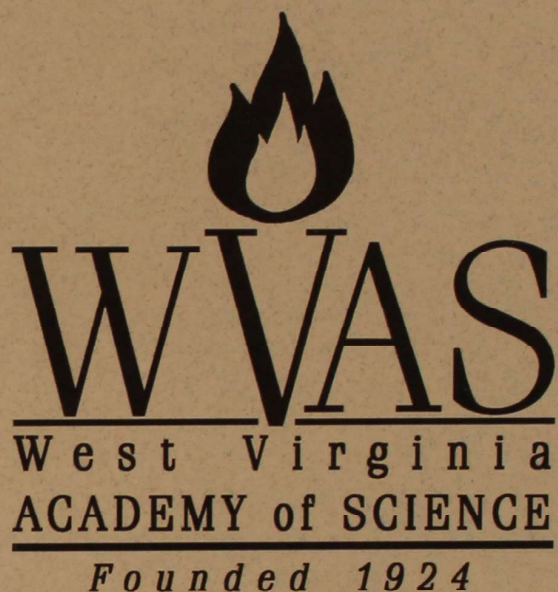


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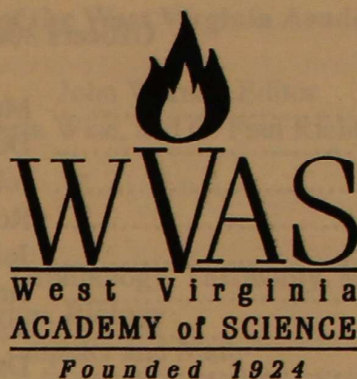
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**Abstracts of the  
Eighty-Second  
Annual Session**









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**Proceedings of the West Virginia Academy of Science  
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2007**

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Oral Presentations

Undergraduate research

**ANDREW BARKER, ROBERT KREISBERG, and ROGER SEEBER,** Natural Sciences and Mathematics, West Liberty State College, West Liberty, WV 26074. Extraction of Genomic DNA from *Lycopersicon esculentum*.

Genomic DNA can be used to explore differences and relationships between similar varieties of a species. In this study, genomic DNA was extracted from tomato plants, *Lycopersicon esculentum*, using the Qiagen Plant Mini Kit. Purity of the DNA samples was determined spectrophotometrically using a NanoDrop ND-1000. Initial DNA extractions from tomato plants demonstrated high levels of salt contamination and low DNA concentrations. After several modifications to the original method, genomic DNA samples registered acceptable A260/280nm and A260/230nm ratios and had higher DNA concentrations. Preliminary restriction mapping was attempted using endonucleases and electrophoresis. Future studies include genetic mapping of 788 varieties from the tomato gene bank at West Liberty State College.

**ASHLEY N. HUDIMAC, MATT MENAS, and DONALD E. TRISEL,** Biology, Chemistry and Geosciences, Fairmont State University, Fairmont, WV

26554. Comparison of mite control methods in *Apis mellifera* (honeybee) colonies.

This study was designed to determine the effect of two separate organic methods, Apiguard (thymol) and Mite Away II (formic acid), on the control of *Varroa* mite (*Varroa destructor*) infestation. The experiment was performed on 10 honeybee (*Apis mellifera*) hives, with five hives receiving the Apiguard treatment, and the remaining hives receiving the Mite Away II treatment. The hives were positioned in three separate locations, with both mite treatments present at each location. Both treatments were applied over a 28-day period. The goal of this experiment was to find which mite treatment would be more effective in controlling *Varroa* mite infestation, and how this treatment affects the overall health and survival of the hives.

The effectiveness of each treatment was measured by the average number of mites in two 5-cm x 7-cm areas, chosen at random, on the removable bottom board of each hive. Mite counts were performed on a weekly basis. Both treatments showed significant results within one week. Our results show that Mite Away II killed an average of 35.2 mites per hive within the first two weeks, while Apiguard killed an average of 9.8 mites per hive. As of February 24, 2007, only two hives are alive and strong; both of those hives received the Mite Away II treatment. A third hive, treated with Apiguard, is alive but very weak and unlikely to survive until spring.

**BRANDON COPPLE,** Biology, Shepherd University, Shepherdstown, WV 25443, and **CLIFFORD STARLIPER,**



USGS Leetown Science Center, Kearneysville, WV 25430. Non-destructive sampling methods for recovery of a bacterium, *Aeromonas salmonicida*, from ebonyshell mussels (*Fusconaia ebena*).

Freshwater mussels are historically one of the most abundant and diverse fauna in North America's rivers and lakes, but the loss of habitat and introductions of non-native fauna have led to significant decreases in their populations. Today, over 70% of species are federally listed, and conservation efforts have increased dramatically. One major effort is captive-propagation of imperiled mussels at refugia; however, there is now growing concern for pathogen introductions. Current pathogen screening methods for mussels involve sacrificing the animals, which is unacceptable for imperiled species. This study evaluated three sample sites collected using non-destructive procedures to recover *Aeromonas salmonicida*, a fish pathogen. Recoveries by the non-destructive methods were compared to those by standard, lethal procedures. A model system was used to introduce the bacterium to ebonyshell mussels (*Fusconaia ebena*); they acquired it through siphoning water while cohabiting in a tank with diseased fish. At a 100% infection incidence, the mussels were moved to "clean" tanks for depuration in pathogen-free water. Groups of 15 mussels each were sampled at intervals (during depuration) by primary culture for *A. salmonicida* on CBB bacteriological medium. Two non-destructive sample sites, fluid clean-catch and mantle clip, yielded bacterial recoveries equal to those by lethal methods. Beyond five days, *A.*

*salmonicida* was recovered from only two of 45 mussels, and both were by non-destructive methods. The third site, hemolymph, was less effective. Non-destructive sampling procedures, alone, caused no mortality, and fluid catch is non-invasive, which is the least stressful to the host.

**FREDERICK GARLAND**, Biology, West Liberty State College, West Liberty, WV 26074, and **KATHLEEN BRUNDAGE**, Immunology, Microbiology, and Cell Biology, Robert C. Byrd Health Sciences Center of West Virginia University; The West Virginia IDeA Network for Biomedical Research Excellence. Immunology of 3, 4 dichloropropionanilide-induced change to the S17 mouse stromal cell line.

DCPA (3,4-dichloropropionanilide) is an herbicide commonly used on rice, wheat, and potato crops. Previous studies in our laboratory demonstrated that co-cultures of stromal cells and B-cells exposed to 100  $\mu$ M DCPA resulted in the stromal cells becoming less adherent and inhibiting B-cell differentiation. VCAM-1 (CD 106) is the adhesion molecule that binds to the integrin VLA-4 on the B-cell. PE-CAM-1 (CD 31) is an adhesion molecule present on the surface of the stromal cell that promotes the adhesion of the stromal cell to its surroundings. Stem cell factor (SCF) is expressed on the surface of the stromal cell and is a growth factor for B-cells. Flow cytometry was used to analyze changes over time to the expression of VCAM-1, PE-CAM-1, and SCF on stromal cells exposed to various concentrations of DCPA (0  $\mu$ M - 100  $\mu$ M). Stromal cells were analyzed using the Becton Dickenson FACSCalibur. The



hypothesis was that exposure to DCPA inhibits the expression of the adhesion molecules PE-CAM-1, VCAM-1, and the growth factor SCF. Prior to staining, the number of live cells present in each culture was determined by trypan blue exclusion. The data derived from the cell counts indicate that in the presence of 100  $\mu$ M DCPA the number of cells decreased compared to controls. VCAM-1 expression levels were not changed by exposure to DCPA. The percentage of cells that expressed PE-CAM-1 increased in the 100  $\mu$ M DCPA treatment compared to the controls, but the level of expression on each cell decreased. SCF expression was also increased in the presence of 100  $\mu$ M DCPA. Overall, the data indicate that the 100  $\mu$ M DCPA exposure increases expression of proteins on the surface of bone marrow stromal cells that are important in B-cell development. *This research was supported by grant 006-32 from John Hopkins University Center for Alternatives to Animal Testing.*

**HEATHER ELLERY** and **PETER VILA**, Environmental Studies, Shepherd University, Shepherdstown, WV 25443, and **LUKE IWANOWICZ**, Fish Biologist, U.S. Geological Survey, Kearneysville, WV 25430. The effect of selected nitrite levels on the hemoglobin of healthy and whirling-diseased *Oncorhynchus mykiss*.

To test the effect of nitrite on hemoglobin, methemoglobin, plasma nitrite, and hematocrit levels in healthy and whirling-diseased rainbow trout (*Oncorhynchus mykiss*), a randomized complete block design study was conducted over a period of two days. Two separate treatments were applied to determine whether

increased cortisol levels, nitrite levels, or a combination of both had any impact on the trout.

Treatment one consisted of three replicates of water nitrite levels: 0, 0.1, and 1.0 mg/L, with four healthy and four diseased trout per tank. A total of nine tanks and seventy-two fish were used.

Treatment two consisted of four replicates of water nitrite levels: 0 and 1.0 mg/L, with four healthy and four diseased trout per tank. In half of the replicates, cortisol injections were administered to both the healthy and then diseased trout. A total of twelve tanks and ninety-six fish were used.

Hematocrit levels showed little variation during both treatments. Plasma nitrite levels for both treatments were higher for trout with whirling disease exposed to the 1.0 mg/L nitrite concentrations. Hemoglobin and methemoglobin levels were lower and higher, respectively, in both healthy and diseased trout in both treatments.

**LAURA KIMPEL**, Schrader Environmental Education Center, Wheeling, WV 26003, and **ZACHARY LOUGHMAN**, Natural Sciences and Mathematics, West Liberty State College, West Liberty, WV 26074. The crayfishes of Potomac Gorge National Park, Virginia

Crayfish faunas across North America in recent years have received increased conservation attention. Impacts from habitat degradation, invasive species, and high levels of endemism warrant increase investigation of this heavily imperiled group of organisms. Specifically, crayfish faunas in the Chesapeake Bay watershed have received little to no investigation and warrant conservation attention. In an



attempt to identify the crayfish fauna of this region, along with potential conservation concerns, a survey was performed on the crayfishes inhabiting Potomac Gorge National Park, Virginia in accordance with the Potomac Gorge Bioblitz. Four species (*Cambarus (C.) b. bartonii*, *C. (L.) diogenes*, *Orconectes (F.) limosus*, and *O. (G.) virilis*) were recorded for the park, two of which (*C. (C.) b. bartonii* and *O. (F.) limosus*) were previously unrecorded within park boundaries. The most pertinent conservation concern was the domination of the crayfish fauna by invasive *O. (G.) virilis* populations. *Orconectes (F.) limosus* populations currently risk extirpation by this invasive species. *Cambarus (C.) b. bartonii* and *C. (L.) diogenes* populations are stable within park boundaries; however, *C. (C.) b. bartonii* is limited to headwater stream environs due to competitive exclusion with *O. (G.) virilis* in broader lentic habitats.

**GINA MARIE COTTRILL**,  
Biology/Chemistry, Glenville State  
College, Glenville, WV 2635, **ROSANA  
SCHAFER**, and **KEITH SALAZAR**,  
WVU HSC Microbiology, Immunology,  
and Cell Biology, Morgantown, WV  
26506. Immune response to  
polysaccharide conjugates following  
exposure to an endocrine disruptor,  
3,4-dichloropropionanilide (propanil).

Initial experiments have established that 3,4-dichloropropionanilide (propanil) enhances by 4- to 6-fold the immune response in C57BL/6 female mice to a vaccination of heat-killed *Streptococcus pneumoniae*. Additionally, experiments in ovariectomized mice proved that the enhanced response is dependent upon the

ovaries, which suggests that a mechanism linked to the endocrine system is responsible. The present study determined the immune response to a purified, bacterial cell wall polysaccharide, phosphorylcholine (PC), after exposure to propanil. The phenotype of lymphocytes located within the ovaries was also determined. In this study, two types of conjugates to PC were used: PC-keyhole limpet hemocyanin (KLH) to elicit a T-dependent immune response and PC-ficoll to elicit a T-independent immune response. The serum antibody response and the response to the antibody-producing cells in the spleen were measured by ELISA and ELISPOT assays, respectively. The lymphocyte populations within the ovaries were isolated and measured using flow cytometry. A dose of 100 µg of PC-ficoll or 100 µg of PC-KLH given in combination with propanil did not exhibit an increase in serum titers. In contrast, propanil exposure increased the number of PC-specific antibody-secreting cells detected in the spleen. Preliminary analysis of the ovaries has identified a decrease in the populations of B-cells, T-cells, macrophages, and dendritic cells when the mice are vaccinated and a further decrease when the mice are exposed to propanil. Defining new mechanisms by which the endocrine and immune systems interact may lead to valuable insight into diseases that differ in males and females, as well as ovarian disease, autoimmune disease, and infertility. *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.*

**EMILY MESSENGER** and **CLARISSA**



at fewer than 20% of the sites, suggesting a narrowing of their distribution. Preliminary results indicate that several factors may be contributing to this trend. Hellbenders were found at sites that had higher particle-size scores. These are generally more heterogeneous environments, which may provide cover objects for both hellbenders and their prey. Conversely, sedimentation may limit access to cover objects, which may be why sites where they were not found had lower particle-size scores. It also appears that specific conductivity, which relates to the biological potential of a stream, is correlated with presence. Research is needed to determine why populations were not found at apparently suitable sites.

**JENNIFER HENDRICKS, AISLINN CREEL, and ROGER VIADERO**, Civil & Environmental Engineering, West Virginia University, Morgantown, WV 26506, and **KEN SEMMENS**, Aquaculture Extension, West Virginia University, Morgantown, WV 26506. Polymer selection for Geotube® application of waste management in a small flow-through aquaculture system.

Small aquaculture facilities would benefit from a simple, inexpensive, labor-efficient technology for managing waste. While various waste management systems have been developed, many aquaculture facilities cannot afford the increases in capital and labor required by most techniques. The Geotube®, a semi permeable geotextile bag has emerged as a simple and passive way to contain and dewater many substances from contaminated sediment to dairy and swine lagoon sludge. This technology has proven successful with concentrated waste

from recirculating aquaculture systems, yet is unproven as a means to contain and dewater the intermittent flow and high water content sludge produced in flowing water aquaculture systems. The efficacy of a Geotube® to remove solids and dewater the solid waste stream of a small flow-through aquaculture facility will be analyzed.

