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## ORAL PRESENTATIONS

**Botany**

SARAH BARRY and DAN DILELLA, Dept. of Chemistry, Shepherd University, Shepherdstown, WV 25443. **Absorption effects of botanical capsaicin spray on tomato plants.**

The Squash bug (Hemiptera: Coreidae) is an agricultural pest causing significant economic losses in summer squash (Cucurbitaceae) due to high feeding damage to fruits and stems and reduced plant productivity. Levels of naturally-occurring biological control are often insufficient to keep damage levels beneath the economic threshold. We investigated the effects of capsaicin, a botanical material derived from hot pepper plants, on tomato plants at a USDA-certified organic farm (Redbud Farm, LLC) in Berkeley County, WV. This project investigated the potential of using capsaicin as a pesticide by spraying tomato plants and analyzing for capsaicin residue. The leaves of the tomato plants were sprayed with a low dose of capsaicin spray and then collected after one week and run through the GC-MS to test for excess capsaicin residue. In analysis of all the samples, it was determined that the GC-MS could detect capsaicin as low as 22.5 pg capsaicin/gram of plant. The samples had no detectable capsaicin in the solution.

**Cell Biology**

TAYLOR BOUND and BRUCE ANTHONY, Dept. of Chemistry and Biochemistry, West Virginia Wesleyan College, Buckhannon, WV 26201. **Analysis of DNA damage in embryonic neuronal stem cells after alcohol exposure.**

Fetal alcohol spectrum disorders (FASD) demonstrate a wide variance of dysmorphic phenotypes. It is known that moderate to high doses of alcohol cause alterations in neuronal stem cell proliferation and induce a subsequent DNA damage. However the mechanism for such alterations is unknown. The objective of this study

was to determine how different concentrations of alcohol exposure affect the DNA integrity of embryonic neural stem cells. Comet assays were used to examine the amount of single and double-stranded DNA damage found in the affected cells. Results indicated a significant amount of DNA damage occurs when the cells are exposed to 400 mg/dL of alcohol due to long “comet-like tails” indicative of double stranded DNA breaks. Lower concentrations of alcohol exposure (300 mg/dL) also show cells with DNA damage, having a shorter tail replaced by an “halo-effect” around the nuclei indicating that slight DNA damage has occurred. In conclusion, alcohol causes single and double-stranded DNA damage to embryonic neural stem cells with DNA fragmentation being dose dependent.

SRICHARAN MAHAVADI, Department of Biology, Shepherd University, Shepherdstown, WV 25443; RYAN ICE and ELENA PUGACHEVA, Department of Biochemistry, West Virginia University School of Medicine, WV 26506. **Metastatic activity of breast cancer cells in the presence of NEDD9.**

Neural precursor cell expressed developmentally down regulated NEDD9, is a proto-oncogenic protein increased in cancer cells resulting in higher rates of invasion and migration. NEDD9 increases the metastatic potential of cancer cells and lead to more aggressive disease. Our lab has previously shown the metastatic potential to be reduced by lowering the levels of NEDD9 in the cancer cells. We sought to determine the mechanism governing the decrease in number and size of metastases in NEDD9 knockdown cells. We used a combination of immunofluorescence and histochemistry to determine if markers for proliferation, apoptosis, and cell survival pathways change as the result of reduced levels of NEDD9 in metastatic breast cancer. Our analysis showed that upon depletion of NEDD9 there was a significant decrease in proliferation and survival signaling, along with



increases in apoptosis of metastases. Along with assessment of cellular markers, we determined the activity of matrix metalloproteinases, which is indicative of invasive potential of primary tumor via in situ zymography. Decrease in NEDD9 expression led to significant decrease in activity of MMPs in tumor microenvironment at the primary site, but not in the lung. The identified molecular mechanisms of NEDD9-driven metastasis will allow for new therapy design to prevent cancer spreading and increase survival of cancer patients.

BINA MALAPUR, Dept. of Chemistry, Shepherd University, Shepherdstown, WV 25443; ROBERT L. GOODMAN and RICHARD B. McCOSH, Department of Physiology and Pharmacology, West Virginia University, Morgantown WV 25755. **Does NKB stimulate GnRH secretion through KNDy neuron activation for human reproduction?**

Neurokinin B (NKB) is essential for human reproduction. Experimentally, NKB has been shown to be a stimulator of gonadotropin-releasing hormone (GnRH). NKB is located in KNDy neurons, which also contain kisspeptin, a potent stimulator of GnRH, and project to GnRH cells. KNDy, but not GnRH, neurons contain NK3R, the NKB receptor. This study tests the hypothesis that NKB stimulates GnRH release by activating KNDy neurons. Sheep were injected with senktide, an agonist for NK3R, and serum samples were collected for one hour prior and two hours after IV injection of senktide. LH concentration was measured by radioimmuno assay to confirm drug response. Next, the hypothalamus of the sheep were removed and sectioned into slices. Selected sections were then processed by dual immunocytochemistry (ICC) to assess KNDy neuron activation by detecting kisspeptin and cFos. LH concentrations dramatically increased after the injection of senktide, indicating that NKB stimulates GnRH, which stimulates LH.

This study was supported by NIH Grant 5P20RR016477 to the West Virginia IDeA Network for Biomedical Research Excellence.

