinations. However, various insults can cause defects in protein folding, including environmental stressors, translational defects, defects in post-translational processing, or genetic mutations. Improperly folded proteins in the secretory pathway can either eventually attain their proper conformations or be targeted by chaperones for ER-associated degradation (ERAD). ERAD not only disposes of misfolded proteins, but also is important for regulating protein levels. Understanding the inherent motifs within a substrate (degrons) that direct a protein toward ERAD is critical for understanding protein regulation during both normal and diseased states. Lesion-folding can exist in a protein's membrane, cytosolic domains, or lumenal domains, which dictates the set of molecular chaperones available to mediate folding/degradation. The aim of this study is to characterize the machinery involved in the degradation of proteins with cytosolic lesions (ERAD-C). To elucidate the chaperones required for ERAD-C, we employed a novel ERAD-C degron in the model organism, *Saccharomyces cerevisiae*. To test the utility of this degron for studying ERAD-C, the stability of chimeric proteins including this motif was measured in mutant yeast strains by cycloheximide chase. These experiments revealed that degradation of the chimeras is dependent on the proteasome and on two E3 ubiquitin ligases, Hrd1p and Doa10p. These data support the use of this misfolded domain (degron) to further study the roles played by chaperones involved in ERAD-C.

BRIDGET D. HINES, JOURDAN T. AROMIN, and LETHA J. SOOTER, Dept. of Biology, WV Nano Initiative, West Virginia University, Morgantown, WV 26505. **Use of optical properties to probe the interaction of molecular recognition elements with single-walled carbon nanotubes.**

Single-walled carbon nanotubes (SWCNTs) have unique optical properties that have shown to be useful in biological and chemical sensors. These highly aromatic, hydrophobic nanomaterials interact with nucleic acids leading to individual dispersion in aqueous solutions. Our laboratory focuses on the use of single-stranded DNA as molecular recognition elements (MREs). We are working to optimize the interaction between MREs and SWCNTs. This attachment can alter the optical spectra of the SWCNTs, giving a platform for chemical and biological detection. The optimization involves studying the optical properties of SWCNTs, particularly the near-infrared (NIR) fluorescence spectra. Once it is determined how hybridization of the MRE affects the optical spectra, the spectra can be used for a solution-based optical sensor. Our sensor platform involves the attachment of DNA that is complementary to an MRE against adenosine triphosphate (ATP.MRE). As in previous literature reports, the hybridization of the ATP.MRE produces changes in the NIR fluorescence spectrum. Current efforts are to characterize the spectral shifts when the target (ATP) is added to the ATP.MRE hybridized to the DNA:SWCNT. Our results show that varying the DNA sequence used for sonication-mediated dispersion of SWCNTs shows shifts in NIR fluorescence spectra. These shifts indicate that the varied DNA sequences can interact with different chiralities of SWCNTs. These results suggest the possibility of using in vitro selection to develop MREs against separate SWCNT chiralities. Such MREs would provide an easy and inexpensive method of purification of chiral molecules from the mixture developed in the production process.

WESTLEY MULLINS, JANE OOSTHUIZEN, and KAITLYN BOWMAN, Dept. of Science and Mathematics, Glenville State College, Glenville, WV 26351, HOWARD WHITE, Dept. of Physiological Sciences, Eastern Virginia Medical School, Norfolk VA 23510, and GARY Z. MORRIS, Dept. of Science and Mathematics, Glenville State College, Glenville WV 26351.

Synthesis of 3′-(7-diethylaminocoumarin-3-ester)-3′- adenosine 5′-triphosphate (or DeacesterATP).

Hydrolysis of adenosine triphosphate (ATP) produces chemical energy that can be used by a cell to do work. The kinetics involving ATP hydrolysis in muscle cells is studied using fluorescent ATP analogs, and actin and myosin proteins. Actin and myosin are proteins found in muscle fibers that do the mechanical work of muscle contraction. A very efficient fluorescent ATP analog for studying myosin-actin kinetics is 3′-(7-diethylaminocoumarin-3-carbonylamino)-3′-deoxy-ATP (deac-aminoATP or DeacATP), which undergoes a 20-fold increase in fluorescence emission intensity when bound to the active site of myosin. This fluorescent ATP analogue is composed of a coumarin tag attached to ATP at the 3′ position thorough an amino group. DeacATP has to be made in its entirety from scratch through seven different reactions. Here we propose an alternative to DeacATP which is to attach the coumarin tag to ATP through an ester. Because ATP already has an alcohol at the 3′ position, this process should require fewer steps and be less expensive; instead of seven reactions, only two reactions are necessary. Coumarin is first activated through mixing with tributylamine (solvent) and isobutyl chloroformate (leaving group). ATP is then added to the activated coumarin, producing the new fluorescent ATP molecule (DeacesterATP), carbon dioxide, and the isobutyl chloroformate leaving group. This specific fluorescent ATP analog has not been synthesized before. TLC, NMR, FTIR, HPLC, and UV-Vis are being used to monitor synthesis of the new compound, and the effects of temperature and light on product yield are being determined.

CASEY NASSIF, West Virginia University, Morgantown, WV 26506, and LETHA J. SOOTER, Dept. of Biology, West Virginia University, Morgantown, WV 26506. **Detection of molecular recognition elements using a yeast library of surface-displayed peptides.**

Molecular recognition elements (MREs) are biomolecules that bind a target tightly and with high specificity. MREs can be created and used to detect a variety of substances. They are isolated through in vitro selection, where a target is exposed to 107 different organic molecules composed of peptides presented on common yeast (*Saccharomyces cerevisiae)*. By using such a large number of potential MREs, we can offset the obstacle of needing to test random molecules for very specific properties. Each yeast cell holds approximately one thousand copies of a single peptide, and an individual yeast cell is used for each peptide being tested. This means that if 107 peptide combinations are tested, 107 yeast cells will be used. The peptide sequences, grown from a single chain fragment variable library, are attached to a hemagglutinin tag on the Aga2 protein of the yeast. To determine if the yeast are properly displaying peptides, fluorescent antibodies that bind specifically to the hemagglutinin tag are used in combination with a flow cytometer. Once this control has been run, the in vitro selection may begin. The selection consists of several cycles of positive selection, where the peptides that bind to that target molecule are isolated and amplified for the succeeding round of selection. Our target is SPIONs, superparamagnetic iron oxide nanoparticles. They were synthesized by Dr. Lloyd Carroll at WVU. SPIONs have a variety of biomedical applications. Peptides that specifically bind to SPIONs can be used as highly functionalized linkers for conjugation to other molecules of interest.