A 15-foot by 25-foot Geotube® will be installed to collect waste resulting from cleaning of in-raceway quiescent zones (QZs) at Reymann Memorial Farm in Wardensville, WV. This production-scale raceway system utilizes 400 gpm of spring water to maintain approximately 8000 lb of trout. The solid waste stream from cleaning QZs contains approximately less than 10 % solids, 7,800 mg/L total suspended solids, and 5,200 mg/L organic suspended solids.

Polymer additions to organic wastes enhance solids removal and dewatering efficiencies of geotextile material and bags. The type, dosage, and effectiveness of polymers used is site- specific, varying with waste and water type; therefore standard jar tests and cone tests were conducted to identify the appropriate polymer treatment for this waste prior to entering the Geotube®. Small-scale pilot studies were conducted to assess water quality of effluent over time with and without polymer treatment. Results of the polymer selection and the small-scale study were used to select a polymer for the Geotube® study.

**NIKKI PANTER and JAMES T. ANDERSON**, Division of Forestry and Natural Resources, West Virginia University, Morgantown, WV 26506. Do clearcuts benefit neighboring avian communities?



Timber production is a major land use in West Virginia, and between 1989 and 2003 harvesting almost doubled to one billion board feet per year. Consequently, more attention has been given to ecological effects of the increased disturbance of forests from harvesting activities. We compared species abundance, richness, diversity, and evenness of breeding birds on 1.5-hectare plots to the presence of neighboring clearcuts. Forty-eight plots (24 riparian, 24 upland) were established in the MeadWestvaco Wildlife and Ecosystem Research Forest (MWERF) in Randolph, Upshur, and Barbour Counties of West Virginia. Call counts were conducted along the centerline of the 1.5-ha plots that were categorized according to number of sides bordered by a clearcut (0, 1, or 2). Count data indicated that certain species were found in only one category. Downy woodpeckers (*Picoides pubescens*), eastern wood-pewees (*Contopus virens*), and hermit thrushes (*Catharus guttatus*) were counted exclusively in plots with neither side neighboring a clearcut. Black-and-white warblers (*Mniotilta varia*), common yellowthroats (*Geothlypis trichas*), eastern towhee (*Pipilo erythrophthalmus*), pileated woodpeckers (*Dryocopus pileatus*), wood thrushes (*Hylocichla mustelina*), and yellow-throated vireo (*Vireo flavifrons*) were found only in plots next to a clearcut on one side. Northern flickers (*Colaptes auratus*) were counted only in plots with clearcuts on both sides. Preliminary analysis of the avian community within the plots suggested that abundance increased with the number of sides bordering a clearcut, while evenness decreased. Species richness and Shannon diversity were greatest when plots had a

clearcut on only one side. Results could provide information to help forest managers attain specific goals regarding the avian community attracted to harvested woodlands.

**BRUCE EDINGER**, Natural Science, West Liberty State College, West Liberty, WV 26074. Importance of ant tenders for survivorship and growth of larvae of the federally endangered Karner blue butterfly, *Lycaeides melissa samuelis* Nabokov.

Blue butterflies (Family Lycaenidae) are characterized by larvae that secrete carbohydrates attractive to tending ants. The Karner blue butterfly (KBB) is a federally endangered lycaenid found in oak savanna and similar habitat. To inform management plans for recovery, the fates of second brood KBB larvae tended by ants were studied at the Indiana Dunes National Lakeshore. About 295 larvae were discovered and monitored every two days until pupation or disappearance. Tending rates were high; 90% of census visits found larvae being tended by one or more ants. Mean larval survivorship was highest when *Lasius neoniger* ants tended (4.3 d), intermediate when *Formica montana*, *F. schaufussi*, or other ant species tended (2.2 d), and lowest when untended (0.5 d). Mean KBB larval growth rates for these groups were, in mm/day, 0.81, 0.79, and 0.59, respectively, but these differences were not statistically different. Controlled



burning to decrease encroaching canopy cover would enhance populations of *Lasius neoniger*. Controlled burning is already known to improve stands of *Lupinus perennis*, the sole larval KBB food plant, and some species of flowering plants used as adult KBB nectar sources.

**CLIFFORD E. STARLIPER, BARNABY J. WATTEN, PHILIP L. SIBRELL, and KELSEY L. RITENOUR**, USGS Leetown Science Center, Kearneysville, WV 25430. A novel approach to prevent introductions of aquatic invasive fauna.

Invasive aquatic organisms can cause serious detrimental consequences to native fauna and to overall aquatic ecosystem health. Recent examples of invasive species that have significantly altered large ecosystems include zebra mussels (*Dreissena polymorpha*), quagga mussels (*D. bugensis*), Asian clams (*Corbicula fluminea*), and New Zealand mud snails (*Potamopyrgus antipodarum*). The best strategy to control invasive organisms is to remove the risks of their introductions. One primary recognized route of spread of invasives is release of ship ballast water. Invasive organisms could survive the trip for days to weeks in water and sediment in a ship's hull and be released at the ship's destination. An environmentally safe and economically feasible procedure to decontaminate ballast on the ship is an effective preventative measure. Microbes are generally intolerant to significant, quick changes in pH. Our laboratory studies are exploring methods to develop this intolerance into an applicable tool. We hypothesize that stabilization using

sodium hydroxide followed by recarbonation with carbon dioxide is bactericidal. Trials are being conducted to determine minimum lethal parameters of pH (10-12) and duration (within 48h), with subsequent carbon dioxide sparging to neutral pH or saturation (about pH 5.0). We have demonstrated 100% lethal effect to the fish pathogen *Aeromonas salmonicida* (mean initial count,  $2.50 \times 10^4$  cfu/mL) within 24 h at pH 11 and above. Further testing on bacteria from pond water (mean initial cfu/mL:  $4.80 \times 10^5$  to  $1.80 \times 10^7$ ) showed viable cell reductions of 98.5 to 100% at pH 12 for 24 h and recarbonation to saturation.

**JAMES T. ANDERSON and JAMES S. RENTCH**, Division of Forestry and Natural Resources, West Virginia University, Morgantown, WV 26506. Wetland identification in West Virginia.

The National Wetland Inventory uses aerial imagery to identify and map wetlands. However, this technique is subject to errors of omission (i.e., occurs in the field but is not identified from imagery) including missing small wetlands, missing some larger wetlands located in forested areas, or classifying the wetlands improperly. Aerial imagery and interpretation is also subject to errors of commission (i.e., identified as a wetland based on imagery but does not actually occur in the field). We compared aerial imagery to on-the-ground field surveys to determine the efficacy of aerial imagery for identifying wetlands on the 1,655-ha Camp Dawson Army National Guard Center, Preston County, WV. Based on our knowledge of the area and additional ground surveys, we found and delineated 43 palustrine wetlands (34 emergent, nine



scrub-shrub, one forested) comprising 5.72 ha of wetland area. Using 9,000 aerial imagery, 17 palustrine wetlands (14 emergent, three scrub-shrub) covering 3.74 ha were identified. Four of these 17 "wetlands" were not actually wetlands. This resulted in a 23.5% error of commission rate and a 70% error of omission rate. The aerial survey underestimated total wetland area by 153% and wetland numbers by 253%. Even the ground-based surveys likely underestimated the true number and area of wetlands. However, increased pre-existing knowledge of an area will improve wetland estimates. We believe that the error rates are high in areas with rugged mountainous terrain because numerous small slope wetlands are missed.

### Biology/Botany

**ALBERT MAGRO**, Biology, Fairmont State University, Fairmont, WV 26554. Emphasis in derived anatomical traits as the Wodaabe dance the geerewol.

Hominid fossils indicate how the shapes and proportions of modern humans have evolved. Ancestral anatomical traits that have been lost and are no longer prevalent in humans are referred to by paleontologists as primitive. Conversely, those anatomical traits that have evolved and have become increasingly prevalent in humans are referred to as derived.

Derived anatomical traits are perceived as attractive while primitive anatomical traits are perceived as unattractive. In judging the perceptive reactions to abstracted line drawings that express primitive and derived anatomical traits, males and females of diverse ages, races, cultures,

and from varied geographical regions demonstrate agreement as to what is perceived to be attractive or unattractive in human form.

The geerewol is a dance in which the handsomest young men of various nomadic tribes of the Niger Wodaabe people compete in a beauty contest. The geerewol is a dramatic exposition where dress, posture, and cosmetically emphasized physical features are presented to enhance the participants' beauty. Derived anatomical traits that are emphasized include: an oval-shaped face, a defined chin, a high forehead, closely spaced and spatulate teeth, orthognathism (nose out beyond the lips), V-shaped torso, long legs, and plantar foot flexion (toe lower than the heel). It is noted that universal attractiveness involves those derived traits shared by modern humans. A case is made that humans enhance their beauty by using cosmetics and apparel that emphasize derived anatomical traits.

**JAMES RENTCH**, Division of Forestry and Natural Resources, West Virginia University, Morgantown, WV 26506, and **KATHLEEN S. SHIELDS**, USDA Forest Service, Hamden, CT 06514. Dendrochronological analyses of host plant susceptibility to hemlock woolly adelgid: a logistic model.

This study examined the relationship between eastern hemlock (*Tsuga canadensis*) crown condition and the odds of radial growth decline due to infestation by hemlock woolly adelgid (HWA, *Adelgis tsugae*) in the Delaware Water Gap National Recreation Area. We first used tree-ring chronologies of eastern hemlock to develop a binomial decline index based on three consecutive years of



below average growth ( $RWI < 1$ ). We then used logistic regression to model decline as a function of tree, crown, and site variables that were collected over an 11-year period. Some site-related variables such as location and aspect were significantly related to decline probabilities when considered individually. However, the total proportion of variance that these two response variables accounted for was low, and these variables did not successfully enter the final model. Live crown ratio, crown density, and the modified ZBadj index, a combination of transparency and dieback, had the most explanatory power, both individually and in the final model; they were relatively accurate predictors of hemlock decline. Of the site variables, only the average percent of branches with HWA present in the plot entered into the final model.

**JOHN C. LANDOLT**, Biology, Shepherd University, Shepherdstown, WV 25443, **ADAM W. ROLLINS**, and **STEVEN L. STEPHENSON**, Biological Sciences, University of Arkansas, Fayetteville, AR 72701. Cellular slime molds from North American grasslands.

The cellular slime molds are bacteriovores that occur as members of the communities of microorganisms associated with surface soil and ground litter. Some early survey work indicated that cellular slime mold densities and diversity are more limited in grassland communities than in forest communities, so the vast majority of survey work carried out has focused on the species found in forests, with grassland data being relatively anecdotal. As part of recent, broader studies of eumycetozoa biodiversity on a global scale, sampling

for the occurrence and distribution of cellular slime molds has been done in several North American grassland (prairie) study sites, especially the Konza National Grassland in Kansas. In general, this sampling has reinforced previous observations of the relative paucity of grassland cellular slime mold assemblages, but the data obtained also suggest that particular species may be as common or perhaps more so in grasslands as compared to forests. Data also suggest that dictyostelid slime mold abundance and species richness may be influenced by such factors as herbivore grazing and burn history. This presentation reports on the results of our ongoing study of grassland cellular slime molds. *The study is supported in part by grants from the National Science Foundation (DEB-0316284), Prairie Biotic Research, Inc., and the Wyoming Native Plant Society.*

**SUSHMA SHRESTHA** and **DAN K. EVANS**, Herbarium, Biological Sciences, Marshall University, Huntington, WV 25755. Marketplace plants used in ceremonial cleansing among Andean Qechuans of Ecuador.

Ceremonial cleansing plays a vital role in indigenous societies where 'folk illnesses' such as susto (fright) are common. Indigenous Andean Qechuans commonly use cleansing plants to treat susto and related 'folk illnesses'. The purpose of this study was to characterize and compare market plants and to define methods and knowledge used in ceremonial cleansing among Ecuadorian Qechuans. Interviews were conducted with 22 vendors at 13 marketplaces. A total of 102 species from 50 plant families was reportedly used for cleansing. Mal aire (bad air), mal energia



(bad energy), and susto were prominent ailments treated. Two types of ceremonial cleansing methods were recorded: banos (bath) and limpia (cleansing). Each method employed both dulce (sweet) and amargos (bitter) plants. Cluster analysis demonstrated that markets of Pujilli and Otovalo were the most floristically related while Cuenca was the least related of the 13. Lamiaceae had the highest number of plant species (15) used. According to residual of RA, Lamiaceae (12.89) was the most selected and Orchidaceae (- 3.733) was the least selected plant family. The Andean region provided the greatest number of native species (52%). Highest residual of RA demonstrated preferential selection of Lamiaceae over other plant families. Similarity in market flora can be partially explained by similarity in geographic location. Further, limited markets having the fewest species shared a similar flora despite being widely separated. Knowledge of plants used in ceremonial cleansing was prevalent throughout the study area, with minor variation in species employed.

### **Biochemistry/Health**

**MELINDA L. ASBURY, MARIELA TASSONE, and KINSLEY K.**

**KININGHAM**, Pharmacology, Physiology and Toxicology, Marshall University, Huntington, WV 25755.

Dopamine-stimulation of neuroepithelioma cells results in iNOS up-regulation, oxidative stress, and apoptosis: A novel model for studying methamphetamine-induced neurotoxicity.