## Chemistry

GERREN D. SIMMS and MENG YANG LI, Dept. of Chemistry, Shepherd University, Shepherdstown, WV 25443. **Mechanical properties of a Langmuir monolayer of a non-polar hydrocarbon chain molecule on water.**

Traditionally, Langmuir monolayers and lipids bilayers (including cell membranes) on water interfaces are made of amphiphilic molecules with both polar hydrophilic and non-polar hydrophobic parts. It has been discovered that some non-polar chain molecules without a polar hydrophilic part, for example, long chain hydrocarbons with more than 30 carbon atoms, also form Langmuir monolayers on water. Here we report the measurements of the compression mechanical properties of a Langmuir monolayer of a non-polar hydrocarbon chain molecule  $\text{H}(\text{CH}_2)_{35}\text{H}$  on water. The  $\text{H}(\text{CH}_2)_{35}\text{H}$  monolayer displays its maximum compression modulus (greatest resistance to lateral compression) at about  $19 \text{ \AA}^2/\text{molecule}$ , independent of the compression rate, like the Langmuir monolayers of long chain saturated fatty acids do. The maximum compression modulus of the  $\text{H}(\text{CH}_2)_{35}\text{H}$  monolayer decreases as the compression rate increases. A similar trend was also observed in Langmuir monolayers of long chain saturated fatty acids. But at all compression rates, the maximum compression modulus of the  $\text{H}(\text{CH}_2)_{35}\text{H}$  monolayer is much lower (i.e., much lower resistance to lateral compression) than those of the fatty acids  $\text{H}(\text{CH}_2)_{23}\text{COOH}$  and  $\text{H}(\text{CH}_2)_{17}\text{COOH}$  monolayers.

JACOB SMITH and JORDAN MADER, Dept. of Chemistry, Shepherd University, Shepherdstown, WV 25443. **Development of H.I.P.E. foams for removal of groundwater contaminants.**

Arsenic contamination threatens the livelihood of many individuals around the world. Arsenic-rich bedrock is common in many areas of the world and toxic species can leach into groundwater and soil. Arsenic can also be



introduced into the environment via pesticides, abandoned mines, and abandoned buildings. Thiol (-SH) groups have the potential to bind arsenic ions. High internal phase emulsion (H.I.P.E.) polymers were studied for their capacity to remove groundwater contaminants such as arsenic. Different foam densities (30, 60, 90, 100, 120, and 500 mg/cc) were explored.

Small scale batches were synthesized via gas-tight syringes and larger batches were made via an overhead mechanical stirrer. Reproducible, stable foams of varying densities could be made with each method, though the 30 and 60 mg/cc were the least stable. Copolymerization with a bifunctional monomer was also investigated to determine the effect on stability. This monomer was introduced into the polymer in varying ratios. It was determined that a ten percent ratio yielded robust foams.

After stable H.I.P.E's were synthesized and consistent densities determined, several attempts were made to thionate the polymer in a reaction with phosphorous pentasulfide. Foam stability and functionalization was studied using thermogravimetric analysis (TGA) and attenuated total reflectance Fourier transform infrared (ATR-FTIR) spectroscopy. While the functionalization was ultimately unsuccessful, data on the byproducts of this reaction were gathered. Several other synthetic pathways to thionation are currently being explored.

This work was supported by a NASA West Virginia EPSCoR Space Grant Consortium Research SEED award and the Shepherd University Chemistry Department.

### Computer Science

SKYLER BARTLES, WILLIAM SLIFER, and OSMAN GUZIDE, Dept. of Computer Sciences, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443. **Acoustic cryptanalysis.**

The objective of this research is to analyze

and define new tactics of cryptanalysis that specifically isolate physical sound and how to use that data in terms of hacking. We are going to be approaching this task by researching and then attempting to physically recreate a basic scenario of this process. We hope to derive a key to RSA encryption, and after sorting through the collective analysis of sound, we believe that we are going to be able to successfully recreate these experiments based on the open availability of the equipment needed.

JASON BERTMAN, Dept. of Computer, Mathematics, and Engineering, Shepherd University, Shepherdstown, WV 25443. **3-factor hardware authentication using asymmetric OTK mechanisms on Bluetooth hardware with access control.**

Techniques such as 2-factor authentication (2FA) have come to shape computer security systems into what they are today. While 2FA solves many problems, these systems can be difficult to integrate, and may require third-party software, hardware, training, or support. The goal of this research was to create a simple, effective, and inexpensive solution that implements trusted user authentication to use in enterprise environments. Using principles employed in asymmetric cryptography, we used everyday hardware and freely available software to create a short-range client-server environment capable of generating one-time keys (OTKs). Attaching the system to an access control keypad allowed us to create an environment secured by three factors of authentication. We were able to control the flow of security by enforcing hardware access control using ordered power-on sequences. Comparisons to traditional access control systems indicate substantial advantages in speed, reliability, and security. By reducing the connection requirement to range only, we effectively eliminated the need for an external server, as well as the risk of man in the middle attacks.

DANIEL BIRD and OSMAN GUZIDE, Dept. of Computer Information Sciences, Shepherd

University, Shepherdstown, WV 25443. **Analysis of superconducting spintronics.**

Superconducting spintronics is an all-new field of science, deemed possible by University of Cambridge's Dr. Jason Robinson and his research team. They discovered that they could take the zero electrical resistance phenomenon produced by a superconductor and apply it to the magnetic junction used for electron manipulating in the field of spintronics. When all other attempts to do this failed, due to the natural tendency of spintronics to reverse the effects of superconductors, Dr. Robinson's team managed to accomplish the feat by adding a layer of the rare metal holmium into the magnetic junction. This new field of superconducting spintronics has theoretically opened up a door to all new innovations in the fields of information transference, and energy efficiency. The question remains though, why is holmium so special as to be able to reverse the natural rejection of superconductors and spintronics, and equally importantly, can other metals cause the same effect? The major bulk of our independent research will involve the examination of the physical traits and reactionary characteristics of holmium that could have caused the rejection phenomenon observed by the Cambridge research team, and to try to find those similar traits and characteristics in other elements and metals.