JANE R. OOSTHUIZEN, PHILIP HOFFMAN, and KEVIN L. EVANS, Dept. of Mathematics and Science, Glenville State College, Glenville, WV 26351. **Synthesis of triacid and triamide amphiphiles.**

Amphiphiles are compounds that possess both hydrophilic and hydrophobic properties. Amphiphiles have practical applications in both industry and medicine. Industry is particularly interested in amphiphiles for their ability to inhibit corrosion and as flotation collectors, which are especially useful in mining. From a medical standpoint amphiphiles are being investigated as a new type of antibiotic. Two series of amphiphiles were synthesized during this research – the triamide and the triacid. Each synthesis involved the condensation of a secondary amine with an isocyanate. Four triamide amphiphiles were synthesized by the condensation of triamide isocyanate with N-methylalkylamines of different alkyl chain lengths (12, 14, 16, and 18 carbons). The triacid amphiphile was synthesized with N-methyloctadecylamine

and weisocyanate. Attempted purification of the compounds included recrystallization and thin layer column chromatography. Characterization of the triacid and triamide amphiphiles included ^{1}H and ^{13}C NMR, FTIR, and melting point.

KAYLA D. SAUNDERS, ZACHARY R. HARTMAN, and JARRETT S. AGUILAR, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **Molecular dynamics and site-directed mutagenesis of a Glu300 mutation in cytochrome P450 2C9.**

Within the liver, the enzyme cytochrome P450 2C9 (CYP2C9) has been shown to hold a number of substrates in its active site simultaneously. This creates the potential for atypical kinetics and various drug interactions. Previous studies have involved various effector molecules (dapsone and dapsone analogs) docked in the active site with flurbiprofen, an NSAID. These studies correlate the distance between the H4´ of flurbiprofen and the heme with the effectors' influences on the rate of metabolism of flurbiprofen. Due to the prevalence of hydrogen bonding between specific amino acids and the effector molecule, the current study involves mutating Glu300 to valine. The mutation eliminates the residue's ability to bond to the effector. The mutated enzyme demonstrated smaller distances between the site of metabolism of the substrate and the heme iron than in previous studies. Site-directed mutagenesis was performed to create the mutant to be used in obtaining kinetics data in the future.

BRIANA D. VECCHIO, ANTHONY GIOVENGO, and LETHA J. SOOTER, Dept. of Biology, West Virginia University, Morgantown, WV 26506. **Evolution of single-stranded DNA molecular recognition elements via CE-SELEX: detection of TNT and biosensor applications.**

Molecular recognition elements or MREs are small biological polymers capable of binding a target with high affinity and specificity. We have sought to evolve single-stranded DNA MREs that bind the explosive, TNT. For our selection, we employed the systematic evolution of ligands via exponential enrichment by capillary electrophoresis (CE-SELEX). Whereas traditional SELEX requires immobilization of the target molecule, CE-SELEX allows the selection to be carried out in free solution. This decreases non-specific binding to the immobilization surface and thus increases overall affinity of the MRE for the target. In addition, CE-SELEX is much more efficient than conventional in vitro evolution methods as it produces high affinity MREs with fewer rounds of selection. CE-SELEX optimization for a single-stranded DNA library targeting TNT is currently underway. Once MREs have been evolved for this target, they will potentially be incorporated into biosensors for detection of improvised explosive devices. This work is funded as part of a cooperative agreement with the United States Army Research Laboratory.

JOHN D. WYATT, ZACHARY R. HARTMAN, and JARRETT S. AGUILAR, Department of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **Molecular dynamics and site-directed mutagenesis of mutated cytochrome P450 2C9 T304A.**

Cytochrome P450 2C9 (CYP2C9), a common liver enzyme, plays a major role in metabolizing xenobiotics and endogenous compounds. Previous studies have shown flurbiprofen and dapsone may be able to bind simultaneously in CYP2C9's active site, which results in atypical kinetics. Amino acid Thr304 has been shown to hydrogen-bond with dapsone. Using molecular modeling techniques, Thr304 was mutated to alanine in order to remove the hydrogen bonding. Computer models show the mutated enzyme results in a reduction in the distance between flurbiprofen's 4´ hydrogen and the heme iron by 1.9Å. Site-directed mutagenesis was performed to physically create a mutated enzyme. This mutated enzyme can be used to compare molecular dynamics and enzyme kinetics.

Engineering & Computer

VIKAS AGARWAL and BRIAN J. ANDERSON, Dept. of Chemical Engineering, West Virginia University, Morgantown, WV 26506. **An integrated model to compare net electricity generation for CO_2- and water-based geothermal systems.**

Utilization of supercritical CO_2 as a geothermal fluid instead of water has been proposed by Brown (2000) and its advantages have been discussed. This work concentrates on assessing the net electricity that could be generated by using supercritical CO_2 as a geothermal working fluid and compares it with water under the same reservoir conditions of temperature and pressure. This procedure providesa method of direct comparison of water and CO_2 as geothermal working fluids in terms of net electricity generation over a project's lifetime. An integrated model has been developed to determine net electricity generation for CO_2 and water-based geothermal reservoirs. This model consists of a wellbore model, reservoir simulation, and surface plant simulation. To determine the bottomhole pressure and temperature of the geothermal fluid (either water or CO_2) in the injection well, a wellbore model was developed using fluid-phase thermodynamic equations of state, fluid dynamics, and heat transfer models. A computer program was developed that solves for the temperature and pressure of the working fluid (either water or CO_2) down the wellbore. For the reservoir simulation, the TOUGH2 code has been used to model the temperature and pressure characteristics of the working fluid in the reservoir over a project's lifetime. The surface plant is simulated using CHEMCAD to determine net electricity generated. A binary organic Rankine cycle is simulated for CO_2 and a flash power plant cycle for water. The calculated net electricity generated for the optimized water and CO_2 systems are compared over the working lifetime of the reservoir.

ASHISH S. BAMBAL, ALA'A H. KABABJI, and VIDYA SAGAR GUGGILLA, Dept. of Chemical Engineering, West Virginia University, Morgantown, WV 26506, TODD H. GARDNER, U.S. Dept of Energy, National Energy Technology Laboratory, 3610 Collins Ferry Road, Morgantown, WV 26507-0880, and EDWIN L. KUGLER and DADY B. DADYBURJOR, Dept. of Chemical Engineering, West Virginia University, Morgantown, WV 26506. **Fischer-Tropsch–synthesis with a chelating-agent-modified Co/SiO_2 catalyst.**

The present study investigates the surface-structure characteristics and Fischer–Tropsch synthesis (FTS) activity of Co/SiO_2 catalysts. A solid-state reaction between cobalt and silica support could result in cobalt silicate formation, which does not catalyze FTS. Therefore, a strong interaction of cobalt with a support is undesired and must be minimized. In this study, two different chelating agents, nitrilotriacetic acid and ethylenediaminetetraacetic acid, were used to modify the support during incipient-wetness impregnation with cobalt nitrate. The physical characterization of catalysts was performed by XRD, XPS, TPR, and N_2-adsorption. The FTS was carried out in a fixed-bed reactor at 230 °C, 2.0 MPa, and 3Nl/g cat/h, using syngas with $H_2/CO = 2.0$. The operating conditions were selected to maximize diesel-range hydrocarbons (C_9-C_{20}). The presence of a Co_3O_4 phase was confirmed by the data from XRD studies. Based on two strong peaks observed in the TPR study, the reduction of Co_3O_4 into metallic Co was shown to proceed in two steps. Finally, catalyst performance was evaluated based on selectivities toward C_5 and higher hydrocarbons and CO conversions.