Methamphetamine-induced neurodegeneration has been associated with abnormally high levels of dopamine

(DA) in the striatum. Recent reports have suggested a link between DA-mediated increases in NOS isozyme expression and elevated neurotoxicity. To examine the regulation of DA-mediated iNOS expression and the neurotoxic effects of acute DA stimulation, we used SK-N-MC cells that endogenously express DA receptors and mimic postsynaptic striatal neurons. The transcription factors NF $\kappa$ B and AP-1 were examined as potential mediators of DA-related iNOS expression. In cells transfected with an NF $\kappa$ B construct, luciferase activity was unaltered after 6 hr treatment with 25 or 50  $\mu$ M DA, whereas cells transfected with AP-1 showed a significant increase. When cells were co-transfected with AP-1 and the dominant negative AFos, luciferase activity was decreased to that of control. Thus, it is possible that DA-mediated iNOS expression occurs through activation of AP-1. Neurotoxicity was assessed based on oxidative and nitrosative stress markers and apoptotic-related protein levels. Increases in 4-hydroxy-2-nonenal-adducted proteins, protein carbonyl formation, and 3-nitrotyrosine levels, were seen following 24-hr DA treatment, thus indicating the presence of oxidative and nitrosative species. Evidence for mitochondrial-mediated apoptosis was seen as caspases 9, 3, and PARP protein levels decreased, whereas their cleaved counterparts increased after DA treatment. We hypothesize that DA-mediated elevation in free radical production by up-regulation of iNOS leads to nitrosative stress and apoptosis in SK-N-MC cells. Once an understanding of DA-mediated iNOS regulation is obtained, great strides can be taken to counteract methamphetamine-induced nitrosative stress and resultant neurodegeneration.



*The research was supported by  
IP20RR020180.*

**BONNIE FREEMAN, SARAH DODSON, and MARK FLOOD,** Biology, Chemistry, and Geoscience, Fairmont State University, Fairmont, WV 26554. Assessing the correlation of homocysteine levels with apoptosis in human umbilical vein endothelial cells (HUVECs).

Homocysteine (Hcy) is an important amino acid occupying a pivotal position in the metabolism of the essential amino acid, methionine. High blood levels of Hcy are known to be an independent risk factor for cardiovascular disease. Individuals with severe hyperhomocysteinemia (HH) have elevated plasma levels of Hcy, which can lead to atherosclerosis via damage to endothelial cells. The objective of this project is to determine if exposure to physiologically relevant levels of Hcy can induce apoptosis in human umbilical vein endothelial cells (HUVECs) and aortic smooth muscle cells (SMCs). HUVECs were purchased from Clonetics and cultured in Medium 199 supplemented with 1% pen-strep, 10% FBS (fetal bovine serum), and 50  $\mu\text{g}/\text{mL}$  ECGF (endothelial cell growth factor). Cells were grown in tissue-culture treated flasks at 37 C in 5%  $\text{CO}_2$  humidified environment. Cell passages 5-10 were transferred to six-well, tissue-culture treated plates and allowed to grow to confluence before exposure to various concentrations (0.01 to 1 mM) of Hcy over a 48-hour period. HUVECs and SMCs were assessed for apoptosis using DNA-laddering techniques. Samples were analyzed using gel electrophoresis. Preliminary results indicate that Hcy does

induce and/or increase apoptosis in HUVECs. The SMCs appear to have no increase in apoptosis with Hcy exposure. The future goal is to determine if SMCs will protect HUVECs from undergoing apoptosis. This co-culture system may be a more relevant model for studying the effects of Hcy on endothelial cells. *This research was supported by WV-INBRE (NIH grant RR16477) and WV-NASA Space grants.*

**ALBERT MAGRO and ALICE MAGRO,** Biology, Fairmont State University, Fairmont, WV 26554, and **CYNTHIA CUNNINGHAM,** WVU Flow Cytometric Core Facility, Morgantown, WV 26506.

Metalloproteinase-dependent down-regulation of integrin and growth factor determinants upon the induction of apoptosis.

Tumor cells obtain survival signals via extracellular signals provided by matrix proteins and growth factors within the tumor's microenvironment. In this investigation we have determined that the LN18 glioblastoma expresses insulin receptor (INSR), insulin growth factor receptors 1 and 2 (IGF1R and IGF2R), epidermal growth factor receptor (EGFR), and a variety of alpha and beta components of integrins. An objective of this study was to determine if the integrin and growth factor receptors are modulated following the induction of apoptosis. Apoptosis was induced either by MK886, a known inhibitor of five-lipoxygenase-activating protein (FLAP), or by staurosporine, a known inhibitor of a number of protein kinases including protein kinase C (PKC). The detection and down-regulation of the receptors were



observed by flow cytometry. INSR, IGF1R, IGF2R, EGFR, and integrin components  $\alpha 2$ ,  $\alpha 3$ ,  $\beta 4$ , and  $\beta 5$  were down-regulated by 7-12 h following the induction of apoptosis. Inhibitors of calpain 1 and 2 and the broad caspase inhibitor, ZVAD-FMK, had no effect upon the down-regulation when added 5-7 h after the induction of apoptosis.

Proteasome inhibitors exacerbated the down-regulation of the surface receptors. However, the broad metalloproteinase inhibitors GM6001 and MM-2/MM-9 Inhibitor V effectively reversed the down-regulation even when added 7 h after the induction of apoptosis. It was determined by real time RT-PCR that the steady-state transcription of integrin and growth factor receptors were not affected by apoptosis. The data have enabled us to formulate the hypothesis that "the final stages of the pharmacological induction of apoptosis, to proceed to a full commitment to non-necrotic cell death, involves the degradation of integrin, insulin and epidermal growth factor receptors caused by a programmed dysregulation of the cell's metalloproteinases." *Funded by grant EPS 2006-15 and by grant P20 RRi6477 from the National Center for Research Resources awarded to the West Virginia IDeA Network for Biomedical Research Excellence.*

**MATT SMITHBAUER, RACHEL MITCHELL, and ROGER SEEBER,** Natural Sciences and Mathematics, West Liberty State College, West Liberty, WV 26074. The use of high-pressure liquid chromatography for isolation and quantification of hypericin and hyperforin produced by St. John's wort.

St. John's wort (*Hypericum perforatum*) is

an over-the-counter medication most often used for treatment of mild to moderate depression. The key components in St. John's wort are hypericin and hyperforin. These have been assessed as anti-inflammatory agent, diuretic, and possible HIV and cancer treatments. Several concentrations of these components were used to obtain a standard concentration curve in a 30-minute HPLC run with photodiode array detection at 290 nm. Four strains of *H. perforatum* callus were grown using tissue culture on modified Murashige and Skoog media by growing a sterile stem. Methanolic extracts of the chemical components from St. John's wort pills and tea were identified by the HPLC and, using the standard curve, were quantified. In the future callus strains will be screened for lines that produce larger quantities of hypericin/hyperforin, therein making research of these components more efficient and less expensive.

#### West Virginia Conservation/Zoology

**JENNIFER P. ADAMS and THOMAS K. PAULEY,** Biological Sciences, Marshall University, Huntington, WV 25755. Home range and behavior of *Crotalus horridus* in high-elevation production forests, Randolph County, West Virginia.

*Crotalus horridus* is an integral component of eastern deciduous forest ecosystems in North America. The ecological significance of *C. horridus* is implied by its broad geographical distribution. In many areas their niche remains unfilled from extirpations caused



by combinations of anthropogenic, biological, and ecological factors. These factors were studied in *C. horridus* populations on production forests in high elevations of West Virginia. Telemetered captures were radio-tracked from 2000 through 2002 to locate and characterize sites of overwintering dens, basking areas, and rookeries; identify forest cover types; ascertain home range sizes; document phenology; determine cause-specific mortality; and discern behaviors. Den sites, basking areas, and rookeries occurred at forest interiors and edges. Snakes were located in clearcuts, mature forests, and nonforest hardwoods. Mean home range sizes were 94.3 ha, males; 31.2 ha, nongravid females; 8.5 ha, gravid females; and 44.7 ha, combined. Mean daily movement rate was 20.2 m per day; mean maximum known distance from den sites was 1110.2 m; mean distance from overwintering dens was 514.2 m; and mean distance moved was 2852.9 m. Mean active season was 165.5 days, males; 171.0 days, females; and 167.3 days, combined. Specific causes of nonresearcher-caused mortality included mammalian predators (17.6%), avian predators (5.9%), and vehicles (17.6%). Remains of vehicle-induced mortalities were unobservable from roads, suggesting caution in using roadkill studies for *C. horridus*.

**TIMOTHY BALDWIN**, Biological Sciences, Marshall University, Huntington, WV 25755. Ecology and distribution of rough greensnakes and eastern smooth greensnakes (*Opheodrys aestivus* and *Opheodrys vernalis*) in West Virginia.

Since 1971, documented rough greensnake

(*Opheodrys aestivus*) occurrences in West Virginia have declined from approximately 100 to fewer than 20 occurrences in the last 10 years. In contrast to the decline of rough greensnakes in WV, smooth greensnake (*O. vernalis*) populations appear to be stable over the same period of time. Historic sites from the West Virginia Biological Survey were cross-referenced with habitat descriptions in published literature to establish research locations. During Summer 2006, 41 smooth greensnakes and 10 rough greensnakes were captured. During Fall 2006, 78 preserved snakes were examined. Plant community data were collected at each collection site (N=51) to define their habitat characteristics along 100-m transects. Morphometric measurements, such as snout-to-vent length, were taken for captured and museum specimens (N=119). The stomachs of field-captured specimens were flushed to identify prey; preserved specimens were dissected. Of the six-month active period, rough greensnakes had the most captures in September, accounting for 30%. In comparison, smooth greensnakes had the most captures in June, accounting for 33%. Exponential regression showed a positive correlation between total length and weight for smooth greensnakes ( $R^2 = 0.9136$ ) and rough greensnakes ( $R^2 = 0.7124$ ). Species occupied different habitats, with rough greensnakes found along forest edges near roadsides and smooth greensnakes in open fields with sparse vegetation. Only *Opheodrys aestivus* adults were found, whereas *Opheodrys vernalis* was represented by age groups from hatchlings to older adults. The data might suggest that differences in both activity period and habitat preference



may explain differences in population structure.

**TRISTAN BOND** and **THOMAS K. PAULEY**, Biological Sciences, Marshall University, Huntington, WV 25755. A Study of *Desmognathus welteri*, the Black Mountain salamander, in West Virginia.

The Black Mountain salamander, *Desmognathus welteri*, is listed as S2 (very rare and imperiled) by the WVDNR. Given the threat of extirpation, this species is in need of studies to facilitate a conservation effort. Streams in southern West Virginia were searched to determine presence or absence of *D. welteri*. A study of habitat partitioning and phenology was performed in two streams in Camp Creek State Park near Princeton, WV. Variables measured in relation to habitat partitioning included cover-object size and distance to water as well as intraspecific and interspecific spacing between individuals. Data recorded for the phenology study included water temperature and number of salamanders observed on each date during one hour visual encounter surveys. Three new sites were found for *D. welteri*, including the first-ever documented occurrence of this species in sympatry with *D. quadramaculatus*. *Desmognathus monticola* selected sites significantly farther ( $P < 0.0001$ ) from the water when sympatric with *Desmognathus welteri* (1 = 70 cm) as compared to when it was the dominant species (2 = 22 cm). Surface abundance reached zero when the water temperature cooled to 7° C in the fall. *D. welteri* is the dominant species when present in sympatry with *D. monticola* and therefore occupies the in-stream habitat, forcing *D. monticola* farther from the stream edge. *D. welteri* is now known

from 21 localities in the southern counties of West Virginia but faces an ever-increasing threat from habitat loss due to valley fills associated with mountaintop-removal coal mining.

**ZACHARY LOUGHMAN**, Natural Sciences and Mathematics, West Liberty State College, West Liberty, WV 26074. Conservation and natural history of West Virginia's Ohio River floodplain burrowing crayfishes.

Crayfishes currently are receiving a resurgence of attention in regards to their conservation globally. Endemism, habitat destruction, and invasive crayfish species all represent threats to North America's native crayfish stocks. In West Virginia, very little conservation-oriented work has been performed regarding crayfish populations since the survey efforts done 20 years ago. To remedy this, burrowing crayfish populations were surveyed along the Ohio River riparian corridor from Huntington, Cabell County, north to Chester, Hancock County, in order to determine the current conservation standing of primary and secondary burrowing crayfishes along the Ohio River floodplain. Minnow traps were placed in 63 sites during late winter and early spring, and burrows were excavated during the summer months. At each site habitat variables were recorded. Results indicate that *Cambarus (T.) thomai* is the dominant burrowing species for the floodplain, and *Fallicambaurus (C.) fodiens* and *Procambarus (O.) acutus* are in need of future conservation efforts. Sites with high species diversity consisted of full canopies in contiguous bottomland forests, reduced anthropogenic pressures, and the absence of invasive species.



## Geology/Engineering

**DAVID SMITH and CLARISSA MATHEW**, Institute for Environmental Studies, Shepherd University, Shepherdstown, WV 25443. Determining the suitability of Shepherd University's waste vegetable oil for conversion to biodiesel.

Waste vegetable oil (WVO) can be used to produce biodiesel, a fatty acid methyl ester (FAME). The suitability of WVO as a feedstock for biodiesel is primarily determined by two factors, the free fatty acid (FFA) content and the suspended water content. This study was performed to determine if there are significant differences between two Shepherd University WVO sources (the Dining Hall and the Ram's Den), and to determine if the FFA and water content are within acceptable biodiesel conversion ranges. A randomized complete block design was performed over a period of ten weeks to determine if either source or time impacted FFA or water content of the WVO. Each WVO source was sampled weekly, heated to determine water content, and titrated to measure pH (an indicator of FFA content). A total of 10 replications was performed per site.

Preliminary results indicated that the FFA content ranged from 0.68% to 0.81% for the Ram's Den and 0.39% to 0.76% for the Dining Hall. The presence of suspended water was not identified in either source.

Results for FFA and water content for both campus WVO sources were within acceptable limits (FFA < 1.62%) for use as a biodiesel feedstock. These findings indicate that the WVO produced at

Shepherd University (Shepherdstown, WV) dining facilities could be used for conversion to biodiesel, potentially offsetting a portion of the university's fossil fuel use. *Support for this research was provided by Shepherd University, Shepherdstown, WV 25443 and the National Aeronautical and Space Administration.*

**BRANDON SILVER, CLARISSA MATHEWS, and EDWARD SNYDER**, Institute for Environmental Studies, Shepherd University, Shepherdstown, WV 25443. Preliminary analysis of wind resources at Shepherd University's renewable energy demonstration site.