MATTHEW MOCNIAK, Dept. of Computer, Mathematics, and Engineering, Shepherd University, Shepherdstown, WV 25443. **Building a web app with Dropbox APIs.**

In conjunction with the senior capstone for the Computer, Mathematics, and Engineering Department, this research project aims to explore the implementation of various Dropbox Developer APIs. Developers who wish to implement Dropbox into their applications commonly use the Dropbox Chooser, Saver, and Datastore APIs. Each API is flexible and accessible by multiple coding languages. For this project, each API will be implemented through a JavaScript component

from within a web application. The web application will perform basic text editing tasks and will utilize the Dropbox APIs to accomplish saving and retrieving text files. In addition to understanding the Dropbox APIs, this project will focus on the creative design process that goes into developing an application. Common practices and approaches will be analyzed and configured for the note-taking web application. The final result should resemble a scalable web application that will utilize Dropbox APIs while following common application design standards.

VASYL SHTANKO and OSMAN GUZIDE, Dept. of Computer Sciences, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443. **Real-Time Operating System for robotics and embedded systems.**

In this modern world, most devices utilize an operating system in order to handle the background tasks and manage resources. Just like personal computers, embedded systems need a way to optimize performance, schedule tasks and manage system resources. Embedded operating systems vary from Linux-based command line solutions to device proprietary operating systems written in C or Assembly. The need for the software to be implemented on such devices grows rapidly as the number of embedded systems inside cars, helicopters and UAV's, robots, and even household appliances such as microwave ovens and toasters increases every day.

The problem lies in having to update the software for the system every time a change is made. On a small scale, it does not seem to make a difference. However, every time a new product is released, the new software has to be implemented in order to make it functional. On costly applications such as helicopters, UAV's and industrial robots this could make a huge impact on the number of units produced and the price companies have to pay to implement new releases.

The main goal of this research is to propose a

design for a real-time modular operating system for embedded applications including robotics, as well as improve some of the strategies existing operating system for such applications use. The research also introduces the idea of running programming environment on top of a Real-Time Operating System in order to reduce modification cost for new solutions.

JARED TOMLIN and JEFFREY R. GROFF, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443. **The development of a low-cost Arduino and Raspberry Pi-based system for environmental monitoring.**

The proliferation open-source hardware and software has made development of low-cost embedded environmental monitoring systems possible. Here we detail our progress toward developing such a system based on the Arduino and Raspberry Pi platforms. The system includes a wireless sensor module, a wireless receiver, and the software stack for hardware control and data processing. The wireless sensor module, which we call "Scout", is Arduino-compatible and can be programmed to accommodate sensors for environmental parameters like temperature, light, and humidity. One such sensor module, which we call "Rucksack TL", was also developed. The wireless receiver, which we call "Basecamp", is built upon a Raspberry Pi running Linux. Wireless communication from Scout to Basecamp is accomplished using XBee RF modules that are integrated into the Scout sensor and connected to the Basecamp Raspberry Pi via its GPIO pins. Prototype printed circuit boards for Scout, Rucksack, and Basecamp have been designed, manufactured, and tested. Software has been written to control the power state of the Scout, to take temperature and light readings, and to relay this data to the Basecamp. In addition, software has been written for the Basecamp to access data being relayed to its XBee radio via a serial port. We aim to extend the Basecamp software stack to include a web server and a database so data can be processed and accessed via internet connections.

This type of system could have many applications where inexpensive sensor networks are necessary, such as greenhouse monitoring, or creating geospatial overlays of environmental data.

### Ecology / Environmental Biology

CODY MARSH and PETER VILA, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443. **Natural resource protection in national parks: paradigm shifts in training for U.S. law enforcement rangers.**

This study examined how the training of a National Park Service law enforcement park ranger interacts with the ranger's role of being an effective natural resource manager and law enforcer.

The National Park Service (NPS) is one of the major agencies tasked with a resource protection mandate. A ranger is a frontline manager of people and resources, and goes through nearly one thousand hours of professional training to become a commissioned law officer. Utilizing data from the Department of the Interior crime statistics Record Management System (RMS), coupled with a survey of the amount of hours of natural resource law training amongst thirty-two former or current NPS rangers, a comparison was made before and after the 1995 Ranger Careers and Futures Initiative, in which law enforcement was professionalized within the NPS. Using a Pearson's bivariate correlation, it was found that as training became standardized after 1995, the amount of hours spent on natural resource law was reduced, and therefore the number of natural resource violations generated by rangers declined significantly ( $r = .513$ ,  $p = .003$ ,  $n = 32$ ). These findings reflect the focus of modern, specialist law enforcement rangers. While there are many other factors contributing to the number of violations generated such as budget cuts and park location, hours of training can impact the time a ranger spends enforcing crucial resource protection laws.