ISABEL CARDONA and XINCHAO WEI, Dept. of Civil and Environmental Engineering, West Virginia University, Morgantown, WV 26506. **Selenium removal by magnetite-impregnated diatomaceous earth.**

The purpose of this study was to remove selenium from aqueous solution using magnetite-impregnated diatomaceous earth as an adsorbent. The adsorbent was prepared at the laboratory with a ratio magnetite/DE of 10%. Batch adsorption experiments were conducted to evaluate the effects of pH, temperature, concentration, selenium speciation, contact time, and presence of competing anions on selenium removal efficiency in conjunction with studies on adsorption kinetics, isotherms, and adsorptive thermodynamics. Rapid adsorption occurred within 30 min, and selenium uptake decreased with increase in temperature. Low pH values (i.e., 2–4) favored selenium adsorption onto magnetite-impregnated DE, as expected for anion adsorption, but the adsorption of selenate (Se(VI)) was more strongly dependent on pH than that of selenite (Se(IV)). The adsorption isothermal data and kinetic data of selenium were well fitted to the Freundlich isotherm and pseudo-second-order kinetic models. The magnetite-impregnated DE showed an adsorption capacity of 0.5 mg Se/g for selenite and 0.25 mg Se/g for selenate at pH 3.0. At an initial selenium concentration of 250 µg/L, more than 96% removal of selenite and 50% removal of

selenate were achieved. It was observed that selenate adsorption was significantly affected by the presence of competing anions, such as chloride, nitrate, and sulfate, whereas selenite removal was affected only by the presence of sulfate in the solution.

LINA CUI, NIANQIANG WU, and LIAN-SHIN LIN, Dept. of Civil and Environmental Engineering, West Virginia University, Morgantown, WV 26506. **Feasibility of using hydroxyl radical production rate as a measure of photocatalytically bactericidal effects of various titanium oxide nanomaterials.**

Widespread uses of engineered nanomaterials due to rapid development of nanotechnologies in recent years has raised public concerns for their potential cytotoxic effects. In particular, photocatalytic production of hydroxyl radical by nanomaterials is commonly considered one of the major reasons for the cytotoxic effects. This study aims to investigate the feasibility of using reactive oxygen species (ROS) production rate for characterizing the bactericidal effects of five titanium oxide nanomaterials with various shapes, sizes, crystal structures, and chemical compositions. Hydroxyl radical (•OH) and superoxide ion (O_2^-) production rates were estimated using fluorometric and absorption measurements respectively. Inactivation of a pure bacterial culture (*Escherichia coli*) was quantified as a function of exposure time and ROS production rate. Bacterial inactivation rates of the tested nanomaterials were used as a biological response and estimated by a series-event kinetic model. Results showed that hydroxyl radical production efficiency (yield) decreased as the light intensity and nanomaterial concentration increased. Hydroxyl radical production rates were substantially higher than those of superoxide ion production rates of all the nanomaterials. However, no linear relationship was found between the hydroxyl radical production rate and bacterial inactivation rate across the different titanium oxide nanomaterials. Although produced at lower rates than hydroxyl radical, superoxide ion has a better correlation with bacterial inactivation. This suggests that it is not feasible to use hydroxyl radical generation rate as a sole indicator to predict the photocatalytically bactericidal effects of titanium oxide nanomaterials with different shapes, sizes, crystal structures, and chemical compositions.

MANOHAR GADDIPATI and BRIAN J. ANDERSON, National Energy Technology Laboratory, Dept. of Chemical Engineering, West Virginia University, Morgantown, WV 26506. **Methane production from complex gas hydrate reservoirs: effects of reservoir heterogeneity on gas production.**

Natural gas is an important energy source, contributing to 23% of the total energy consumption in United States. Development of new alternatives, such as natural gas from methane hydrate, can play a major role in ensuring adequate future energy supplies in the United States. Methane hydrates are crystalline solids very similar to ice in which non-polar molecules are trapped inside the cages of water molecules. The National Energy Technology Laboratory (NETL) and the U.S Geological Survey (USGS) gas hydrate code comparison project is the first of its kind; it aims at a worldwide understanding of the hypotheses involved in the gas hydrate modeling and problem solving. The initial phase of the code comparison was achieved by simulating five problems of increasing complexity for five different reservoir simulators: CMG STARS, HydrateResSim, MH-21 HYDRES, STOMP-HYD, and TOUGH+HYDRATE. This paper presents the second phase of the code comparison project involving long-term simulations for three different model reservoirs. These three different model reservoirs are based on data available for Mt. Elbert gas hydrate accumulation and Prudhoe Bay L-Pad accumulation. The objective of this work is to generate results for CMG STARS for these model reservoirs. A good agreement was obtained for CMG STARS with other simulators. The effect of reservoir heterogeneity on gas production was also studied. An increase in gas production was observed with increasing heterogeneity in the reservoir.

NAGASREE GARAPATI, SRINATH CHOWDARY VELAGA, and BRIAN J. ANDERSON, Dept. of Chemical Engineering, West Virginia University, Morgantown, WV 26506. **Predictions of phase equilibrium data of mixed hydrates using the cell potential method.**

Natural gas hydrates are likely to contain more carbon than in all other fossil fuel reserves combined. Most of the natural gas hydrate deposits contain CH_4

along with other hydrocarbon and non-hydrocarbon gases. Thus, if CH_4 stored in the natural gas hydrates can be recovered, the hydrates will become a potential clean energy resource for the next 10,000 years. Current reservoir simulators are capable of predicting production rates from pure CH_4 hydrates but natural gas hydrates are mixed hydrates, hence there is a need to modify the simulators for implementing the mixed hydrate data. Therefore, it is very important to predict accurately phase equilibria of mixed hydrates. Based on an analytical solution to the Lennard-Jones–Devonshire approximation to the van der Waal–Platteeuw statistical mechanics model for hydrate equilibrium, the cell potential method was used to predict the phase equilibrium data of the mixed hydrate. The cell potential method developed by Anderson et al. (J. Phys. Chem. B. 2005, **109**, 8153) was modified for variable reference parameters, as it is found that the reference parameters vary with guest molecules. The cell potential parameters were calculated using ab initio calculation methods. The three-dimensional phase equilibria of CH_4–C_2H_6, CH_4–CO_2, and CH_4–N_2–CO_2 hydrates were predicted. The structural transitions that are known to occur in a CH_4–C_2H_6 mixed hydrate can also be predicted accurately. These phase equilibrium predictions can be incorporated into reservoir simulators to assess the production of CH_4 from the hydrate reservoirs. The authors thank Department of Energy (DOE) and National Energy Technology Laboratory (NETL) for their financial support of this research.