The Shepherd University Institute for Environmental Studies (Shepherdstown, WV) has purchased a small wind generator (1.8 kW Skystream 3.7) for installation at the Renewable Energy Demonstration Site, located near the Byrd Science Center. To determine the location that would provide the greatest wind resource, a study was undertaken to characterize wind resources at the site. The prevailing wind at the site was determined via a preliminary study in March 2006 (four replicates conducted per day for nine days). A randomized complete block design study measured wind speed at a fixed height and direction, to determine the average wind speed (m/s) in winter 2007. Wind speed measurements were taken twice a day, at 0800 and at 1200, for a 40-minute duration at 9.1 m (northwest orientation) at three locations, using a Kestrel 1000 hand-held anemometer. Maximum and average wind speeds were recorded in February and March (total 25 days). The results indicate that the prevailing winds arise from the



northwest direction at the site, and the maximum and average wind speeds recorded were 9.7 m/s and 1.96 m/s, respectively. Preliminary results indicate that sufficient wind resources exist at the Renewable Energy Demonstration Site to power only a small wind generator that initiates rotor movement at low wind speeds. Further research during summer months is required to create a complete wind speed frequency distribution for this site.

**EGEMEN OGRETIM** and **DONALD D. GRAY**, Civil & Environmental Engineering, West Virginia University, Morgantown, WV 26506. Computer simulation of carbon dioxide leakage from geologic sequestration sites.

Carbon dioxide emissions to the atmosphere from fossil fuel combustion will need to be significantly reduced if global warming is found to be occurring. Assuming global warming is occurring and if West Virginia's abundant coal reserves are to continue as a major source of electrical energy, it will probably be necessary to capture CO<sub>2</sub> from the combustion products of power plants and to store it for extended periods in geological formations. Research is essential to validate this strategy and to identify any significant negative consequences for potential future use.

To address these critical questions, major research programs are underway at West Virginia University and in many other institutions around the world. Among the complexities that make this a challenging area are the uncertain nature of the underground formations, the existence and importance of fracture zones, and the need to develop

technologies for detecting and mitigating any potential leakage of the sequestered CO<sub>2</sub>. Computer simulations are key components of this research due to the long time scales involved in the process. In this presentation, numerical simulations will be presented for deep land sequestration, shallow land sequestration, and sub-seafloor sequestration. The findings are (1) permeability can have much more impact on the migration of the injected gas than the injection depth; (2) plant roots can provide a highway of transmission for the sequestered gas; (3) sub-seafloor sequestration represents a permanent mode of sequestration since CO<sub>2</sub> is negatively buoyant at the given conditions. *This work was performed in support of the National Energy Technology Laboratory, U.S. Department of Energy. The conclusions are those of the authors.*

**DEWEY D. SANDERSON**, Geology, Marshall University, Huntington, WV 25755. Hydrology of a proposed mitigated wetland, Wayne County, West Virginia.

The West Virginia Division of Highways purchased a tract of land in Wayne County as a site for a mitigated wetland to replace expected loss of wetlands due to improvements on US 52 (Tolsia Highway). Five potential mitigation cells ranging from one to four acres occur on the floodplain of Mill Creek. The hydrology of the largest cell has been investigated. To create a viable wetland, there must be surface or near-surface water for a long enough period during the growing season to support wetland vegetation. A consultant's report proposes a combination of flooding and diversion of surface runoff to shallow, excavated, and



diked ponds. Monitoring wells and rainfall data were collected onsite. Assuming that flooding is a random and independent event, analysis of 46 years of daily precipitation indicates a probability of 36% of no floods/year and also 36% of one flood/year based upon a precipitation of 10 cm over a one or two day period. Fifteen monitoring wells were installed in Cell 1 and water levels were recorded over a period of five months, May – September, 2001. With flooding, water levels rose at a rate of about 1 meter in a week and declined the same amount in two weeks. The approximately 3 meters of alluvium was found to contain sand at a depth that allowed relatively rapid loss of near-surface water. Containment of water as originally proposed is problematic. Groundwater modeling suggests that an impermeable curtain may be a more effective and less costly way to create a viable mitigated wetland.

**DONALD D. GRAY**, Civil & Environmental Engineering, West Virginia University, Morgantown, WV 26506. The remarkable contributions of Leonhard Euler to fluid mechanics.

This year is the tricentennial of the birth of the Swiss mathematician Leonhard Euler (1707-1783). Euler (pronounced "oiler") is usually ranked with Archimedes, Newton, and Gauss in mathematical importance. Indisputably, he was the most prolific mathematician in history. He made fundamental contributions to many fields of pure and applied mathematics including algebra, trigonometry, calculus, numerical analysis, number theory, and topology. Even today, almost every college math course bears his imprint. His contributions to physics are no less

significant. He made fundamental discoveries in the mechanics of particles, rigid bodies, solids, and fluids. He was the first to formulate Newton's second law of motion as a differential equation, and he reduced Newton's three laws to two laws that apply directly to bodies of finite size. In fluid mechanics, the science of the motion of gases and liquids, he was the first person to "get a handle" on fluid motion by conceiving of the fluid particle, the streamline, and the Eulerian and "Lagrangian" viewpoints. He formulated the compressible continuity equation, the concept of the internal pressure field, and the partial differential equation for the conservation of momentum in an inviscid fluid (the Euler equation). He introduced the velocity potential, discovered "d'Alembert's" paradox, and derived the fundamental equation governing turbomachines. As Lagrange wrote, Euler "did not contribute to fluid mechanics but created it." He achieved all this in spite of personal tragedies such as the early deaths of eight of his thirteen children, the destruction of his house by fire, and his progressive blindness.

### Poster Sessions

#### **Biology/Biochemistry/Botany/Health Sciences**

**ASHLEY HOTSINPILLER, BONNIE FREEMAN, and MARK FLOOD**, Biology, Chemistry, and Geoscience, Fairmont State University, Fairmont, WV 26554, and **JEAN CHAPPELL, BOWIE KAHLE, GARY WRIGHT, TODD GREEN, PAULETTE WEHNER, MARK STUDNEY, and ELIZABETH MURRAY**, Marshall University, Huntington, WV 25755. Assessing the



correlation of homocysteine levels with dihydrofolate reductase (DHFR) mutations.

Homocysteine (Hcy) is a biologically important amino acid occupying a pivotal position in the metabolism of the essential amino acid, methionine. High blood levels of Hcy are known to be a risk factor for Coronary Artery Disease (CAD), which is one of the leading causes of death in the US. Elevations of plasma Hcy have various causes, including low levels of folic acid, vitamin B6, and vitamin B12, and genetically controlled variations in Hcy metabolic enzymes. Several single nucleotide polymorphisms (SNPs) were identified for genes involved in the metabolic pathway of Hcy and evaluated in an effort to assess the effect of genotype on plasma Hcy levels within an obese population. DNA was extracted from the patient population using a QIAamp DNA Blood Mini Kit, and plasma Hcy levels were quantified using an Abbott Diagnostics IMX autoanalyzer. Dihydrofolate reductase (DHFR) gene SNPs (RS1643638, RS10072026, RS1677693) were genotyped by amplification (PCR) followed by pyrosequencing of the polymorphic regions. The polymorphic rate for each SNP will be compared to the various population data available, and statistical correlations with plasma Hcy will be conducted. Further studies are expected for additional SNPs in Hcy metabolism candidate genes to assess whether elevated Hcy levels are caused by mutations and lead to increased risk for CAD. Once SNP mutations that correlate with plasma Hcy levels are found, then specific treatment regimes can be recommended. *This research was supported by a WV-INBRE*

*Grant (NIH grant RR16477) and Fairmont State University Student Research Program Grant.*

**IAN WILHELM and MARK FLOOD,** Biology, Chemistry, and Geoscience, Fairmont State University, Fairmont, WV 26554. Determining the effect of benzopyrene on frog embryonic survival and development.

Benzopyrene is a five-ringed polycyclic hydrocarbon that is a known carcinogen. It is the result of incomplete combustion. Benzopyrene is prevalent in today's environment due to increased burning of fossil fuels. It is also encountered daily in the form of second-hand smoke and in charbroiled foods. In its base form benzopyrene is a procarcinogen and poses little threat to organisms. However when ingested into the body it is metabolized into benzopyrenediol epoxide. This compound then can be inserted into DNA in place of the nucleobase guanine. The net result of the insertion is the distortion of the double-helix structure of DNA, which leads to mutations through improper copying of the DNA. Most organisms are able to conjugate benzopyrene into a non-reactive form and remove it from the body. However developing organisms without fully developed excretory systems could be more susceptible to benzopyrene's effects. The frog species *Rana pipiens* was selected as the species of choice to test the effects on developing embryos exposed to benzopyrene. They were allowed to grow for two weeks, with emergence levels taken at 72 hours, 96 hours, one week, and two weeks. Statistical analysis of the data indicated that the rate at which the frog embryos emerged and the total number of emerging



tadpoles were affected by the presence of benzopyrene. A more detailed investigation including a more thorough concentration series needs to be conducted to verify the results of this experiment.

*This research was supported by a Fairmont State University Student Research Program Grant.*

**MONICA LEE, ZACH HARTMAN, ERIC DANHART, and JARRETT AGUILAR**, Natural Sciences and Mathematics, West Liberty State College, West Liberty, WV 26074, and **PETER GANNETT**, Basic Pharmaceutical Science, West Virginia University, Morgantown, WV 26506. Molecular dynamics study of dapsone analogs bound to Cytochrome P450 2C9.

Cytochrome P450 (CYP) 2C9 is an enzyme that plays an important role in the metabolism of many drugs. It has the ability to bind more than one drug molecule at one time. Molecular modeling is being used to determine the interactions within the protein responsible for the increased rate of metabolism of flurbiprofen, a non-steroidal anti-inflammatory, when it is inside CYP2C9 with dapsone, a topical anti-bacterial drug. Hydrogen bonding of central amino acids with both drugs is being investigated in our lab, and several amino acids appear to have a large effect on determining the position of flurbiprofen and dapsone. Drugs that are nearly identical to dapsone were studied in an effort to understand the importance of the sulfur-oxygen portion and the amino portion of the molecule in positioning dapsone inside the enzyme. When the sulfur-oxygen bonds were changed, distance data suggested the sulfur-oxygen bonds may have a less

important role than once believed. When the amino side groups were changed, it was shown that amino acids surrounding the molecules played an important role in anchoring the molecules. In the future, these studies could help doctors make safer choices about drug-drug interactions when prescribing.

**STEPHANIE BOBLETT and SARAH DODSON**, Biology, Chemistry, and Geoscience, Fairmont State University, Fairmont, WV 26554. Effect of *in vitro* homocysteine exposure to bone marrow stromal cells.

Homocysteine is a sulfur-containing amino acid that is produced as a result of methionine metabolism. High levels of homocysteine, or hyperhomocysteinemia, have been associated with various diseases including cardiovascular disease, Alzheimer's disease, and diabetes. Both genetics and diet have been indicated as factors that influence whether an individual has higher-than-normal levels of circulating homocysteine. Because the effect of circulating homocysteine on bone marrow stromal cells has not been studied extensively, the objective of this study was to examine the direct effects of high homocysteine levels on these cultured cells. Adherent bone marrow cells (S10) were cultured using standard tissue culture techniques and directly exposed to 0.1, 0.5, 1.0, and 5.0 mM concentrations of D,L-homocysteine in serum-free culture medium. Control groups were cultured in medium alone. Cells were collected after 48 hrs of exposure. Since homocysteine has been reported to induce apoptosis in several cell types, DNA integrity was examined. DNA laddering, indicative of apoptosis, was not observed in these cells



following the exposure period. Additionally, cell morphology was not altered by direct exposure to homocysteine. Preliminary results from this study indicate that S10 bone marrow stromal cells do not undergo apoptosis following exposure to homocysteine. *This work was supported by the Office of Research at Fairmont State University through an Undergraduate Research Award, WV-INBRE (NIH grant RR16477), and WV-NASA Space grants.*

**STEPHANIE BOBLETT**, Biology, Chemistry, and Geoscience, Fairmont State University, Fairmont, WV 26554, **CHRISTOPHER GARTON**, Biology and Environmental Science, West Virginia Wesleyan College, Buckhannon, WV 26201, **CLAYTON CASSWELL**, **EWA LUKOMSKA**, and **SLAWOMIR LUKOMSKI**, Microbiology and Immunology, West Virginia University, Morgantown, WV 26506. Cloning of collagen-like proteins BclD and BclE of *Bacillus anthracis*.

*Bacillus anthracis* is a non-motile, spore-forming, gram-positive rod, which is the causative agent of anthrax. Previous studies have shown the presence of collagen-like proteins in the exosporium of *B. anthracis* spores. The first of these collagen-like proteins to be reported was named the *Bacillus* collagen-like protein of anthracis (BclA). A second collagen-like protein was also identified in the exosporium layer of *B. anthracis* spores and was given the designation BclB. Through the use of bioinformatics, we have identified three other genes in *B. anthracis* that encode collagen-like proteins. These proteins are presumably associated with the exosporium, similar to

BclA and BclB. In this study, two of the newly identified genes, BclD and BclE, were cloned and expressed in *E. coli*. Individual genes were amplified from *B. anthracis* (Sterne strain) genomic DNA by PCR, and the resulting DNA fragments were ligated into the *E. coli* expression vector pASK-IBA6. Ligated DNA was introduced by electroporation into *E. coli* strain BL21, and selection was carried out based on ampicillin resistance. Suspected clones were individually tested by PCR for the presence of the specific *bcl*-gene inserts, and positive colonies were then further confirmed by DNA sequence analysis. Following clone confirmation by DNA sequencing, small-scale protein induction, expression, and purification experiments were carried out in order to determine the ability of the *E. coli* expression system to produce recombinant Bcl proteins. *Research funded by grant P20 RR16477 from the National Center for Research and West Virginia IDeA Network for Biomedical Research Excellence.*

**CHRIS SEDLACEK**, **ALICE MAGRO**, and **ALBERT MAGRO**, Biology, Fairmont State University, Fairmont, WV 26554, and **CYNTHIA CUNNINGHAM**, Flow Cytometric Core Facility, West Virginia University, Morgantown, WV 26506. Pharmacologically induced apoptosis reduces cell surface determinants.