DAVID B. WING, Dept. of Biology, Shepherd University, Shepherdstown, WV 25443. **In vitro shoot induction of shale barren rockcress, *Arabis serotina*.**

Continued investigation of the regeneration of endangered shale barren rockcress, *Arabis serotina*, confirmed a range of tissue culture conditions that induce leaf explants to form callus. Of the induced callus, one treatment best responded to shoot induction media. A ratio of 10:1 or 5:1 auxin 2,4-D to cytokinin kinetin induced leaf tissue to form callus. Auxin concentrations from 0.25 to 2 mg/L with cytokinin concentrations from 0.025 to 0.2 mg/L were successful for both callus initiation and prolonged growth. One shoot induction regimen of auxin 3-indoleacetic acid at 0.1 mg/L with cytokinin 6 - ( $\alpha,\alpha$ -dimethylallylamino) - purine (2iP) at 5 mg/L was used to compare the shoot regeneration capability of each callus sample. All calli yielded shoots, but callus initiated on 0.5 mg/L 2,4-D with 0.05 mg/L kinetin produced more than twice as many as any other sample. Because sampling of endangered species is restricted, regenerated shoots may be used as a source of nuclear DNA to establish a genomic library of *Arabis serotina*.

This work was supported by grants from the WV Nongame Wildlife and Natural Heritage Program and WV-EPSCoR.

### Engineering

KRISHNA TEJA MEDAM, MURAT DINC, J. STEPHEN TAYLOR, NICHOLAS L. HILLEN, DONALD D. GRAY, and JOHN M. KUHLMAN, Statler College of Engineering and Mineral Resources, West Virginia University, Morgantown, WV 26506. **The impact of a single drop on a liquid film: comparisons of axisymmetric and fully three-dimensional simulations with experimental measurements.**

As the size of the electronic equipment is reduced, the ability to reject waste heat is also reduced due to smaller component surface areas,

thereby affecting the component performance and potentially leading to damage of the component. Spray cooling offers a means to achieve high rates of heat transfer at uniform temperatures from microelectronic components and other high energy density devices. As a first step in investigating spray cooling, a single liquid drop impacting onto a thin liquid film was studied at isothermal conditions. Two-dimensional axisymmetric cases were simulated with the commercial program ANSYS Fluent using the Volume of Fluid (VOF) model. The post processing of the results was performed in Surfer (Version 9) software in order to calculate the liquid film thickness and the volume of the liquid under the cavity (sub-cavity liquid volume) as functions of time. These axisymmetric simulations agreed with the experimental data during the cavity formation phase, but did not closely match with the experiments during the refilling of the cavity. It was speculated that the discrepancies could be due to the three-dimensional instabilities leading to droplet ejection from the crown during the retraction phase. For this reason, identical cases were simulated in three dimensions with the public domain OpenFOAM program using the VOF model. The improved agreement with experiments obtained with the three dimensional simulations will be discussed.

This work is supported by NASA EPSCoR.

J. STEPHEN TAYLOR, JOHN M. KUHLMAN, DONALD D. GRAY, MURAT DINC, KRISHNA T. MEDAM, and NICHOLAS L. HILLEN, Statler College of Engineering and Mineral Resources, West Virginia University, Morgantown, WV 26506. **Techniques to quantify dynamic phenomena of spray droplets impinging on a smooth surface.**

A Monte-Carlo based simulation model of spray cooling is being developed at West Virginia University. It currently provides qualitatively accurate predictions of some spray cooling phenomena, but needs more comprehensive physical models added to become quantitatively accurate. One area of great importance is



understanding the droplet impact dynamics surrounding spray droplet impingement on a surface, specifically the dynamics of cavities formed by droplets impacting the residual liquid layer underneath a dense spray. The diameters and lifetimes of these cavities, as well as the thickness of the liquid layer in their bases (i.e., sub-cavity liquid layer thickness) are believed to be a critical component in accurately calculating heat flux through a surface undergoing spray cooling. Two experiments are being conducted to measure these quantities. Each experiment utilizes a Spraying Systems 1/8G full-cone nozzle to generate a spray of atomized water which impinges on a 2 mm thick transparent rectangular glass target surface. Cavity lifetimes and diameters have been measured by analyzing high-speed video recorded from a Photron FASTCAM SA5 digital video camera recording at 30,000 frames per second. These recordings look from beneath the target surface in order to normalize the viewing angle and avoid looking through the “noise” of the spray. The second experiment synchs high speed video with measurements of the sub-cavity liquid layer thickness, which has been collected from a Precitec non-contact optical thickness measuring device.

This work is supported by NASA EPSCoR.

### Forest Ecology

MARK BURNHAM, CHRISTOPHER WALTER and LILLIAN HILL, Dept. of Biology, West Virginia University, Morgantown, WV 26506; MARY BETH ADAMS, USDA Forest Service Northern Research Station, Parsons, WV 26287; WILLIAM PETERJOHN, Dept. of Biology, West Virginia University, Morgantown, WV 26506. **Whole-watershed nitrogen fertilization effects on tree nitrate reductase activity and stand nitrogen demand.**

Small watersheds are powerful tools to study the impacts of N deposition on the N cycle of forests. At the Fernow Experimental Forest in Parsons, WV, 35 kg N ha<sup>-1</sup> yr<sup>-1</sup> has been added as (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> to one watershed (WS3) to study

the effects of increased N deposition of forest ecosystems, while an adjacent unfertilized watershed of similar age (WS7) is used as a reference. This led to a ~50% increase in stream water NO<sub>3</sub>, but soil NO<sub>3</sub> production in the fertilized WS is not detectably higher. Since the supply of NO<sub>3</sub> via nitrification is not higher in the fertilized forest, then the biotic demand for NO<sub>3</sub> must be lower. To test this idea, NO<sub>3</sub> reductase activity (NRA) was measured on roots and leaves of four common overstory tree species growing in these two WS. Additionally, dendrometer bands were used to measure annual radial tree growth.