SHIYU LIU, CHET-MUN LIEW, JOHN NUSZKOWSKI, TIMOTHY GATTS, RICHARD ATKINSON, HAILIN LI, and NIGEL CLARK, Dept. of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506. **An experimental investigation of the combustion process of a heavy-duty, H_2-diesel, dual-fuel engine.**

This paper presents the combustion characteristics of a heavy-duty, H_2-diesel, dual-fuel engine. The effects of H_2 addition on the cylinder pressure and combustion process were experimentally investigated at 15, 30, and 70% of the maximum load at 1200 rpm. The addition of up to 6% H_2 in the intake air contributed to as much as 77% of the total intake energy when operated at 15% load and as little as 31% at 70% load. When operated at 70% load, the addition of a relatively large amount of H_2 substantially increased the cylinder pressure and the heat release rate, with their peak values observed at slightly advanced phasing. However, the addition of a large amount of H_2 at 15% load reduced the peak cylinder pressure and the peak heat release rate observed at premixed combustion but enhanced the heat release rate observed at the diffusion process. When operated at 30% load, the addition of H_2 has a mild effect on the cylinder pressure and heat release process. In contrast to the featured two-stage combustion process of diesel engines, a three-stage combustion process of the H_2-diesel, dual-fuel engine was observed with the addition of a relatively large amount of H_2 at high load. The extremely high peak heat release rate represented a combination of diesel diffusion combustion and the premixed combustion of H_2 consumed by multiple turbulent flames. However, the addition of H_2 under low load did not change the two-stage heat release process pattern.

JEREMIAH PEPPER, OSMAN GUZIDE, and WEIDONG LIAO, Dept. of Computer Science, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443. **A universal communication bridge between high-level languages and spreadsheets.**

In this research project, we intend to investigate and analyze the *Obba* software that provides a communication bridge between Java classes and spreadsheets, including *Excel* and *Open Office*. The idea has been elaborated and extended to other programming languages so that a universal communication bridge can be achieved. A comparison study between *Obba* and other similar software such as *XLL4J, XLW, ExcelDNA* will be conducted. Investigation will also be done to extend *Obba* package to work with *Google* spreadsheet. The research will benefit both software developers and end users. Software developers will be able to use the software package to access convenient functionalities from spreadsheet software. The end users who are familiar with spreadsheet software could access complex computations through simple command buttons.

SRINATH VELAGA, NAGASREE GARAPATI, and BRIAN J. ANDERSON, National Energy Technology Laboratory, Dept. of Chemical Engineering, West Virginia University, Morgantown, WV 26506. **Calculation of N_2 hydrate reference parameters and cell potential parameters to analyze the N_2–CO_2 and N_2–CH_4 three-phase equilibria and structural transitions.**

Gas hydrate reserves are receiving increasing attention as the potential source of CO_2 sequestration, but when pure CO_2 is used, only 64% of the methane is recovered because of the less occupancy of CO_2 in the small cages. It has been proposed that the addition of the nitrogen in the swapping process of CH_4–CO_2 hydrates can increase the methane recovery. There has also been an increasing interest in the separation of greenhouse gases from flue gas. Nitrogen hydrates form structure II hydrates. The nitrogen hydrate reference parameters and cell potential parameters are very important to understand the N_2–CO_2 and N_2–CH_4 mixed hydrate thermodynamics. Ab initio quantum mechanical calculations were used to obtain accurate intermolecular potentials. A potential energy surface (PES) between H_2O and N_2 was computed at the MP2/aug-cc-pVTZ level and corrected for basis set superposition error (BSSE), an error caused due to the lower basis set, by using the half counterpoise method. Intermolecular potentials were obtained by fitting Exponential-6 model to the ab initio PES. Reference parameters for structure II N_2 hydrate have been calculated with these site-site ab initio intermolecular potentials to be 1104 J/mol and 1305 J/mol. The pure N_2 hydrate equilibrium pressure was predicted with an average absolute deviation of less than 2% from the experimental data. The small-cage occupancy is more than 90% and the large cage is fully occupied. Using these reference parameters and cell potential parameters, N_2–CO_2 and N_2–CH_4 three-phase equilibria and structural transitions are predicted accurately.

Medicine & Health Sciences

ASHLEY M. CARROLL and KENNETH A. CUSHMAN, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **Localization of a nonfunctional ASIC in CHO Cells.**

Acid-sensing ion channels (ASICs) are ion channels that open and close due to pH changes in a tissue. It has been proposed that these channels are what allows one to sense ischemic pain. The D439A mutation of ASIC3 (acid-sensing ion channel 3) forms a nonconductive ion channel. It is uncertain why it is inoperable. Possible reasons for this include the protein not localizing to the plasma membrane or that the gate is not working correctly. In order to test this, we used an ASIC3-GFP fusion protein and made the D439A mutant using PCR. The ASIC3-GFP and D439A-ASIC3-GFP along with mCherry were then transfected into CHO cells; these cells were imaged on a laser scanning confocal microscope so we could determine localization. Our results showed protein expression of the mutant. Efforts to localize the mutant channel were inconclusive because the wild type ASIC3 showed abnormal targeting.

MEGHAN FRANCIS and ROBERT KREISBERG, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074, and RAVI SUBRAMANIAN, JULIA WILDSCHUTTE, and JOHN COFFIN, Dept. of Microbiology, Tufts University, Boston, MA 02111. **Antibody detection of human endogenous retrovirus env proteins in breast cancer.**

HERVs are inactive remnants of ancient germ-line retroviral infections that may be transcribed. HERV-K members are expressed in breast cancer tumors but not in normal mammary epithelial cells. Breast cancer begins with an abnormal growth of cells, which may remain benign but may also advance into a carcinoma and metastasize throughout the body. Studies analyzing viral RNA expression within breast cancer cell lines, representative of the three major subtypes of breast cancer, have not examined HERV protein expression. We will look at HERV protein expression in these subtypes. While approximately70 proviruses belong to the HERV-K family, only six express a full length Env protein required for entry into the host cell. Of those six, we used HERV-K108, a well-studied HERV whose Env is capable of mediating infection. The project goal was to investigate the biology of HERV-K proteins expressed in tumor cell by (1) examining the viral envelope glycoprotein of Env and (2) identifying HERVs that are exclusively expressed in tumor cell lines using an anti-Env antibody.

These studies will allow us to determine potential marker genes associated with breast cancer. In order to achieve this goal, we measured endogenous Env expression in normal mammary epithelial cells and tumor cell lines to examine the link between Env expression and tumorigenesis. We also identified genes flanking HERV-K loci that potentially have roles in breast cancer development. Our results suggest that the locus of provirus expression may be distinguished, providing the location within the genome of a dysfunction leading to breast cancer.