This investigation determined that CRL-2610 glioblastoma cells undergoing apoptosis manifested a decrease in cell adhesion molecules and other surface proteins that confer survival signals thereby providing a commitment by the cell to apoptosis.



Apoptosis was induced by MK886, a known FLAP and PPAR- $\alpha$  inhibitor, and staurosporine, a known inhibitor of protein kinases including protein kinase C (PKC). The detection and decrease of surface cluster determinants (CDs) were observed by flow cytometry using CD-specific mouse monoclonal antibodies followed by goat anti-mouse-IgG conjugated to phycoerythrin. We focused on CDs that interact with extracellular matrix proteins (i.e., integrins) and growth factors, along with class-1 histocompatibility markers (MHC-1). It was determined that there was an apoptotic-induced decrease of the growth factor receptors EGFR and IGFR1. The MHC-1 cell surface marker HLA-ABC was also severely reduced in the apoptotic cells. This is of interest, for abnormally low levels of MHC-1 surface determinants can be stimulatory to the NK cell surveillance system. The detected alpha and beta integrins all dropped dramatically. It was determined by real-time RT-PCR that the decrease in CDs was not due to a reduction in transcription. Inhibitors of the proteases calpain-1 and calpain-2 and proteasome inhibitors exacerbated the apoptotic decrease in the CDs. Conversely, inhibition of a number of metalloproteases reversed the apoptotic decrease in the CDs. Overall, the data indicate that there is a metalloprotease-mediated reduction in CDs in mid to late apoptosis in a manner that can reduce growth and survival signals and stimulate surveillance systems. *Funded by grant EPS 2006-15 and by grant P20 RRi6477 from the National Center for Research Resources awarded to the West Virginia IDeA Network for Biomedical Research Excellence.*

**CHRIS TAYLOR, AMANDA FRANCIS, and ROBERT KREISBERG**, Natural Sciences and Mathematics, West Liberty State College, West Liberty, WV 26074. Detection of genomic markers for cardiovascular disease: Single nucleotide polymorphisms in the LIPA gene.

Nearly 2,500 Americans die of cardiovascular disease (CVD) each day, an average of one death every 35 seconds. The American Heart Association estimates there were 71.3 million people in the U.S. living with one or more forms of CVD for the year 2003. Their medical care will cost 403.1 billion dollars to treat in 2006. West Virginia has one of the highest population percentages with CVD in the United States. While much of the problem can be accounted for by environmental risk factors such as obesity, smoking, diabetes, and lack of health care, there may also be genetic risk factors in West Virginia's population. DNA samples from 264 West Virginians were analyzed for Single Nucleotide Polymorphisms (SNPs) in the Lipase A (LIPA) gene using Assays-on-Demand™ designed by Applied Biosystems®. The LIPA gene has been implicated in the development of atherosclerosis in the population at large due to its role in regulating intracellular cholesterol flux. One of the four tagging SNPs previously genotyped for LIPA was found to be significantly correlated to CVD. Five SNPs for LIPA were genotyped. Genotypic frequencies for each analyzed gene were determined through fluorescent markers specific to the published single nucleotide polymorphism (SNP). *This research has been made possible by NIH Grant Number 2P20 RR016477, WVEPSCoR SURE, WVNASA,*



and West Liberty State College  
Foundation.

**MIA L. BROWN** and **MARCIA A. HARRISON**, Biological Sciences, Marshall University, Huntington, WV 25755. Ethylene regulation of gravitropic curvature in *Arabidopsis* stems.

Horizontal placement of a plant stem causes the redistribution of the hormone auxin and stimulates biosynthesis of the gaseous hormone ethylene. While auxin is the primary plant hormone engaged in gravitropic responses through stimulation of growth, ethylene plays a modulating role in regulating the kinetics of this process. Ethylene is produced by the oxidation of 1-aminocyclopropane-1-carboxylic acid (ACC). The regulation of ACC synthesis by ACC synthase (ACS) serves as the rate-controlling step in ethylene biosynthesis. ACS enzymes are encoded by a gene family whose expression is differentially regulated in various tissues. Our major research objective is to evaluate individual ACS forms in the regulation of gravitropism in *Arabidopsis* seedlings.

Potential changes in expression of the various ACS forms were evaluated in transgenic plants carrying ACS promoter-GUS fusions and by RT-PCR. Preliminary results do not reveal distinct changes in ACS expression in curving hypocotyls in wild-type plants. The role of each ACS member in hypocotyl growth and gravitropic curvature was determined by comparing wild-type responses with those of mutants that do not express specific ACS forms. Compared to wild-type seedlings, mutants with increased ethylene production showed significantly increased curvature by 7 hours after horizontal

placement. Other ACS mutants that did not exhibit increased ethylene production did not show changes in curvature kinetics. Overall, these results indicate a stimulatory role for ethylene in gravitropic curvature for *Arabidopsis* hypocotyls. *Supported by the USDA National Research Initiative Competitive Grants Program, the American Society of Gravitational and Space Biology, and the WV Space Grant Consortium.*

**MICHAEL CUNNINGHAM**, Science and Mathematics, Glenville State College, Glenville, WV 26351. Heat energy potential of an invasive tree as compared to high-energy firewood.

Tree-of-heaven, a fast growing tree with few economic uses, has become a problem invasive species in many parts of the United States. Meanwhile, alternatives to fossil fuels are in great demand. If tree-of-heaven could be burned as firewood, its spread could be slowed and more valuable trees could be saved for other uses. The purpose of the research was twofold: to determine whether more energy is stored in tree-of-heaven roots or branches and how the energy allocation compares to a known valuable firewood species. Four sample types were tested: white oak roots and branches along with tree-of-heaven roots and branches. Each group was tested four times. All samples were combusted using a plain jacket oxygen bomb calorimeter. The white oak root samples released the most energy, while the tree-of-heaven root samples released the least energy. The tree-of-heaven branches released less energy than the white oak root, but more than the branches of the white oak. The energy allocation of the two species is very different as shown by



the results. A fast growing short-lived invasive will place its energy into growth as opposed to the white oak which places the energy into the roots allowing it to survive for much longer than the tree-of-heaven. Further testing is needed to determine if burning tree-of-heaven is safe, but the initial results suggest the species has potential as firewood.

**SHAUNA OGLE**, Biological Sciences, Marshall University, Huntington, WV 25755. Marshall University Herbarium.

Herbaria are repositories for collections that document research in all areas of plant science. These are actual plants that scientists have set aside for voucher specimens for their work. Herbarium collections document the results of research in plant evolution, plant breeding, experimental plant physiology, karyotyping, rare and endangered species, and the flora and community structure of natural areas, including wetlands and other unique regions of the earth. Herbaria also house collections that document plant diseases and insect hosts, surveys of rain forest medicinal plants, and other areas of noteworthy research.

The herbarium collection is a necessary resource to teach courses in Plant Taxonomy, Economic Botany, Plant Morphology, Wetland Science, Medicinal Plants, and Dendrology.

**WESLEY CALDWELL** and **CARL WELLSTEAD**, Biology, WVU Institute of Technology, Montgomery, WV 26506. Additions to the Middle Pennsylvanian Ash Branch fossil vertebrate fauna.

Presented here are the current results of an on-going program of collection and preparation of vertebrate fossils from Ash

Branch, a Middle Pennsylvanian locality in the Kanawha Formation of southeastern Kanawha Co., WV. The productive stratum is a 15-cm thick bed of black shale overlying what is interpreted here to be a portion of the Eagle Coal. Collection of the specimens involves splitting blocks of shale, which generally destroys the actual fossils, but allows the production of high-fidelity, acid-etched molds (negatives) suitable for the casting of latex positives. Ash Branch continues to yield only disarticulated skeletal elements, specifically isolated teeth of a xenacanth (fresh water) shark (cf. *Orthacanthus*), *Ageleodus* (a presumed shark, relatively rare in North America and known only from teeth), and a lungfish (cf. *Sagenodus*), as well as isolated bones and scales of a coelacanth and the scales of a rhipidistian fish (cf. *Megalichthyes*). A rhombohedral element appears to be a fragmentary interclavicle, but its surface ornamentation suggests that it belonged to a rhipidistian fish rather than to a tetrapod. The most common elements at Ash Branch are sinuous, sharp teeth bearing fine striae and ranging in length from 2 mm to 10 mm. These latter teeth provide a mystery in that they resemble one-third sized versions of the tooth-whorl teeth of *Onychodus*, a crossopterygian fish otherwise known only from the Devonian Period.

**AMY SCHNEIDER**, **AMY HAMILTON**, and **THOMAS K. PAULEY**, Biological Sciences, Marshall University, Huntington, WV 25755. A continued study of the use of man-made ponds for amphibian breeding in fragmented forested areas.

Amphibian populations are declining



worldwide due to factors such as habitat degradation, fragmentation, and destruction. We conducted a study to explore the use of man-made ponds in a forested habitat by breeding amphibians, specifically *Rana sylvatica* and *Ambystoma maculatum*. The objective was to examine the movement of these animals after leaving the ponds and the survival and movement of juveniles. Nine ponds were constructed in December 2002 in the MeadWestvaco Wildlife Ecosystem Research Forest (MWERF) in Randolph County, West Virginia. Three fragmentation treatments (clear-cut to one hectare surrounding a pond, clear-cut to one hectare surrounding a pond with forested corridor, and no treatment) were cut in all compartments in August 2006. Drift fences with funnel traps surrounded each pond to monitor amphibian movements. All amphibians captured were batch marked with pond-specific tags using visible implant elastomers (VIE). No amphibians bred in the ponds in 2003, therefore the ponds were stocked with *R. sylvatica* and *A. maculatum* egg masses from nearby permanent pools. Thirty *R. sylvatica* juveniles and three *A. maculatum* juveniles emigrated from the ponds in 2005. Only five *R. sylvatica* juveniles and no *A. maculatum* juveniles had emigrated from the ponds in 2006. Five *R. sylvatica* adults were fitted with radio transmitters and tracked for ~35 days to determine movements after leaving the breeding ponds. *R. clamitans melanota*, *Notophthalmus v. viridescens*, *R. catesbeiana*, and adult *R. sylvatica* populated the ponds after the breeding season. Monitoring will be continued in successive seasons and post-cut data will be compared.

**CHRISTOPHER GUERRIERO, KELLY WEIXEL, LAUREN KESTER, JOHN JOHNSON, and ORA WEISZ,** Cell Biology and Physiology, University of Pittsburgh, Pittsburgh, PA 15260. Multiple roles for PI5-kinase in regulating membrane trafficking.

Polarized epithelia are comprised of highly differentiated cells that function to maintain a protective barrier and enable vectorial ion and solute transport. The function of these cells requires that they maintain differentiated plasma membrane domains, termed apical and basolateral, which have distinct protein and lipid compositions. This asymmetry is maintained by precise delivery of newly synthesized and recycled proteins to their appropriate site of function. We are interested in understanding how delivery to the apical cell surface is regulated by phosphatidylinositol (PI) metabolism. PIs are inner leaflet lipids that can be phosphorylated at various positions on their inositol ring to generate lipid species that mediate signaling, cytoskeleton rearrangements, and membrane trafficking. Phosphatidylinositol-4,5-bisphosphate (PIP<sub>2</sub>) is one such lipid whose synthesis is catalyzed by the enzyme phosphatidylinositol-4-phosphate-5-kinase (PI5K). Because PI5K is localized primarily at the apical surface of polarized epithelial cells, we hypothesized that localized production of PIP<sub>2</sub> may play a selective role in regulating membrane traffic to and from this cell surface domain. To test this, we overexpressed wild-type and catalytically inactive versions of PI5K in polarized cells and examined the consequences on apical biosynthetic delivery and endocytosis.



Much to our surprise, expression of even catalytically inactive mutants of PI5K stimulated both PIP<sub>2</sub> production and apical biosynthetic delivery. By contrast, PI5K mutants that did not localize to the apical membrane did not affect endocytosis of an apical channel protein. Our data suggest that localized synthesis of PIP<sub>2</sub> at the apical surface is required to support apical membrane traffic.

**ELIZABETH V. FET, JON SCOTT,**  
and **DAN EVANS**, Biological Sciences,  
Marshall University, Huntington, WV  
25755. Biological activity and  
ethnomedicinal uses of the family  
Cyperaceae (sedge).

The Cyperaceae (sedge) is a large and varied family with 70 to 105 genera and 4,000 to 5,000 species. This study looked at literature entries compiled by NAPRALERT, a pharmacological database maintained by the University of Illinois (Chicago) College of Pharmacy. The database shows 167 references to biological activities of 57 species within 10 genera of the family Cyperaceae. The majority of records were for the genus *Cyperus* with 143 (out of 167) records, or 85%. *Cyperus rotundus*, commonly used as an insect repellent, is cited most frequently in scientific studies with 65 records, or 46%. Other species were found to be antibacterial, antifungal, as well as cellular inhibitors, important in cancer research. Other frequently cited genera are *Bolboschoenus* (4%) and *Carex* (5%). Seven genera—*Baumea* (n=1), *Cladium* (n=1), *Kyllinga* (n=1), *Lepidosperma* (n=3), *Mariscus* (n=1), *Scirpus* (n=2), and *Scleria* (n=1)—had less than five records (6%). Thirty-eight species, 42%, had less than five records.

Ethnomedicinal use of *Cyperus articulatus* and *C. prolixus* has also been recorded among the Shuar and Achuar Indians of Southeastern Ecuador. These indigenous peoples have a variety of uses for these two species including use as a vomitory, for stomach pain, as a contraceptive, and as a vitamin for children.

**EMMY JOHNSON, AMY  
SCHNEIDER,** and **THOMAS K.  
PAULEY**, Biological Sciences, Marshall  
University, Huntington, WV 25755.  
Response of forest salamanders to  
diflubenzuron treatments as a method to  
control gypsy moths.