While NRA per g tissue was ~50% higher in the fertilized WS versus the unfertilized WS, lower root biomass in the fertilized WS caused this trend to reverse when NRA was expressed per m<sup>2</sup>. Tree growth was ~98% lower in the fertilized WS. Individual trees do not reduce their reliance on NO<sub>3</sub> as NH<sub>4</sub> availability increases, but fertilization and acidification decrease the overall fine root and radial tree growth. The dominant factor contributing to a ~50% increase in stream water NO<sub>3</sub> in the fertilized WS is likely the overall reduction of tree N demand under N addition rather than the form of N used.

EVAN LAU, JOSEPH NOLAN, RYAN DAGUE, ZACHARY DILLARD and WENDI WENTZELL, Dept. of Mathematics and Natural Sciences, West Liberty University, West Liberty, WV 26074. **Bacterial diversity and abundance in peat, moss and soil from Cranesville Bog and adjacent temperate forest using Illumina MiSeq multiplex sequencing.**

Northern Sphagnum-dominated peatlands and temperate forest soils play an important role in the global carbon cycle. However, bacterial diversity and abundances in these ecosystems remains poorly described. These ecosystems are a major source and sink of methane (CH<sub>4</sub>), a greenhouse gas. Here, we compared the bacterial community composition of three sites (aerated peat, submerged moss tissue and organic layer of forest soil) from Cranesville Bog and adjacent temperate forest using Illumina MiSeq high-

throughput multiplex sequencing of partial 16S rRNA genes. Our de-noised sequences (average length ~200 bp, ~1 million reads) comprised over 550,000 OTUs (Operational Taxonomic Units) from over 25 bacterial phyla, constituting over 200,000 unique taxa. Methanotrophic bacteria (from the families Alphaproteobacteriaceae, Gammaproteobacteriaceae and Beijerinckiaceae) constitute < 2% of microbiota in these environments. We detected and described over 800 sequences affiliated with known groups of methanotrophs in the abovementioned families for analyses of phylogeny and abundance. Our study highlights bacterial communities in surface layer of northern peatlands and temperate forest soils are highly diverse and taxonomically distinct, reflecting the different environmental conditions in microhabitats within the peat, moss and forest soils.

ROBERT SHAW and PETER VILA, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443. **A comparison of native tree and shrub sapling mortality rates in USDA Hardiness Zone 6B.**

Mortality rates of native trees and shrubs are important in order to understand ecosystem processes in forest environments and reforestation projects need baseline data on mean mortality rates for native vegetation species for increased efficiency. Mean mortality rate was compared among six containerized, bare-root stock, native tree and shrub species at Shenandoah Junction, WV for three months. Mean mortality rates varied considerably between species as some species such as *Sambucus nigra* (common elderberry), *Viburnum trilobum* (cranberry viburnum), *Physocarpus opulifolius* (Atlantic ninebark), and *Corylus americana* (American hazelnut) all had high (greater than 75%) mean survival rates, while *Crataegus phaenopyrum* (Washington hawthorn) and *Pinus strobes* (eastern white pine) had a low (less than 50%) mean survival rate. A comparison between the mean mortality rates showed a significant difference among the six tree and shrub species. The study provided baseline tree mortality data and will increase the efficiency

of native tree and shrub reforestation projects by providing empirical data for native species that have little to no previous study.

CHRISTOPHER A. WALTER and MARK B. BURNHAM, Dept. of Biology, West Virginia University, Morgantown, WV 26506; BRENDEN McNEIL, Dept. of Geology and Geography, West Virginia University, Morgantown, WV 26506; MARY BETH ADAMS, Northern Research Station, USDA Forest Service, Parsons, WV 26287; WILLIAM T. PETERJOHN, Dept. of Biology, West Virginia University, Morgantown, WV 26506. **Does nitrogen fertilization alter stand resistance to storm damage?**

Storms are the most significant natural disturbance in the forests of eastern North America. We hypothesized that nitrogen fertilization might decrease resistance to storm damage. To test this hypothesis, damage from Superstorm Sandy (2013) was compared between a fertilized (WS 3) and unfertilized watershed (WS 7) at the Fernow Experimental Forest, near Parsons, WV. Damage was estimated using a classification system with seven categories of damage. Comparisons between watersheds and tree families were performed using a one-way analysis of variance. Heavy snowfall by Superstorm Sandy damaged 42% of the total basal area (BA) in both watersheds – 38% of canopy BA and 63.2% of sub-canopy BA. The mean BA damaged was lower in the fertilized watershed ( $p = 0.0090$ ). Specifically, 35.9% of BA was damaged in WS 3 vs. 48.6% in WS 7. Overall differences in stand damage were driven by differential damage to both the canopy BA (WS 3 – 30%; WS 7 – 44.1%;  $p = 0.0249$ ) and among the major tree families ( $p = 0.0450$ ). Differential damage among families indicates that watershed differences in storm damage may have resulted from differences in species composition. However, damage to trees in the Rosaceae and Sapindaceae families was lower in WS 3, indicating the likelihood of a direct watershed effect. The watershed results contrast with findings from a 2009 windstorm that damaged adjacent fertilization plots, where fertilized treatments were damaged more than

unfertilized. This suggests the effect of fertilizer may depend on the nature of the storm event (snow loading vs. strong winds).