NOELLE JULIANO, HAITAO LUO, and YI CHARLIE CHEN, Natural Science Division, Alderson-Broaddus College, Philippi, WV, and BING-HUA JIANG, Mary Babb Randolph Cancer Center, Robert C. Byrd Health Sciences Center of West Virginia University, Morgantown, WV 26506. **Kaempferol inhibits expression of VEGF and HIF-1α in human cancer cells.**

Kaempferol is a flavonoid found in apples, onions, leeks, citrus fruits, grapes, red wines, *Ginko biloba,* St. John's wort, strawberries, and teas. HIF-1α is a protein that reacts to hypoxia in the body by stimulating VEGF expression. Inhibiting VEGF expression would hinder angiogenesis within tumors, which would diminish growth and metastasis of cancer cells. The objective of our research is to determine the effect of kaempferol on cell proliferation, VEGF mRNA, and protein expression in DU-145 prostate cancer cells and on HIF-1α protein expression in Ovicar-3 and CP-70 ovarian cancer cells. Our results indicated that cell proliferation was significantly reduced as prostate cancer cells were treated with increasing doses of kaempferol. ELISA and Western blot detected a decrease in VEGF, HIF-1α, and interleukin-6 protein expression in Du-145 cells. HIF-1α protein expression was reduced by kaempferol treatment in Ovicar-3 and CP-70 ovarian cancer cells.

CHRISTOPHER R. RACINE, MOLLY E. SEIDLER, DUSTIN L. MOORE, and GERALD R. HANKINS, Dept. of Biology, West Virginia State University, Institute, WV 25112. **In vitro screening of *Hibiscus sabdariffa* extracts for anti-tumor properties.**

Hibiscus extracts are used in traditional African and Chinese medicine to treat a wide variety of ailments. Previous studies have demonstrated medical properties, including anti-tumor activity, of select *Hibiscus sabdariffa* extracts including hibiscus anthocyanins and polyphenol-rich extracts. However, information is very limited about variations among different hibiscus accessions. The accessions of *Hibiscus sabdariffa* can be separated by the color of the calyces into four different groups: green, pink, red, and dark red. This study was designed to examine differences in vitro in anti-tumor properties among the accessions. NIH3T3, U87, A172, CH157, Neuro2A, PANC1, SW480, and SW620 cells were maintained in DMEM with 10% FBS. The cells were exposed for 24 h to various concentrations (0.0, 1.0, 1.5, 2.5, 3.0, 3.5, and 4.0 mg/mL) of the dark red, red, pink, and green extracts (supplied by James Simon, Rutgers University), and Cell Titer Glo assays were performed. The results show a dose-dependent decrease in cell proliferation (and/or increased cell death) after treatment with the dark red extract at a final concentration of 1.0 mg/mL for all cell lines except A172 (2.5 mg/mL). The red extract decreased proliferation for most cell lines at approximately 3.0 mg/mL. Pink showed data much closer to the dark red extract, significantly reducing cell proliferation between 1.0 and 2.5 mg/mL, depending on cell line. The green extract was least effective in reducing cell proliferation, with no significant decrease until 3.0-3.5 mg/mL. Support by USDA/CREES, NSF EPSCoR, and the WV NASA Space Science Consortium is appreciated.

SHANNON STRALEY, KAITLIN MARPLE, MEGAN SMITH, ALYSSA PENA, HAITAO LUO, and YI CHARLIE CHEN, Natural Science Division, Alderson-Broaddus College, Philippi, WV. **Time course of antibody-antigen reactions.**

Despite the wide use of antibodies (Ab) in various assays for specific detection and quantification of antigens (Ag), little is known about the time needed for Ab-Ag reaction to reach equilibrium. The objective of this study is to time an Ab-Ag reaction and provide a practical understanding of incubation time in future Ab-based assays. GAPDH mouse Ab served as an Ag in this system to be specifically recognized and bound by Goat-Anti-Mouse-Poly-HRP. The bound Ab levels were analyzed by detecting its

HRP activities with QuantaRed Enhanced Chemifluorescent HRP Substrate and a microplate reader.

Goat-Anti-Mouse-Poly-HRP can coat 90% of available sites by 4–6 hours incubation as compared to 24-hour coating, and prolonged coating time does not bring further coating effect. Blocking time (from five minutes to 48 hours) does not affect the blocking effects of 1% BSA and 5% milk. For Goat-Anti-Mouse-Poly-HRP to recognize GAPDH mouse Ab, six-hour incubation is needed to reach 93% of its binding of 24-hour incubation. Our results also suggest that the Ab-Ag reaction at room temperature is slightly higher than that at 4 °C, but significantly better than that at 37 °C between 0.5- and 4-hour incubation.

Overall, our data suggests that while blocking with BSA and milk is immediate, Ab-Ag binding is slow and the sensitivity of Ab-based assays may be improved by a longer incubation, up to six hours at room temperature. This research was supported by grant P20 RR16477 from the National Center for Research Resources awarded to the West Virginia IDeA Network for Biomedical Research Excellence.

RYAN WILLIAMS and LETHA J. SOOTER, Dept. of Biology, West Virginia University, Morgantown, WV 26506. **Prostate cancer detection by molecular recognition elements.**

Prostate cancer is the most-diagnosed carcinoma among men in developed nations and is responsible for the second-most cancer-related deaths. Current detection methods for the disease lack ideal specificity and sensitivity. A mechanism to selectively target prostate cancer for detection and improve upon current methods is necessary. This project aims to identify molecular recognition elements (MREs) that specifically and preferentially bind to prostate cancer cells. Quantum dots will be attached to these MREs to signal binding to the target. It is expected that this complex will specifically bind to and signal the presence of these cells. In order to identify MREs specific for prostate cancer cells, a yeast-displayed scFv antibody pool will be used. This pool will be incubated with the prostate cancer cell line LNCaP. Molecules that bind the cells will be incubated with the benign prostate cell line BPH-1, discarding MREs that bind to it. The remaining molecules will be amplified and incubated with the cells again; this process continuing for ten rounds. The MREs will then be attached to quantum dots and excited with infrared waves. Fluorescent signaling dependent upon binding will indicate suitability as a non-invasive detection mechanism. This project aims to improve upon current prostate cancer detection mechanisms. They allow unabated tumor proliferation in some patients and unwarranted stress in many patients with BPH. Therefore, this research may reduce patient mortality while relieving fears due to false positive test results.