The purpose of this study was to determine if application of the insecticide diflubenzuron negatively impacts forest salamanders, *Plethodon cinereus*, *Desmognathus ochrophaeus*, and *D. monticola*. Potential effects were observed by examining the number and volume of mature follicles, tail fat percentage, and stomach contents. Four watersheds, 2 treatment and 2 controls, within the Fernow Experimental Forest, Tucker County, West Virginia were used as experimental sites between 1989 and 1993. Diflubenzuron was applied to 2 watersheds in 1992. Three years of pretreatment data and 2 years of post-treatment data were collected. The diet of *D. monticola* shifted from soft-bodied prey to hard-bodied prey after treatment, but not in untreated watersheds. The diet for *P. cinereus* and *D. ochrophaeus* also shifted, but in both untreated and treated watersheds. There was a significant increase in carcass fat and total weight for both terrestrial species after treatment in both treated and untreated watersheds. There was no significant difference in tail



fat, carcass fat, or total fat of all species between the watersheds. The volume and number of follicles and snout-vent length also had no significant difference between the watersheds. Our study revealed that diflubenzuron had no apparent effect on terrestrial or stream salamanders. A possible problem was that the length of the study was not adequate to observe the effects of diflubenzuron on future generations of salamander.

**ERIC H. DIEFENBACHER,**  
**KATHRYN R. PAWLIK,** and  
**THOMAS K. PAULEY,** Biological  
Sciences, Marshall University,  
Huntington, WV 25755. Morphological  
examination of green salamander (*Aneides  
aeneus*) toe discs.

Organisms such as insects, geckos, and frogs exhibit amazing adhesive properties on their limbs. It was not until recently that biologists started to unravel the structures and mechanisms behind these unusual adaptations. Insects use a combination of flexible cuticles, arolia, and pretarsal claws to cling to objects; frogs use mucous glands to form wet adhesion; and geckos employ scansors with rows of setae containing spatulae that create van der Waals forces to adhere to various surfaces. Virtually no studies have been done on possible adhesive structures of arboreal salamanders. In this study, we examined the distal digital toe disc structures of the arboreal green salamander, *Aneides aeneus*, which are known to climb vertical surfaces such as trees and rock outcrops. While toe discs are hypothesized to be an adaptation to a climbing lifestyle, no studies have been done to describe this structure or the possible adhesive mechanisms that may

accompany this behavior. Preliminary scanning electron micrographs confirm the presence of a suction cup-like structure on the distal tip of each digit. This structure appears to contain a hard yet flexible outer "ring," lending to the disc shape of the toe, with a soft center covered in dermal tissue. Internal anatomy of observed structures was examined using histology employing hematoxylin and eosin stains. Further investigation into these structures will help us gain a better understanding of its morphology and how this species exploits certain habitats.

**JASJEET BHULLAR** and **VINCENT  
SOLLARS,** Biochemistry and  
Microbiology, Marshall University,  
Huntington, WV 25755. Epigenetic  
regulation of Wnt pathway in  
hematopoietic stem cells via Hsp 90.

Among bone marrow and lymphatic cancers, acute myelogenous leukemia (AML) is considered the most deadly. Hsp-90 has recently been found to be a major indicator of poor prognosis in AML and other cancers. It has been seen that Hsp-83 (the Hsp-90 homolog in *Drosophila*) acts through epigenetic mechanism in *Drosophila*. Our primary question is: "Are the interactions of Hsp-83 with epigenetics that we found in the *Drosophila* model conserved in humans". The role of the Wnt pathway in the normal maintenance of hematopoietic stem cells has been established. However, the activation of the Wnt pathway can lead to cancer through the stabilization of its downstream target protein,  $\beta$ -catenin. We have shown that Hsp-90 regulates the Wnt pathway through an epigenetic mechanism in *Drosophila*. Since the components of the Wnt pathway are conserved in



vertebrates, it is thought that Hsp-90 will regulate the Wnt pathway epigenetically in humans as well. We are using the EML cell line in vitro to ascertain the  $\beta$ -catenin expression by flow cytometry. Increased  $\beta$ -catenin accumulation has been found in EML cells as compared to a variety of L Cell types (L Cells, L Wnt 3A and L Wnt 5A). These results suggest that the Wnt pathway may be up-regulated in EML cells. Further studies to see the involvement of Hsp-90 in the regulation of the Wnt pathway using Hsp-90 inhibitors can lead to effective therapies targeting AML.

**JENNIFER M. NAPPER, VINCENT E. SOLLARS, and HARSH PRATAP,** Biochemistry and Microbiology, Marshall University, Huntington, WV 25755. EML cells as a model to determine if Hsp90 is an epigenetic enabler in leukemia.

Acute myelogenous leukemia (AML) is the deadliest among the lymphatic and bone marrow cancers. It is characterized by an accumulation of undifferentiated and functionless myeloid precursors in the bone marrow and blood. Patients diagnosed with AML have a five-year survival rate of less than 20%. New treatment strategies are needed to increase patient survivability. Heat shock protein 90 (Hsp90) inhibitors such as 17-AAG, an analog of geldanamycin (GM), are currently undergoing phase I and II clinical trials for various cancers. Previous studies in *Drosophila* have shown that inhibition of Hsp90 by GM produced a transdifferentiation event in which eye tissue developed into an outgrowth. The outgrowth persisted after several generations in the absence of GM, indicating the occurrence of an epigenetic

event.

Our current studies suggest that Hsp90 plays a similar role in mammalian EML cells. These cells, which are stem cell factor (SCF) dependent, can be induced to differentiate into any of the mature cells of the blood. By treating these cells with GM prior to differentiation, we have seen a dose-dependent survival of the cells after selective conditions are imposed. This suggests that Hsp90-inhibition is causing an epigenetic modulation that makes the treated cells better suited to survive. Studying the role of Hsp90 in myeloid cell differentiation will provide insight into normal blood development as well as possible treatment strategies for AML.

**MELINDA VARNEY, VINCENT SOLLARS, and HARSH PRATAP,** Biochemistry and Microbiology, Marshall University, Huntington, WV 25755. Comparing the myeloid progenitor cell compartment among inbred strains of mice to identify possible leukemia susceptibility genes.

Acute myelogenous leukemia (AML) is a rapidly progressing cancer of the blood and lymph. It is characterized by the overproduction of immature cells of the myeloid lineage, which are classified as myeloid progenitor cells. While the importance of stem cells in initiation of cancer is the prevalent view, evidence is accumulating indicating that progression to the malignant state involves acquiring progenitor cell characteristics. Our objective is to identify genes that are involved in the regulation of progenitor cell frequency, thus identifying possible oncogenes and tumor suppressor genes relevant to leukemia. Our method is to compare the phenotypic differences in the



size of the myeloid progenitor cell compartment among several strains of inbred mice. These phenotypic differences are studied using hematopoietic progenitor cell assays, more specifically, colony-forming cell assays. Using this technique, progenitor cell types can be identified based on the morphology of the colonies produced. Phenotypic differences found will be compared to genotypic differences among the mouse strains using *in silico* genetic mapping. This will allow for the determination of chromosomal regions containing genes that play a role in leukemia susceptibility by regulating the size of the myeloid progenitor cell compartment. Our results thus far show phenotypic differences in the size of the myeloid progenitor cell compartment among five mouse strains. Obtaining further data may lead to the identification of oncogenes and tumor suppressor genes relevant to leukemia. Future studies would include determining factors involved in regulating these genes in hopes of leading to more effective treatments for AML.

**MICHAEL BREWER, MATTHEW GRAHAM, and VICTOR FET,** Biological Sciences, Marshall University, Huntington, WV 25755, and **MICHAEL SOLEGLAD,** Borrego Springs CA. Scorpion serrula: an enigmatic structure under SEM.

The serrula, a small comb-like structure on the ventral aspect of cheliceral movable fingers in scorpions, has often been overlooked or ignored. The inconsistency in reporting the structure is likely based on several factors (or combination thereof): (a) serrula tines can quite often be broken off partially or completely, especially in

adults; (b) serrulae can be vestigial and hardly visible under a dissection microscope; and (c) serrulae can be obscured by long, dense setae. To elucidate the serrula, we provide detailed descriptions and SEM images illustrating its various manifestations. Six families are currently known to possess serrulae (Chactidae, Euscorpidae, Iuridae, Pseudochactidae, Superstitioniidae, and Vaejovidae). Here we pay particular attention to the North American family Vaejovidae and establish the character for four vaejovid genera: *Paravaejovis*, *Paruroctonus*, *Smeringurus*, and *Vejovoidus*. A brief systematic overview of this structure in extant scorpions is also presented.

**NOAH MCCOARD, KERIE CORLEY, and THOMAS K. PAULEY,** Biological Sciences, Marshall University, Huntington, WV 25755. Effects of water pH and ultraviolet radiation on the reproductive success of wood frogs (*Rana sylvatica*) in high elevations of West Virginia.

Wood frogs (*Rana sylvatica*) were monitored in a high-elevation wetland in West Virginia to determine potential effects of pH and UV radiation. The study site located at 3120 ft includes a large beaver pond with large standing spruce trees and sphagnum moss. Wood frogs were the predominant species of amphibian in the study area. Hundreds of wood frogs migrated to the wetland, mated, and deposited eggs; however, during two years of observation from 1995 to 1996 no reproductive success was observed. Wood frogs have been found to have a high tolerance toward acidity, however pH values of 3.5 and lower are



lethal, and values of 3.5 to 3.9 result in a 50% reproductive success rate. According to historical records at our study site, there has been a drop in pH, however this drop should not be lethal to wood frogs. The average pH from 1946-1951 was 4.75; from 1957-1985, 4.12; and the average pH from 1995 and 1996 was 4.05. Other factors, such as ultraviolet radiation, may have contributed to the lack of reproductive success. We hypothesize that UV radiation and low pH in the high elevations of West Virginia alone are not lethal but when combined can result in mortality.

**AMANDA B. STEWART, JEREMY CONNOLLY, BETH GREGORY, ELIZABETH RANDOLPH, and DUSTIN WAGONER**, Science and Mathematics, Glenville State College, Glenville, WV 26351. Use of polymorphic markers developed in bluegill (*Lepomis macrochirus*) for genetic analysis of green sunfish (*Lepomis cyanellus*).

The use of genetic analysis tools can enhance development of *Lepomis* crosses with improved growth rate. Using previously designed primers for identification of *Lepomis macrochirus* microsatellite sequences, analysis of PCR products was performed to determine if these primers were of use in other *Lepomis* species. Gel electrophoresis of PCR products was performed to determine success of the reaction. Primers Lma 10, Lma 21, and Lma 26 successfully amplified DNA from bluegill, green sunfish, redear sunfish, Georgia Giant hybrids, and second-generation Georgia Giant hybrids. Primer Lma 25 successfully amplified DNA from bluegill, Georgia Giant hybrids, and second-

generation Georgia Giant hybrids. Primer Lma 20 successfully amplified Georgia Giant hybrids, second-generation Georgia Giant hybrids, and redear sunfish. All primers successfully amplified DNA in each *Lepomis* examined, with the exception of Lma 20, which failed to amplify in Bluegill, suggesting absence of this allele in the individuals examined. Primers Lma 10, 21, and 26 successfully amplified green sunfish DNA, indicating that these primers will be of use in further genetic analysis of this species.

**JAMES RENTCH and JAMES ANDERSON**, Division of Forestry, West Virginia University, Morgantown, WV 26506. A floristic quality index for West Virginia wetland and riparian plant communities.

To ensure long-term conservation of the state's natural biodiversity and to set conservation priorities, land managers often require a practical method of identifying, comparing, and ranking the value of natural areas. One technique of assessing the conservation value of a site is the Floristic Quality Index (FQI). First developed in the Midwest, this method relies on the assignment of a Coefficient of Conservatism (C value) ranging from 0 to 10 to each plant taxon based on its tolerance to disturbance and habitat degradation, as well as its fidelity to specific habitats. Taxa with low C values are very tolerant of site degradation and show little fidelity to any specific community or habitat. Taxa with high C values are much less tolerant of degradation and are generally found only



in a small number of high quality habitats. The aggregate conservatism of all native plant species found on a site is then used to calculate a FQI.

Here we report efforts to extend the FQI methodology to West Virginia. We compiled a list of wetland and riparian plant taxa in the state, along with their origin. We then enlisted the contributions of eleven botanists in WV to assign C values to 1,745 plant taxa, using guidelines modeled after efforts in other states. Altogether, contributors submitted over 24,000 C values. These were averaged and reconsidered for each taxon until: a) each taxon had at least two C values, b) the range of values for a taxon was 3 or less, and c) the standard deviation was less than the mean. Only 38 taxa failed to satisfy these conditions and were deleted from the final list. The entire native flora had a mean C value of  $6.1 \pm 1.9$ . A FQI can be calculated by averaging C values for each community (native species only) and multiplying by the square root of the number of native species present. We recommend application of this technique where the objective is to (1) identify natural areas with high conservation value, (2) compare the floristic quality among similar community types at different locations, (3) monitor trends in floristic quality over time, and (4) assess restoration efforts.

**LISA M. CASTLE** and **BIOLOGY 305 BOTANY STUDENTS**, Science and Mathematics, Glenville State College, Glenville, WV 26351. How much to harvest? Students assess plants for population vulnerability.

Increasing demand for wild-harvested plant products has led to increasing

concerns about the over-harvesting of medicinal plants. Few tools exist, however, to help herbalists, land managers, and herbal products consumers recognize the plants most at risk. The United Plant Savers identified a need for a means of ranking wild-harvested plants found in the US and Canada. The non-profit organization created a tool for ranking species that is transparent, adaptable to new information, expandable to include more plants, simple to use, and based on objective criteria. Because plants can be vulnerable for different reasons, the assessment tool uses questions that address life history, effects of harvest, abundance and range, habitat vulnerability, and demand in separate subsections. Initial scores suggest that the tool is working both qualitatively and mathematically, but the low total number of plants scored to date has limited the usefulness of the tool. As part of a botany course, Glenville State College students selected plant species to investigate and score using the tool. Through this on-going project, students have gained botanical knowledge and information retrieval and sorting skills while contributing data essential for setting plant conservation priorities.