### Genetics

S. JOANNA MARTINEZ, Dept. of Education, Shepherd University, Shepherdstown, WV 25443, and SHER HENDRICKSON, Dept. of Biology, Shepherd University, Shepherdstown, WV 25443. **Phylogenetic analysis of wild horses of the Andes with mitochondrial and genomic data.**

The wild populations of horses living in the Andes are from Ecuador who have genetically adapted to the unique environmental pressures of high altitude. Introduced by the Spanish in the 1500s, these horses have adapted to extreme conditions including oxidative stress, increased UV radiation, and limited vegetation. Because of these challenges, we believe that the Andean horses show genetic differences in genes involved in metabolic performance when compared to horses from their ancestral Iberian background. The actual founding breed composition of the wild population is not yet known. By extracting the DNA from 110 horses (both from the Andean herd and from related Iberian “out-group” breeds), sequencing the mitochondrial DNA, and analyzing the entire genome through the Equine SNP50 GenoTyping BeadChip (Illumina, Inc.), we generated two phylogenetic trees representing the phylogenetic history through both the maternal and paternal lines. Future studies are intended to uncover mutations in the mitochondrial DNA that may be advantageous to optimal metabolism under altitude conditions.

### Health Science

ALICE J. LIN, Dept. of Integrated Science and Technology, Marshall University, One John Marshall Drive, Huntington, WV 25755; CHARLES B. CHEN, School of Medicine, West Virginia University, Morgantown, WV 26506. **A three-dimensional computerized craniofacial**

### **assessment for surgical operation planning of facial deformities and injuries.**

By simulating surgical operations beforehand, one can reduce the risk of a failed operation and increase the patient's participation in the design of the operation. The aim of the planning is to determine which measurements are suitable and surgically feasible to secure a good morphological and functional result. The simulation is an objective analysis that replaces subjective visual judgment (anthroposcopy) with quantitative dimension. By using virtual three-dimensional head and face models on preoperative planning, one can make exact statements about necessary corrections. We have developed a method for simulation of clinical operation planning in three-dimensional models. The simulation is based on anthropometry and prediction intervals to design the areas which need to be operated. The method of moving least squares is used to reconstruct the new head and face surface. Simulating operation planning provides a platform which makes head and face surgery possible to remain both an art form and a science. Although there is no substitute for experience and sound clinical judgment, computer-aided planning will assist the craniofacial surgeon. The purpose of planning is to help confirm or refute clinical impressions, aid in treatment planning, and provide a framework in the objective assessment of intraoperative results. It is not only reliable and accurate but inexpensive. It can easily be performed by clinicians. Once the basic technique is mastered, facial anthropometry can be used successfully in everyday practice.

RODGER J. McCORMICK and MIKAELA I. POLING, Dept. of Applied Physiology, FSRG deGruyter-McKusick Institute of Health Sciences, Buckhannon, WV 26201. **Heat tolerance of exercising lean and obese middle-aged men.**

To investigate occupational heat tolerance differences among lean and obese middle-aged men, lean (N 6) and obese (N 6) middle-aged men, aged 39-54 years, with estimated body fat



percentages of 17.1 and 31.9%, exercised on a treadmill at 4.8 km/h and 5% grade in a series of increasing effective temperatures ( $T_{\text{eff}}$ ) (21.1, 26.7, 29.4, 32.2, and 35.0 °C  $T_{\text{eff}}$ ) on separate days until reaching critical effective temperature, 29.4 °C for lean and 26.7 °C for obese men.

With  $T_{\text{eff, cr}}$  rectal temperatures of 37.7 °C and 37.9 °C for lean and obese men, combined exercise and environmental heat load stress exceeded subjects' abilities to compensate for their global physiological strain.  $\text{VO}_2$  in exercise Bout 3 [f(1, 43)=25.39,  $p<0.001$ ], percent of  $\text{VO}_{2\text{max}}$  (L/min) [f(1, 43)=99.16,  $p<0.001$ ], VE for Bout 1 and 3 ( $p<0.001$ ), baseline METs [t(10)= -4.12,  $p<0.001$ ], all heart rates ( $p,0.05$ ), all blood pressures ( $p,0.05$ ), all mean sweat rates and loss ( $p<0.05$ ), and all rates of body weight loss ( $p<0.001$ ), significantly higher for obese men, increased with effective temperature. Interestingly, as  $T_{\text{eff}}$  increased, heat gain also increased in both groups, but lean men demonstrated a non-significant trend toward progressively higher rates of gain. Radiative and convective heat loss, higher in obese men, appeared to differ less with increasing environmental temperatures. During rest, there were no significant differences.

Middle-aged men thermoregulate during heat stress exercise efficiently, but obese middle-aged men do so at a considerable handicap. Physiological burden is caused by work, not  $T_{\text{eff}}$ .

BRIAN PHAIR and JOSEPH HORZEMPA, Department of Mathematics and Natural Science, West Liberty University, West Liberty, WV 26074. **Ecotopic expression of proteins encoding protective antigens of *Pseudomonas aeruginosa* in the *Francisella tularensis* live vaccine strain - development of a novel vaccine platform.**

A licensed vaccine against the opportunistic pathogen *Pseudomonas aeruginosa* does not currently exist. To develop a possible vaccine, *Francisella tularensis* LVS (Live Vaccine Strain), was selected as a novel platform. The *F. tularensis* LVS vaccine has proved to be a successful

immunological agent. Patients immunized with the *F. tularensis* LVS vaccine presented a long-term immunological memory response, along with cytokine production. We hypothesize that *F. tularensis* LVS can function as a vaccine platform to express genes encoding protective antigens against the opportunistic pathogen *P. aeruginosa*, while maintaining its long-term immune memory. *F. tularensis* LVS was genetically modified to express the *P. aeruginosa* pilin subunit gene *pilA* (LVS/pBR), the flagellin structural gene *fliC* (LVS/pGFLI), and the outer membrane protein *oprF* (LVS/pOPRF). A western blot of the strains LVS/pBR, LVS/pGFLI, and LVS/pOPRF showed expression of PilA, FliC, and OprF proteins, respectively. These vaccine strains were administered to mice intranasally, and subsequently serum was analyzed for anti-*Pseudomonas* antibody responses. High levels of antibodies were detected in serum from mice receiving a sham vaccination indicating the mice may have contracted an infection with *P. aeruginosa* prior to this study. We are currently conducting a second trial and employing tactics to minimize the risk of exposure to *P. aeruginosa* prior to testing.