Social Sciences. & Psychology

DEBRA HULL, LAUREN COOK, JOAN COTTER, STEFANIE MERTZ, and LINDSAY MOFFATT, Dept of Psychology, Wheeling Jesuit University, Wheeling, WV 26003. **The effect of body size on the way others perceive personality characteristics.**

Black and white human-figure line drawings, often used to measure body satisfaction, were selected in this study to assess personality stereotypes associated with different body sizes. College student participants looked at a selection of line drawings (chosen randomly) of men and women who ranged in body size from extremely thin to extremely obese, then rated those figures on 18 personality traits. Nine of the personality traits showed statistically significant differences among the body sizes. Generally, moderately sized figures were rated most positively, with extremely thin and extremely obese figures rated more negatively. Obese figures were rated the most negatively. Male and female participants did not differ in how they rated the figures, nor were male and female figures rated differently on the personality characteristics. These results indicate that there are identifiable personality stereotypes based solely on body size. Future studies will investigate the impact that a participant's body size has on how that participant rates the personality characteristics of line drawings of figures with different body sizes.

LEVI R. NAYLOR and JOHN H. HULL, Dept. of Psychology, Bethany College, Bethany, WV 26032. **You CAN tell a book by its cover (at least somewhat): information provided by covers of books written for children.**

Thirty-five college student participants viewed either clear (N = 18) or pixelated (N = 17) versions of covers of books marketed on Amazon.com to age ranges birth–toddler, 4–8 years, and 9–12 years. Books were listed as all-time bestsellers on Amazon.com. Pixelation included reversal, then rotation, of the pixelated image. There were 15 covers in each of the age categories, and the order of PowerPoint presentations was randomized. Each cover was evaluated by participants on three Likert-like scales ranging from 1–5: Very masculine–Very feminine, Very passive–Very active, and Very interesting–Very uninteresting. Mixed-design ANOVAS (repeated-measures variable: age category; between-participants variable: clear vs. pixelated PowerPoint) were conducted for each of the three scales. Results showed that both clear and pixelated versions of the book covers were evaluated as significantly more masculine as age category increased; did not show significant age or clear-pixelated trends on the active-passive dimension; were rated as significantly most interesting in the 4–8 years category. Our pixelation process removed virtually any cues except predominant colors of the book covers, yet the evaluations of clear and pixelated book covers were so similar, it may be that color is an important cue people use in selecting children's books. For example, there was a statistically significant correlation ($r(43)= 0.495$, $p<0.005$) between masculine-feminine means for the 45 clear-pixelated cover pairs. Future research will address this possibility, including books for adults as well as for children, and attempt to assess the relationship between book cover and book content, at least for children's books.

DARCEY N. POWELL, KATHERINE KARRAKER, MARION YOUNG, and JESSICA STOLTZFUS, Dept. of Psychology, West Virginia University, Morgantown, WV 26506. **Adults' liking of infant names.**

Little research has addressed why some names are preferred over others. The goal of this study was to examine both characteristics of names and characteristics of adults that influence individuals' liking of particular names. Male (N = 148) and female (N = 464) college students were recruited from introductory psychology classes. They completed a demographic questionnaire, the Big 5 Personality Inventory, and indicated their liking of infant names in a list containing currently popular, previously popular, and unusual names for both boys and girls. Participants' openness and agreeableness scores significantly correlated with their average liking of all names, $r(609) = 0.10$, $p < 0.05$ and $r(608) = 0.08$, $p < 0.05$, respectively. Also, participants with more contact with infants were more variable in their liking of infant names. A Sex of Participant x Sex of Baby Name x Type of Baby Name analysis of variance found no main effects of Sex of Participant or Sex of Baby Name, but all other effects and interactions were significant, $p < 0.05$. Follow-up paired t-tests, $p < 0.05$, revealed the following: Both male and female participants liked unusual names less than currently popular and previously popular names, regardless of the sex of the name. Male participants liked currently popular and previously popular names equally, whereas female participants liked currently popular names more than previously popular names, again regardless of the sex of the name. These results suggest that individuals with more positive personality characteristics tend to be more positive and optimistic about infants and their names. In addition, the current popularity of names influences women's liking of names more strongly than men's liking.

DARCEY N. POWELL, KATHERINE KARRAKER, MARION YOUNG, and JESSICA STOLTZFUS, Dept. of Psychology, West Virginia University, Morgantown, WV 26506. **Adults' perceptions of infants depicted through names and photographs.**

Previous studies have found that adults perceive other adults, college students, and children differently based on their names. A separate line of research has determined that the physical appearance of infants, children, and adults elicits differential perceptions from others. The goal of the present study was to determine how adults' perceptions of infants are influenced by infants' names and physical appearance, both separately and in combination. Male (N = 148) and female (N = 461) college students, recruited from introductory psychology classes, rated the personality and behavioral characteristics of three male and three female infants. Participants were randomly assigned to one of three groups. One group (N = 127) rated infants based only on the infants' names, another group (N = 94) rated infants based only on photographs, and the third group (N = 388) rated infants based on photographs with names, using combinations of the

names and photographs rated by the first two groups. Ratings were summed to create a "positive traits" rating. The mean of these ratings across participants was calculated for each name alone, each photograph alone, and each name-photograph combination. The average positive traits rating of the name-photograph combination was significantly predicted by the average rating of the photograph included in the combination, $r(58) = 0.51$, $p < 0.001$, but not by the average rating of the name included in the combination, $r(58) = 0.08$, $p > 0.05$. Results indicate that infants' physical appearance is more predictive of adults' general perceptions of infants than are infants' names. These results are consistent with other research supporting the salience of physical appearance in interpersonal perceptions.

JESSICA STOLTZFUS and KATHERINE KARRAKER, Dept. of Psychology, West Virginia University, Morgantown, WV 26506. **Father–infant play is influenced by infant temperament and sex.**

In general, father–infant play is qualitatively different from mother–infant play. For example, father–infant play is often more physical and less predictable than mother–infant play. Fathers may find high levels of certain temperament traits, such as activity level, adaptability, and intensity, particularly amenable to their active play style. Participants were 373 fathers participating in the NICHD Study of Early Child Care. Temperament was assessed at 6 months of age using a maternal report measure. Father–infant play was assessed at 6, 15, and 24 months of age using a paternal report measure. Separate multiple regressions were conducted to predict fathers' play with their infants at each age from ratings of infant temperament. The regression was significant at 15 months, $F(5, 372) = 2.32$, $p = 0.04$, $R^2 = 0.03$, but not at 6 or 24 months. At 15 months, fathers reported playing and talking with their infants more if the infants were *less* intense ($\beta = -0.12$), *more* approaching ($\beta = -0.17$), and *less* adaptable ($\beta = 0.18$). Repeating analyses separately for fathers of boys and girls indicated that infant temperament and father play were related only for fathers of boys, $F(5, 192) = 2.76$, $p = 0.02$, $R^2 = 0.07$. Results suggest that, contrary to expectations that fathers would prefer to play with more intense and adaptable children, fathers interact more with *less* intense and adaptable infants. Moreover, these results were specific to boys. Observations of fathers' behaviors when interacting with their non-adaptable and mild boys and girls would allow for a better understanding of the mechanisms behind these findings.