**PAUL J. HARMON**, WV DNR Natural Heritage Program, Charleston, WV 25305, **DONNA FORD-WERTZ**, Biology Dept, West Virginia University, Morgantown, WV 26506, and **BILL GRAFTON**, WVU Cooperative Extension Service, Morgantown, WV 26506. Checklist and Atlas of the Vascular Flora of West Virginia.

This book (381 p) updates vascular plant nomenclature and county distribution data recorded in the state manual, Flora of



West Virginia (Strausbaugh & Core, 1977).

Checklists display the currently accepted names linked to those used in Strausbaugh & Core (1977). Nomenclature primarily follows Kartesz (1999). Over 93,300 herbarium vouchers entered into a database were used to compile a table of the most recent record per county per taxon. A dot-map atlas was subsequently generated reflecting the known distribution of taxa.

There are 2503 taxa of vascular plants (including subspecies or varieties), 2349 species recognized in 752 genera and 151 families. Three-fourths of the flora is native to West Virginia, while the remainder is adventive, introduced, or exotic. Twenty-four taxa were removed from the state vascular flora list.

The number documented per county varies from 307 (Logan Co.) to 1533 (Monongalia Co.); four taxa have been documented from all 55 counties. Specimens were collected from 1872 (*Heuchera pubescens*, Jefferson County) through 2005, most of them in the 1930s and 1990s.

Distribution patterns reflect differences in county size, collecting frequency, accessibility, plus actual levels of biodiversity. Over 5500 specimen records of rare plant elements are now being incorporated into the Natural Heritage data system. Seven percent of the documented flora is exotic or introduced, many of those invasive. Continued data entry and geocoding are needed.

*This project was funded through six WV DNR research grants and by four awards from the WVU Public Service program and the American Women in Science.*

ZINA-ANN CARDOZO, ANNE

SILVIS, and KELLEY K.

KININGHAM, Pharmacology, Physiology and Toxicology, Marshall University, Huntington, WV 25755. All-*trans*-retenoic acid (ATRA) induces resistance to cisplatin (CDDP) in the SK-N-SH neuroblastoma cell line: A potential mechanism through modulation of BclXL and Bax.

Neuroblastoma is an extracranial solid tumor of the nervous system that occurs predominantly in infants and children younger than ten years of age. It is one of the most common solid tumors of early childhood, with recurrence presenting a challenge mainly due to a decreased responsiveness of the tumors to anti-cancer agents such as CDDP. Vitamin A and its derivatives, also known as retinoids, are found to be preventive against cancer and induce differentiation in some cell lines. They have been successfully used in treating acute promyelocytic leukemia and are now being tested clinically for the treatment of neuroblastoma. One of the main impediments to retinoid therapy is the development of chemoresistance. In the present study we investigated the effects of ATRA and CDDP on the SK-N-SH human neuroblastoma cell line obtained from the bone marrow tumor of a four-year-old girl. Cells were treated with ATRA (10  $\mu$ M) for 24 h prior to treatment with CDDP (10 or 25  $\mu$ M). In order to investigate the mechanism of retinoid-mediated resistance, we measured caspase-3 activity and analyzed levels of proteins involved in the apoptotic process. ATRA was observed to reduce CDDP-induced caspase-3 activity. Furthermore, ATRA attenuated caspase-3 proteolysis caused by CDDP treatment. ATRA also decreased



Bcl-2 levels in the cells, whereas the retinoid increased levels of the anti-apoptotic MnSOD. In addition, ATRA was able to enhance BclXL levels in CDDP-treated SK-N-SH cells, which may contribute, at least in part, to chemoresistance. Finally, ATRA pretreatment attenuated the pro-apoptotic Bax protein increase upon CDDP treatment. Taken together these results suggest that an increase in the anti-apoptotic proteins, along with a reduction in the pro-apoptotic proteins, may contribute to ATRA-mediated drug resistance. (*Supported by NIH grant IP20RR020180*).

### Chemistry

**BRENTON DRAKE, SARAH RAMEZAN, and KEVIN L. EVANS,** Science and Mathematics, Glenville State College, Glenville, WV 26351. Synthesis of alkenyl bromides and alkyl dibromides.

Alkyl and alkenyl halides are frequently needed as key intermediates in a variety of multi-step organic syntheses. The synthesis of alkyl and alkenyl halides can be accomplished with the addition of anhydrous hydrohalic acid to alkenes or alkynes, respectively. The required hydrohalic acid can be generated in situ from a variety of inorganic and organic acid halides using surface-mediated reactions.

The in situ generation of hydrobromic acid using surface-mediated hydrolysis of phosphorous tribromide on silica gel was reported as a method to convert alkenes to alkyl bromides. Our research has expanded this method to convert terminal and internal alkynes into either alkenyl bromides or alkyl dibromides. The

regiochemistry of the terminal alkynes and stereochemistry of internal alkynes will be presented with respect to the addition of hydrobromic acid.

**MATT HIENER, BONNIE FREEMAN, and MARK FLOOD,** Biology, Chemistry, and Geoscience, Fairmont State University, Fairmont, WV 26554, **JEAN CHAPPELL, BOWIE KAHLE, GARY WRIGHT, TODD GREEN, PAULETTE WEHNER, MARK STUDNEY, and ELIZABETH MURRAY,** Marshall University, Huntington, WV 25755. Determining the effect of cystathionase (CYS) gene mutations on plasma homocysteine levels.

Homocysteine (Hcy) is a biologically important amino acid occupying a pivotal position in the metabolism of the essential amino acid, methionine. High blood levels of Hcy are known to be a risk factor for coronary artery disease, which is one of the leading causes of death in the US. Elevations of plasma Hcy have various causes, including low levels of folic acid, vitamins B6, and B12, and genetically controlled variations in Hcy metabolic enzymes. Several single nucleotide polymorphisms (SNPs) were identified for genes involved in the metabolic pathway of Hcy and evaluated in an effort to assess the effect of genotype on plasma Hcy levels within an obese population. DNA was extracted from the patient population using a QIAamp DNA Blood Mini Kit, and plasma Hcy levels were quantified using an Abbott Diagnostics IMX autoanalyzer. Several cystathionase (CYS) gene SNPs were determined by amplification (PCR) followed by pyrosequencing of the polymorphic region. The polymorphic rate for each



SNP will be compared to the various population data available, and statistical correlations with plasma Hcy will be conducted. Further studies are expected for additional SNPs in Hcy metabolism candidate genes to assess whether elevated Hcy levels are caused by mutations and lead to increased risk for CAD. Once SNP mutations that correlate with plasma Hcy levels are found, then specific treatment regimes can be recommended. *This research was supported by a WV-INBRE Grant (NIH grant RR16477) and Fairmont State University Student Research Program Grant.*

### Computer Science

**JONATHAN P. OKEEFE, WEIDONG LIAO, and OSMAN GUZIDE**, Computer Science, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443. Providing GCD computation service over the internet/web using grid computing.

As simple as it is, the greatest common divisor (GCD) computation is a very basic component for many scientific computations. As a result, it is important to make GCD computations as fast and readily available as possible. In this research project, our student group has implemented a Java-based GCD module using Euclid's algorithm and its binary algorithm version. Experiments have been made to run our Java module over the grid computing platform Global Grid Exchange (G2EX), which is based in West Virginia. Performance has been evaluated for both Euclid's algorithm and binary algorithm. Experiments have also been made to use our GCD services in cryptography and network security. We have also worked

on encapsulating this service through XML and Web services infrastructure. The goal is to provide effective, efficient, and readily available GCD computing services over the Internet and Web for grid computations and basic GCD computation needs.

### Geology

**ANDREW J. LINO**, Geology, Marshall University, Huntington, WV 25755. Precipitation trends in the state of West Virginia.

A study was conducted to investigate possible trends in precipitation across West Virginia reflecting climate change. Have average yearly precipitation and its year-to-year variation changed over the past half century? This study was originally initiated in response to the state legislature's mandate to study the state's water resources and its impact on all facets of life and economy of the state.

Monthly precipitation amounts were collected from 104 weather stations in and around the state from NOAA's National Climatic Data Center online data archive. Daily precipitation data had to have records for 50 previous years' precipitation. The data were compiled in Excel and tested for trends using linear regression.

Results suggest that the average annual precipitation in West Virginia has been increasing over the past 50 years. It has increased at 80% of the weather stations used in this study. The average annual precipitation for the last 50 years is 42.2 inches. It has increased statewide an average of 3 inches in that period of time. The average variation from year to year is about 7 inches. The rate of change



indicates that the 7-inch variation has remained fairly constant from year to year with an average change of 0.02 inches per year.

### Psychology

**DAVID BOWDEN, DEBRA HULL, JERRY NOLAN, and KATE GARLICK**, Psychology, Bethany College, Bethany, WV 26032. The impact of professors' gender roles on student evaluations.

Undergraduate college students read six descriptions of hypothetical male and female college professors, described with feminine, masculine, or androgynous characteristics. The descriptions were made up of traits drawn from the Bem Sex Role Inventory. Twenty descriptors were used for the masculine, feminine, and androgynous professors. The order in which the six conditions were presented varied randomly, according to a Latin Squares design. After reading the descriptions, participants rated the hypothetical professors on 12 statements related to the probable teaching effectiveness of the professor, using a 5-point Likert scale. Results were analyzed using a 2 (participant sex) x 2 (professor sex) x 2 (professor gender role) x 12 (teaching effectiveness statements) mixed factorial design analysis of variance. Overall, participants rated the androgynous professors more positively than either the masculine or feminine ones. However, masculine professors were rated as being the most competent in their discipline and the most intelligent. Feminine professors were rated as the warmest and most liked by students. In addition, students thought they would get

the highest grade from a feminine professor. Male college students rated masculine professors significantly lower than androgynous and feminine professors. Female college students rated both masculine and feminine professors significantly lower than androgynous professors.

**JOHN H. HULL, SUZANNE MARTISS, and LAUREN LACEY**, Psychology, Bethany College, Bethany, WV 26032. Body images in men's magazines.

Fifteen female and 12 male college student research participants looked at a total of 71 pictures of men taken from October, 2006 editions of two men's magazines targeting heterosexual men (Gentlemen's Quarterly, Men's Health), and two men's magazines targeting gay men (Freshmen, Genre). Participants rated each picture separately for obesity and muscularity by comparing each picture to a set of line drawings of males ranging from 1 = very thin to 9 = very obese, then to a set of line drawings of males ranging from 1 = very thin to 9 = very muscular. Some of the pictures from each magazine were from articles, some were from advertisements. Overall, repeated measured ANOVAs showed that mean muscularity ratings of men pictured in magazines targeting gay men were significantly higher in both articles ( $M = 5.75$ ) and advertisements ( $M = 5.69$ ) than were mean muscularity ratings of men pictured in magazines targeting heterosexual men (article  $M = 4.72$ ; advertisement  $M = 4.66$ ). There were no significant differences between magazine types for obesity ratings either for articles or for advertisements. Finally, women and men participants did not differ



significantly in their mean ratings for either magazine type, for both advertisements and articles.

**JOHN H. HULL** and **SUZANNE M. MARTISS**, Psychology, Bethany College, Bethany, WV 26032. The first 50 years: Body images in Sports Illustrated from 1954-2004.

Four trained assistants looked at full-body pictures of athletes appearing in randomly selected March, June, September, and December issues of Sports Illustrated every five years from 1954 to 2004. Since relatively few full-body pictures of female athletes appeared, only pictures of male athletes were rated. Assistants rated each picture separately for obesity and muscularity by comparing each picture to a set of line drawings of males ranging from 1 = very thin to 9 = very obese, then to a set of line drawings of males ranging from 1 = very thin to 9 = very muscular. Muscularity ratings increased significantly across the 11 years sampled from 1954-2004 (1954  $M = 4.28$ , 2004  $M = 5.89$ ), while obesity ratings did not change significantly (1954  $M = 3.48$ , 2004  $M = 3.61$ ). Further, muscularity ratings were highest for the months of September and December, reflecting the kinds of athletes generally pictured during those months (e.g., football players), as opposed to those generally pictured in March and June (e.g., basketball players, baseball players). Sources for the significant increase in muscularity of men pictured across the 50-year time span, including intensive training and steroid use, are discussed.

**MARK AFFELTRANGER**, **TYLER KOWCHECK**, **STEPHANIE RIKER**, and **ANDREW LANCE**, Psychology,

Bethany College, Bethany, WV 26032. Behavioral changes evident three weeks after immunization in the rat.

Several researchers have investigated how a challenge to the immune system can affect behavior. However, these researchers only examined behavioral changes during the peak immune response, which is typically a few days after immunization with an antigen. We were interested in examining any behavioral changes after the peak immune response, so we assessed a change in rat activity three weeks after immunization. We randomly assigned 50 rats to receive either an intraperitoneal injection with saline or an injection with ovalbumin. Three weeks later, each rat ran in an activity wheel that tabulated number of rotations during a two-hour period. The ovalbumin-injected animals demonstrated significantly less activity than the saline controls. We failed to find a gender effect or gender-by-ovalbumin interaction. The longer-term (beyond immune peak) behavior changes may have important implications, including behavioral changes that could result from childhood immunizations. Possible physiological mechanisms are also discussed.

**MARK AFFELTRANGER**, **BRENDAN CYPHER**, and **TYLER KOWCHECK**, Psychology, Bethany College, Bethany, WV 26032. Adaptation and sensitization to pulsed presentations of oral piperine or zingerone: Analysis with a mathematical model.

Presentations of oral irritants (piperine from black pepper and zingerone from ginger) produce a burning sensation that shows a distinct profile over time. Some irritants like piperine produce a tonic (slow rise and plateau) burn and others



like zingerone produce a phasic (fast rise, peak, and adapting) burn. We implemented a mathematical model based upon these two burn profiles. This model predicted how the burn was affected by pulsed (two 10-minute pulses separated by a 10-minute rest interval) presentations of these two irritants. College students were randomly assigned to receive pulsed piperine or zingerone and they rated the burning sensation every 3 minutes with magnitude estimates. Consistent with the predictions of the model, subjects given pulsed zingerone (phasic) experienced the burn of the second pulse as weaker than that of the first pulse since the adaptation to the first pulse subtracted from the burn of the second pulse. Subjects given pulsed piperine experienced the burn of the second pulse as stronger than that of the first pulse since the residual burn to the first pulse summated with the burn of the second pulse. These results verify the use of mathematical models, common in engineering, to the field of perception.