DI WANG and FEI DAI, Dept. of Civil and Environmental Engineering, West Virginia University, Morgantown, WV 26506. **Decomposing typical construction task processes for vision-based risk assessment of work-related musculoskeletal disorders: case studies of bricklaying and roofing.**

Construction tasks are well-known to be physically demanding. They place a sheer volume of stresses on the musculoskeletal systems (e.g., muscles, tendons, ligaments and bones) of workers and result in one of highest musculoskeletal disorders (MSD) incidence rates among all industries. A diversity of MSD risk assessment methods has been developed to reveal and reduce MSD risk factors on construction sites. However, these methods rely heavily on expert judgment to detect risk, and most MSD prevention guidelines are general, intended to be used for all industries.



The recent development of non-invasive sensing techniques such as Kinect has allowed tracking spatiotemporal information of human joints to objectively capture human motion and to detect very basic unsafe actions. However, the construction field has diversely complex activities, each of which consists of a group of distinguishable operations. We propose decomposing typical construction task processes into step-by-step operations and interpreting each operation with physical postures and motions, denoted as working behaviors. Based on a literature review and site observations, typical construction jobs tend to have one or several repetitive work processes. These jobs include, but are not limited to, masonry, carpentry, drywall installing, roofing, and plumbing. We selectively focus on bricklaying and roofing in this study. Through site survey and surveillance video study, the processes of these two tasks are decomposed into detailed actions and represented in two ways: step-by-step operations and working behaviors. The working behaviors include risk-oriented behaviors like handling, lifting, stretching, carrying, turning, squatting, and bending on even and uneven ground. In the future, the sequential operations of a construction task process will be mimicked in a laboratory environment in which Kinect and Vicon can be used to detect unsafe behaviors and quantify level of risk of these behaviors.

### Microbiology

JAMES BIRCH and JOSEPH HORZEMPA, Dept. of Natural Science and Mathematics, West Liberty University, West Liberty, WV 26074. **The role of erythrocyte cytoskeleton during invasion by *Francisella tularensis*.**

Needing fewer than ten bacteria to establish a lethal infection, *Francisella tularensis* has been classified as a Category A bioterrorism agent by the Centers for Disease Control and Prevention. One novel characteristic of *F. tularensis* is its ability to invade erythrocytes; however the mechanism of entry into these host cells is still

unknown. Research has shown that cytoskeletal rearrangement of hepatocytes and macrophages is necessary for invasion of these host cells by *F. tularensis*. Therefore, we evaluated the role of the erythrocyte cytoskeletal constituents during invasion. To test this, cytochalasin D, mitoxantrone, or phalloidin, (inhibitors of actin polymerization, spectrin-phospholipid interactions or actin depolymerization, respectively) were administered during an in vitro erythrocyte invasion assay. Equivalent numbers of *F. tularensis* bacteria were found in erythrocytes treated with and without the aforementioned inhibitors. This suggests that neither actin polymerization, depolymerization, nor spectrin-phospholipid interactions are involved in bacterial entry.

COREY CLEAVENGER and DONALD TRISEL, Dept. of Biology, Chemistry, and Geoscience, Fairmont State University, Fairmont WV 26554. **Antimicrobial activity of natural products on *Escherichia coli*, *Bacillus cereus*, *Klebsiella pneumoniae*, and *Staphylococcus epidermidis*.**

Bacterial infections are becoming harder to treat as they become more resistant due to the repetitive use of manufactured antibiotics employed by healthcare. Research must be conducted to further explore and identify possible natural products that may contain antimicrobial characteristics. The objective of this experiment was to screen a variety of natural products, including Christmas fern (*Polystichum acrostichoides*), common dandelion (*Taraxacum officinale*), red clover (*Trifolium pretense*), broad leaf cattail (*Typha latifolia*), and propolis from a local bee hive for antimicrobial activity. Extracts from these natural products were prepared in 100% distilled water, 70% methanol, and 70% ethanol to test against *Escherichia coli*, *Bacillus cereus*, *Klebsiella pneumoniae*, and *Staphylococcus epidermidis*. Extracts were administered using a series of assays, including a paper disk diffusion assay, an agar well assay, a serial dilution assay, and a leaf disk assay. The 70% methanol and 70% ethanol extracts of propolis inhibited *Bacillus cereus* and *Staphylococcus epidermidis* in the

disk diffusion and agar well assays. The 70% methanol extract of Christmas fern inhibited the same bacterial strains in the agar well assay. The serial dilution assay indicated possible inhibition toward *Bacillus cereus* down to an amount of 50  $\mu$ L of 70% methanol extract from Christmas fern. The leaf disk diffusion assay did not result in the inhibition of bacterial growth for any of the species tested. This study concluded that extracts from Christmas fern and propolis effectively inhibited Gram positive bacterial strains.

This project was supported by a Fairmont State University SURE grant.