MARION E. YOUNG, Dept of Psychology, West Virginia University, Morgantown, WV 26506, SUSAN LYNCH, MARK POLAK, and SUSAN RITCHIE, Dept. of Pediatrics, West Virginia University, Morgantown, WV 26506, and KATHERINE KARRAKER and HAWLEY MONTGOMERY-DOWNS, Dept. of Psychology, West Virginia University, Morgantown, WV 26506. **Maternal perceptions of their premature infants' sleep.**

Thirteen percent of infants born in the United States each year are delivered prematurely. Premature infants have more irregular sleep/wake patterns than full-term infants. Mothers of premature infants view their child as more vulnerable than do mothers of full-term infants. The current study investigated mothers' sleep-related cognitions and perceptions of premature infants. Maternal cognitions and perceptions of infant sleep were assessed using the Maternal Cognitions about Infant Sleep Questionnaire (MCISQ) and the Vulnerable Child Scale (VCS). Lower VCS scores reflect greater belief of infant vulnerability. Higher MCISQ scores represent more negative concerns and doubts about infant sleep. Infant medical history data were collected. The sample consisted of 19 infants born at 29.3 (SD+8.5) weeks with birth weight of 3.1 (SD+2.1) pounds. The infants spent 35.9 (SD+ 40.7) days on oxygen and 16.5 (SD+15.1) days on mechanical ventilation. VCS scores were negatively correlated with the MCISQ ($r = -0.47$, $p<0.05$). VCS scores were significantly different between infants who had never had reflux compared to those who had a history of or concurrent reflux ($t(17) = -16.3$, $p<0.01$).

Mothers who viewed their infants as vulnerable were more likely to doubt their parental competency relating to their infant's sleep. Mothers viewed premature infants who had concurrent reflux as more vulnerable. Premature infants presenting with reflux tend to have less gastric motility, making them fussier during the day and more restless during sleep. Reflux may contribute to both poor infant sleep and maternal perception that the infant is vulnerable.

INSTRUCTIONS TO AUTHORS [from http://www.marshall.edu/wvas/AUTHORS.HTML]

1. General Policy

The publications policy of the Academy is intended to implement the goal of publication of the *Proceedings* by the Academy, namely, stimulation of research on the part of West Virginia scientists and Academy members by providing an outlet for publication of their research results. Within the limits of available resources, the Academy will attempt to maximize the number of articles it can publish, while maintaining standards by the peer review process. Where selection must be made, the sole criterion for judgment shall be the quality of the research involved. Articles of a local or regional nature, as well as those of broader scope, are encouraged. Articles will not be discriminated against because of their subject matter, as long as they satisfy the requirement of the bylaws (http://www.marshall.edu/wvas/WELCOME.HTML; click on the bylaws link) that they be "...of a scientific nature" (Section VII, Article 1).

The Academy will consider papers that report the results of original research or observation. The Academy will not publish papers that have been published elsewhere. Each manuscript will be reviewed by the Publications Committee and by referees. Manuscripts longer than 15 pages of double-spaced, typed copy normally will not be accepted. Membership in the Academy is a requirement for publishing in the Proceedings. In the case of joint authorship, at least one author must be a member of the Academy. No author or co-author may submit more than two papers for any volume of the Proceedings. Ordinarily, papers offered for publication must have been presented at the annual meeting of the Academy, but presentation is not a requirement for publication. Publication is not automatic. The *Proceedings* editors also solicit outstanding expository papers.

2. Abstract for Annual Meeting

A 'call-for-abstracts' announcement is mailed to each member in the fall.

The abstract will be formatted in the following manner:

JOHN SMITH, Dept of Biological Mathematics, West Virginia University, Morgantown, WV, 26506, and JIM DOE, Dept of Chemical Sociology, Marshall University, Huntington, WV 25755. **Analysis of trigonometric cell structure in the chromosome.**

Skip one line and begin the first paragraph of text. Single-space the text. Start each new paragraph by indenting 0.25" (¼") using a tab, not the space bar. Do not skip a line between paragraphs. Standard abbreviations may be used. The abstract should contain a brief statement of (a) the objectives of the study, (b) the method of study used, (c) the essential results including data and statistics, (d) the conclusions, and (e) the source of support (if applicable). Figures and tables cannot be accommodated. Please check the abstract for misspellings, poor hyphenation, and poor grammar. The text of the abstract should not exceed 250 words.

3. Manuscripts

Manuscripts for publication should be sent to the editor, Dr. G. Paul Richter, 112 Fayette Street, Buckhannon, WV 26201. Manuscripts must be sent electronically (email or compact disk) in Microsoft WORD to richter_p@wvwc.edu. One hardcopy should also be sent to the address above. Proofs, edited manuscripts, and all correspondence regarding papers for publication should be directed to the editor. For additional information, call (304) 472-3317.

a. Cover-sheet (Title and by-line)

The cover sheet for each manuscript should include the title (bold, 12-pt. New Times Roman font) of the paper followed by the names and business addresses of all authors. The corresponding author should be indicated by an asterisk and include a business phone number, fax number (if available), and e-mail address (if available)

b. Organization of Manuscripts

Each manuscript shall start with an abstract (no more than 250 words) that should summarize the primary results. In general, the introductory abstract will replace a summary. This abstract should be suitable for sending to international abstracting services for immediate publication in the event that the paper is accepted for publication in the *Proceedings*.

The following sequence is suggested for organizing a paper: Introduction, Materials and Methods, Results, Discussion, Acknowledgments, and Literature Cited.

The text should be double-spaced (Times New Roman 12 pt. font size), and pages should be numbered consecutively in the top right-hand corner of each page preceded by the author's last name.

Major section headings **(INTRODUCTION, METHODS,** etc.) are to be bold and all caps and subsection headings should presented in 10-pt font size, in all caps but not bolded.

Using a tab, not the space bar, indent each paragraph 0.25" (¼").

c. Grammatical Considerations

Place two spaces between the period at the end of one sentence and the first letter of the next sentence.

Hyphenate compound modifiers and compound words. A modifier made up of an adverb (other than adverbs ending in -ly) + adjective, adjective + noun, or two nouns is a compound or unit modifier. E.g., *plum-pox-resistant, transgenic plum,* where *plum-pox-resistant* is the compound modifier. Note: chemical names used as modifiers are not hyphenated except when misinterpretation is likely. Examples: 1. Iron sulfide containing bacteria is commonly found ... ; 2. Iron sulfide-containing bacteria are … (In example 1., a sample of iron sulfide that contains bacteria within it is the subject; in example 2., the bacteria contain iron sulfide and *bacteria* is the subject.