**West Virginia State Science and  
Engineering Fair - First Place Category  
Winners**

**Behavior & Social Science**

**SAIGE KOLPACK**, Jefferson High School, Shenandoah Junction, WV 25442. How background music affects memorization capability.

My science project was to determine how background music affects your

memorization capability. I predicted that techno music would increase memorization capability because the high frequency tones in the music would increase ones brain waves. I believed that techno music would be more effective than memorization in silence. In order to test my hypothesis I made three study sheets on basic Russian phrases, memorization of a 20-digit number, and quotes. I made tests to go along with these three study sheets as well. I took fifteen subjects and put them into three groups of five. One group would memorize with the techno music in the background, one with music they preferred, and one in silence. Each group studied each material with the music with the background; given ten minutes for the basic Russian phrases, five for the 20-digit number, and seven for the quotes. They were then tested on each topic and given as long as they needed to complete the test. I then found the average number missed for each quiz and compared them. I found that for the 20-digit number and basic Russian phrases silence was the most effective for memorizing. The techno seemed to be more of a distraction. However, with the quotes, which were more simple study materials, preferred music was the most effective. Therefore, when studying more complex materials, one should study in silence for best results; however, with simpler materials preferred music in the background will probably not affect and might improve you memorization capability.

**Biochemistry**

**AMANDA CHAPMAN**, Musselman High School, Inwood, WV 25413. Comparing biodiesel fuel percentages:



Which delivers the greatest distance and time in a farm tractor?

The purpose of this project is to determine which percentage (20%, 40%, 60%, 80%, or 100%) of biodiesel fuel (corn oil fuel mixed with petroleum diesel) will deliver the greatest distance and time in a farm tractor.

My hypothesis is that if one compares the differing biodiesel fuel percentages (20%, 40%, 60%, 80%, or 100%) of corn oil fuel mixed with petroleum diesel, then the 40% mixture will deliver the greatest distance and time in a farm tractor.

First, I set up marked a tractor course, and measured the lap distance. Then I processed corn oil into a fuel, letting it sit for 12 hours. An alternative fuel tank and line were attached to the tractor. On three different days, a trial was conducted on each fuel percentage, rotating the sequence of the fuels, to determine distance and time the tractor ran on 1/4 gallon of each fuel at 1500 RPMs with the same driver. The tractor had to be re-primed and towed to the starting line after each trial.

In conclusion, my hypothesis was incorrect. The 40% mixture of corn oil fuel and petroleum diesel did not allow the best distance and time. Of the five-biodiesel fuel mixtures tested, the 60% mixture delivered the greatest total and mean distance, as well as the greatest total and mean time.

Utilizing several sources for fuel makes sense to help our country become less dependent on foreign fossil fuels and allow us to use renewable and environmentally friendly alternative fuels.

### Botany

SARA DYCHE, Keyser High School,

Keyser, WV 26726. Does smoke increase the germination rate of seeds? Year II.

This year I am continuing my project from the previous year and testing the germination rate of oat and rye seeds. Based on my data from the first year of experimentation, my hypothesis is that the smoke will have a negative or no effect on either type of seed.

After collecting my materials, I conducted fourteen trials and recorded the data on sheets. On the sheets, I recorded the number of the Petri dish, the type of seed in the dish, whether the dish was control or experimental, and how many of the five seeds placed in each dish germinated. I found that the oat had a wide and unreliable rate of germination with a range of almost 50%, so I did not make a conclusion for this group. However, the germination rate for rye was impressive with a 93% average germination. The experimental group had a larger germination rate than the control group 50% of the time. My conclusion is inconclusive for both groups because I believe the oat data are unreliable. I believe I should do more testing before I can make a conclusion for either group or state that my hypothesis was wrong.

I wanted to do this project again this year because I am interested in botany, and I wanted to do a continuation from last year. My eighth grade science teacher first gave me the idea for the project after he showed me an article from a science magazine in which a scientist describes similar testing.

### Chemistry

MILEN BODURSKI, Wahama High School, Mason, WV 25260. Mole ratio



and fuel efficiency.

The purpose of my experiment was to determine which ratio of hydrogen to oxygen propels the projectile the longest distance away from the launch pad. I divided the rocket's combustion chamber into six equal spaces, that way I could use six different hydrogen-to-oxygen ratios to determine which will release the most energy. To produce my hydrogen and oxygen gases I used the following chemicals: hydrochloric acid (HCl), mossy zinc solid (Zn), 3% hydrogen peroxide ( $H_2O_2$ ), and dry yeast. To produce the hydrogen, I added hydrochloric acid to the zinc metal and caught the produced gas by bubbling it into a water-filled container. To produce the oxygen gas I decomposed hydrogen peroxide by adding a catalyst to it therefore speeding up the reaction rate ( $2H_2O_2 \rightarrow 2H_2O + O_2$ ). To collect the gas I used the same method that I used to collect the hydrogen gas. The different ratios of hydrogen to oxygen (6:0, 5:1, 4:2, 3:3, 4:5, 0:6) were then put into the combustion chamber of the "rocket" and combusted using piezoelectric crystals to give the activation energy needed to start the reaction. My hypothesis was that the 4:2 hydrogen-to-oxygen mixture would go the longest distance from the launch pad. I based my hypothesis on my chemistry knowledge that when water is formed (hydrogenesis), the reaction is the following  $2H_2 + O_2 \rightarrow 2H_2O$ , and you can simplify 4:2 to 2:1 and it would have no effect on the reaction. After I conducted my experiment, I found that my hypothesis was right, and the 4:2 mixture propelled the projectile the farthest—588mm—away from the pad it was launched from.

### Computer Science

**MICHAEL COGSWELL**, Jefferson High School, Shenandoah Junction, WV 25442. Comparing random number generators: Multiply-with-carry generator vs. combined linear congruential generator.

The purpose of this project is to compare random number generators (a multiply-with-carry generator (MWC) and a combined linear congruential generator (CLCG)) in order to find out which one would perform better when submitted to statistical tests and therefore would be a better generator. Each number was generated and tested by a program I wrote.

In order to test the random number generators a program was written. This program applied the frequency (equidistribution) test, the serial test, the gap test, the poker test, and the coupon collector's test, each of which is a statistical test that judges the ability of a pseudorandom number generator to generate random numbers.

The results of these tests did not come out as was hypothesized: I thought that the CLCG would be the best generator, but this was not the case. The MWC came in first. The C# generator (one of the control generators from the programming package used to create the program that evaluated the tests) came out second. The CLCG came out third and the LCG (a control from which the MWC and the CLCG are based) came out last. So, in a one-sentence conclusion, the MWC was found to outperform the CLCG in most areas and is recommended by this study.

The CLCG came in third instead of first or second because its performance varied



from test to test, whereas the MWC was a consistent performer.

### Engineering

**ZACHARY MORSE**, Jefferson High School, Shenandoah Junction, WV 25442. Most effective wavelength of light to consistently power a machine.

The purpose of my experiment was to determine what wavelength of the visible light spectrum would most consistently power a machine. I tested photovoltaic cells ten times each for the amount of volts and milliamps they produce under a 1000-watt halogen lamp and under a 120-watt incandescent lamp. The cells were covered and tested with seven different colored cellophane lenses (colorless, red, orange, yellow, green, blue, and purple).

The cells were then used to power a homemade car. The car was constructed using a Lionel toy train car and five feet of track. The track eliminated variables from the path taken. The machine was tested using all of the previous filters while moving the 120-watt light with the car, keeping it at uniform distance from the cell's surface. A stopwatch was used to record the time taken for the car to travel five feet. The time and distance were used to calculate the average speed for each color.

Statistical analysis showed that the full spectrum of visible light waves (the plain control tests) will continually produce more power than any single wavelength tested. Out of the single wavelength tests, yellow produced the highest power levels and speeds, whereas green and blue produce the lowest. These results do not follow the pattern set by the electromagnetic spectrum and can most

likely be attributed to the amount of light the filters allowed to pass through due to their density, not the frequency of the light.

### Mathematics

**SARAH SELLERS**, Hedgesville High School, Hedgesville, WV 25417. Prime magic square: Possible or impossible?

The purpose of this experiment was to find out whether or not it was possible to create a magic square using only prime numbers and only using each number once. The experiment first involved finding a pattern or some correlation between the prime numbers and then writing those prime numbers down. Once the pattern was found, the experiment then involved choosing a prime number ("n"), subtracting twice "n" (or  $2n$ ) from every prime number smaller than "n", and recording each of those prime numbers along with their difference from "n". The last step involved making the magic square using only the prime numbers that were written down and placing them in a pattern so that all the rows, columns, and diagonals of the prime magic square equal the same number.

The experiment confirmed the hypothesis that it is possible to create a prime magic square. It was discovered that the larger the prime number is for "n", the more potential the prime magic square will have to be larger and the more borders it could potentially have. In this experiment, the first 25 possible  $3 \times 3$  prime magic squares were made. The  $43 \times 43$  square that was made during this experiment also sets a world record for the largest handmade prime magic square. It also includes cryptology, which spells out



a single word using only palindromic prime numbers (or prime numbers that read the same forward and backward).

### Microbiology

**KEITH DAVIDSON**, Keyser High School, Keyser, WV 26726. Man vs. dog.

The objective of my project is to find out if a dog's mouth is really cleaner than a human's mouth. The materials used were six sterile swabs, six sterile bags, seven Petri dishes, nutrient agar, rubber gloves, sterile inoculators, and an incubator. First I labeled all materials to avoid mix-ups. Then I swabbed the mouths of the subjects. I swabbed the subjects' mouths early in the morning to avoid food contamination, drinks filled with caffeine or acid, and mouth hygiene products like toothpaste. Shortly after, I melted my red algae-based agar solution and placed five milliliters into each of the seven Petri dishes. After that, I placed the saliva into the agar solution. Next, I placed the dishes into an incubator at 30° C for seventy-two hours. Finally, I recorded the results for each 24-hour period. The final results of my project were: 25 colonies for the control; 33, 84, and 70 for the dog; and 32, 30, and 25 for the human. The conclusion for my project is that a human's mouth appears to be cleaner than a dog's, but further study is needed to know for sure. I also need to conduct the experiment in a more sterile environment to avoid mishaps like having clusters in the control.

### Physics

**TIMOTHY FISHER**, Jefferson High

School, Shenandoah Junction, WV 25442. Zero-gravity propulsion using electron emission from cathode rays: Theory presented through macroscopic testing.

The purpose of this project was to suggest that a propulsion system, expelling electrons, could recollect its fuel source, the electron, while maintaining a positive net force.

To test this idea, a steel ball with a mass of 8.38 grams was fired by a spring through a copper pipe, diverted back toward the "ship" by a half-circle pipe, and struck a collection module on the frame of the "ship". The firing pin, running perpendicularly through the copper pipe was pulled out by an expansion spring when released by the motor. The motor, wired in series to a reed relay and a Zener diode, was activated when a wireless phone connection to the relay's coil was paged.

The "ship's" tracks rested on four ball bearings that rested on a level sheet of glass. When fired, the "ship" showed no movement. The results of the experiment showed that that momentum was conserved. Hence, either the hypothesis or the calculations supporting the hypothesis must be incorrect. The force of thrust from the ball being discharged was cancelled out by the force exerted on the curve as the ball decelerated to zero speed relative to x. Thus the ball accelerated in the negative x-direction, giving the ship a negative velocity. That force was canceled out when the ball again decelerated to zero as it struck the collection module. This ended in a net force equal to zero.

Now tests are being done to determine if cathode rays can be freely emitted into space when not part of the accelerating system.



## Zoology

**RACHEL RAWN**, Jefferson High School, Shenandoah Junction, WV 25442. Sweet Dreams: Determining and comparing the cost efficiency of dairy calf bedding materials.

The purpose of my project was to determine which bedding, straw, wood shavings, sand, or newspapers, is the most cost-efficient dairy calf bedding material. My hypothesis was that the straw would be the most efficient followed by, in order of decreasing efficiency, sand, newspapers, and wood shavings. After monitoring each bedding material's longevity and combining that data with the cost of each material, I found my hypothesis to be partially confirmed. Straw had the smallest rate of spoilage, followed by (in order) wood shavings, newspaper, and sand. However, once I calculated the cost per month to bed using each material I found that sand would be the least costly, followed by straw, newspapers, and wood shavings. In conclusion, the results of my study support that sand would be the most cost-efficient bedding, followed closely by straw, then newspaper and wood shavings.

### Team

**BRANDON HOLLAND** and **QUENTIN JACKSON**, Withrow School, Davis, WV 26260. How does the shape of a coil affect the performance of an electric motor?

Our purpose is to test the way different coil shapes may affect the performance of a simple DC electric motor. Our experimental design will be testing the null hypothesis. We used parts of a kit to

standardize as much of the motor as possible, but we built four each of four differently shaped coils to test. We attempted to make all the coils for each shape as much alike as possible using a consistent method of construction and consistent materials for construction. All the coils were made using the same type of wire, the same number of turns of wire, and the same length of wire. The reason we built four examples of each coil shape was to see if we would get consistent results with similarly made coils for each design. This should minimize differences in performance due to the way the coils were made, so any differences in performance should be due to the shape of the coil.

We tested two performance criteria: speed in revolutions per minute (rpm) and temperature (in degrees Celsius) during operation. Since the motors were small and very low-powered, we took the measurements without touching the motors. Our preliminary research found two mechanic's tools that worked well: an infrared thermometer and a digital tachometer. We "tinkered" with one coil of each shape and once they were running consistently, we made the same modifications to the other coils.

Our data showed that the circular coil ran the best overall. The circular coil averaged 196 rpms. This was 22 rpms faster than any other coil design. The operating temperature was 26° C, which was the highest operating temperature.