Include a comma after each member in a series of words that forms a list in a sentence, forms a series of

modifiers modifying the same item, or for a series of phrases, as this sentence itself exemplifies. E.g., ... *dogs, horses, antelope, and trout*... A different example exemplifies an important exception: When an adjective or noun acting as an adjective is conceptually very closely related to the immediately following noun, as *big* in *big apple*, it is not considered part of the series of modifiers modifying the noun. Thus in ...*moldy, green, foul-tasting big apple* ... commas follow all of the modifiers prior to *foul-tasting,* but because *big* is closely associated with *apple*, it is not in the series; hence *foul-tasting* is the last modifier in the series (it could have been preceded by *and*).

Latin epithets used in scientific names for animals and plants follow a different set of rules than English names, even "official" English names. The guideline for English names is based on the rule "only proper nouns are capitalized in sentences". E.g., *coastal plain oak, raspberry horntail sawfly* would not be capitalized in a sentence. Capitalize the first letter of the first word in a sentence and capitalize the first letter for each major term in titles, figure captions, and table headings. Note: the symbol *pH* always has a lowercase *p* and uppercase *H*; it should not be the first "word" in a sentence, caption, or title if things can be conveniently rearranged.

Spell out numbers "one" through "nine"; use numerals for numbers higher than nine. As with *pH*, avoid beginning sentences, captions, and titles with a numeral.

There exist hyphens, en-dashes, and em-dashes, and each has a use. One should distinguish especially between the hyphen (the shortest of these marks) and the en-dash (the intermediate in length of the three). The en-dash should be used in two-word concepts (e.g., *nickel–metal hydride battery*) and spans of time (e.g., *for the period January–June*), among other situations. In "Word" for PCs, the en- and em-dashes are available in the "Special Characters" tab of the "Symbol" sub-menu, which is under the "Insert" menu. In Macintosh computers, the en-dash is also available directly when the "alt/option" key is held down while striking the hyphen key.

For other grammatical considerations, please consult a good scientific writing reference, such as the *Scientific Style and Format: The CSE Manual for Authors, Editors, and Publishers* by Council of Science Educators Style Manual Committee.

4. Figure, Illustrations, and Table Preparation

Each table or figure should be supplied with a legend sufficiently complete to make the table or figure intelligible without reference to the text. Footnotes may be used in connection with tables and figures where necessary. Footnotes should be avoided whenever possible in the text itself. Complicated formulas should be prepared with care in a form suitable for camera-copy reproduction. Avoid such formulas in the text. Acceptable fonts include Times, Times New Roman, Arial, Courier, Helvetica, and Symbol. Table and figure format should follow those in issue **79***(2)* or later.

Example Table:

Table 1. Synthesis of PIT tag retention rates from American eel studies.

Study	Location of Study	Duration	Eel Length (mm)	Tag Location	Tag Retention
Thomas (2006)	Laboratory	6 months	> 500	Dorsal musculature	100%
Morrison and Secor (2003)	Hudson River, NY	2 months	Mean = 457	Visceral cavity	89%
Verdon and Desrochers (2003)	St. Lawrence River, NY	1998-1999	Mean = 471.7 (1998) Mean = 468.7 (1999)	Behind the head	98%
Verdon et al. (2003)	Richelieu River, Quebec	1997-1999	Mean = 379.7	Dorsal Musculature	93.9%

Prepare figures and illustrations to be close to the expected size within the publications, with a width of no less than 3 inches (column width) or 6.5 inches for full-page width.

All illustrations and photographs will be published in black and white or grayscale. Use shaded fills for shapes and graphs. For figures with bars, shading, diagonal, and horizontal lines are allowable. Each bar fill-type should be clearly distinct. All drawn lines must be greater than 0.25 pts (0.1 mm) thick. All figures should have a white chart area. See WVAS *Proceedings* **79***(2)* or later for example formatting.

The recommended file format and resolution for various types of line drawing and photos are:

- Black and white line art, use 1000 dpi minimum resolution
- Half tone and grayscale – use minimum resolution of 600 dpi
- Images and photos need to be in grayscale with a minimum resolution of 600 dpi

All illustrations should be submitted electronically as a separate file for each figure. Acceptable file format are TIF, PDF, Microsoft PPT, DOC, or XLS. No other formats are accepted at this time.

Please note: Illustrations, graphs, and photos that do not comply with the recommended format will be returned to the author for correction. The manuscript will not be considered for review until it is resubmitted with the required corrections. Figures and tables covering more than one page should have the figure or table number repeated at the top of each of the other pages followed by the word "continued" within parentheses. Data, legends, and other identifiers that appear within a figure or table need to be large enough in the published version to be easily read.

5. Literature Cited

References shall be collected at the end of the manuscript as "Literature Cited" and must be cited in the text.

- Citations within text:

  References should be cited by author and date within the text. Separate multiple citations with a semicolon.

• Example citations within text:
Single author: (Dare 2003)
Two authors: (Buzby and Deegan 1999)
Multiple authors: (Feldheim et al. 2002)
Multiple citations: (Buzby and Deegan 1999; Feldheim et al. 2002)

• Citations at the end of paper:
The title of the papers cited and the inclusive page numbers must be given.
The article title should be italicized and the journal name should be in normal font.
Bold the volume number, italicize the issue, and present page numbers in normal font.
End each citation with a period.
Citations should be formatted with hanging indentation of 0.5".
Do not skip a line between citations.

• Example journal citations:
Buzby, K. and L. Deegan. 1999. *Retention of anchor and passive integrated transponder tags by arctic grayling.* N. Am. J. Fish. Manage. **19***(4)*: 1147-1150.
Dare, M.R. 2003. *Mortality and long-term retention of passive integrated transponder tags by spring Chinook salmon.* N. Am. J. Fish. Manage. **23**: 1015-1019.
Feldheim, K.A., S.H. Gruber, J.R.C. de Marignac, and M.V. Ashley. 2002. *Genetic tagging to determine passive integrated transponder tag loss in lemon sharks.* J. Fish Biol. **61**: 1309-1313.

Example book citation:
Stacey, M. and S. A. Barker. 1960. *Polysaccharides of microorganisms.* Oxford Univ. Press. London. 228 pp.
Freemark, K. and B. Collins. 1992. *Landscape ecology of birds in temperate forest fragments* in J. M. Hagan, III and D. W. Johnston (eds.), Ecology and Conservation of Neotropical Migrant Landbirds, pp. 443-454. Smithsonian Institution. Washington, D.C.

6. Submission of Revised Manuscripts

All manuscripts accepted by the peer reviewers that need to be revised must be done according to instructions and submitted to the editor either by e-mail or on a compact disk.

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If galley proofs are sent to authors for corrections they should be made on margins of the proof. Proofreader's marks may be found in dictionaries and in style manuals (e.g., "Style Manual for Biological Journals"). Changes in text after the manuscript is in galley proof are quite expensive and in general are not permitted. Galley proofs must be corrected and returned promptly (within ten days).

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