JOSEPH HORZEMPA and DEANNA SCHMITT, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **The use of resazurin as a novel antimicrobial agent against *Francisella tularensis*.**

The highly-infectious and deadly pathogen, *Francisella tularensis*, is classified by the CDC as a Category A bioterrorism agent. Inhalation of a single bacterium results in an acute pneumonia with a 30–60% mortality rate without treatment. Due to the prevalence of antibiotic resistance, there is a strong need for new types of antibacterial drugs. Resazurin is commonly used to measure bacterial and eukaryotic cell viability through its reduction to the fluorescent product resorufin. When tested on various bacterial taxa at the recommended concentration of 44  $\mu$ M, a potent bactericidal effect was observed against various *Francisella* and *Neisseria* species, including the human pathogens type A *F. tularensis* (Schu S4) and *N. gonorrhoeae*. A concentration as low as 4.4  $\mu$ M resazurin was sufficient for a 10-fold reduction in *F. tularensis* growth. In broth culture, resazurin was reduced to resorufin by *F. tularensis*. Resorufin also suppressed the growth of *F. tularensis*, suggesting that this compound is the biologically active form responsible for decreasing the viability of *F. tularensis* LVS bacteria. Replication of *F. tularensis* in primary human macrophages and non-phagocytic cells was abolished following treatment with 44  $\mu$ M resazurin, indicating that

this compound could be an effective therapy for tularemia *in vivo*. We are currently investigating the therapeutic efficacy of resazurin in the mouse model of tularemia.

SIRISHAMANTHA and JENNIFER WEIDHAAS, Civil and Environmental Engineering, West Virginia University, Morgantown, WV 26505. **A poultry litter marker gene correlates with pathogen and fecal indicator bacteria deposition, growth and transport from poultry bedding.**

Poultry is one of the major contributors of fecal inputs to U.S. environmental waters due to their importance in agriculture and disposal practices. Deposition studies were conducted to evaluate the deposition rate of microorganisms during the growth of poultry, while simultaneously evaluating growth or decay of microorganisms after deposition on the wood shavings. Culture and qPCR analysis revealed growth of *Enterococcus*, *Staphylococcus* and *Bacteroidales* in the litter for up to four weeks after deposition in feces. In contrast, *Escherichia coli* concentrations declined after deposition in feces on litter. The poultry litter marker *Brevibacterium* sp. LA35 was found to increase in the litter over time. The deposition study aids in our understanding of the deposition, survival and growth of microorganisms in and on poultry litter. We also evaluated the release and transport of pathogens (*Salmonella* spp.), FIB (*Enterococcus*, and *E. coli*) and MST markers (LA35 and *Bacteroidales*) from poultry litter under simulated rainfall events through soil columns. The transport and attenuation of microorganisms was observed through an acid washed sand column and organic soil columns over 10 to 30 pore volumes of deionized water. The qPCR analysis revealed that breakthrough of pathogens and MST markers were correlated. These soil column studies aid in our understanding of the release, transport and attenuation of pathogens from poultry litter.

KAITLYN MARTIN, STEPHANIE REMIAS, STEVEN ROOF, and DONALD TRISEL, Dept. of Biology, Chemistry and Geosciences, Fairmont

State University, Fairmont, WV 26554. **Bacterial inhibition of extracts from *Allium sativum*, *Juglans nigra*, *Liriodendron tulipifera*, and *Echinacea purpurea*.**

Many native West Virginia plants have known medicinal properties and have been used historically before modern treatments and antibiotics were available. These secondary compounds in plants can still play an important role in medicine today for home remedies, extracts for commercial drugs, and models for synthetic drugs. We characterized antibacterial activity of plant extracts of *Allium sativum*, *Juglans nigra*, *Liriodendron tulipifera*, and *Echinacea purpurea*. Compounds from these plants were tested against eight species of bacteria chosen to fall into four groups: Gram positive/human source, Gram negative/human source, Gram positive/soil source, and Gram negative/soil source. Antibacterial activity was determined using the agar well diffusion method and measuring the zone of inhibition. Results showed there were no significant differences between Gram positive and Gram negative bacteria, or bacteria from human and plant hosts. However, there was a trend for stronger inhibition against bacteria from a human host and a weaker trend for stronger inhibition against Gram negative bacteria. *Juglans nigra* extract had the greatest inhibition effects against bacteria, while the other three plants showed much weaker results.

STEPHANIE REMIAS, KAITLYN MARTIN, STEVEN ROOF, and DONALD TRISEL, Dept. of Biology, Chemistry, and Geosciences, Fairmont State University, Fairmont, WV 26554. **Antimicrobial effect of fresh and dried *Juglans nigra* extracts against *Staphylococcus epidermidis*.**

This study looked at fresh and dried *Juglans nigra* leaf extracts to determine if the drying and storage process affects antimicrobial properties of the extract. If dried plants are equally effective, then this opens up more options for keeping specimens stocked over time for use later, for example when the plant isn't in bloom. Plant extracts were prepared

by blending fresh and dried *Juglans nigra* leaves in methanol. To determine antimicrobial effect, tryptic soy agar was inoculated with *Staphylococcus epidermidis* and allowed to harden. A cork borer was used to punch holes into the agar, the plant extracts were dispensed into the wells, and the plates were incubated at 37 °C overnight. The zones of inhibition were measured in millimeters. The fresh extract had the largest zone of inhibition, with much smaller zones seen for the dried extracts. Further research would need to be done to determine the specific compound(s) in *Juglans nigra* leaves responsible for the antimicrobial effects seen here. It would also be useful to examine the antimicrobial ability of *Juglans nigra* extracts against other bacteria. Research could also be done to determine if long-since dried plants from a herbarium exhibited the same inhibition patterns seen as the dry extracts in this study.

DEANNA M. SCHMITT and BRIANNA S. COWAN, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074; DOUGLAS S. REED, Regional Biocontainment Laboratory, Center for Vaccine Research, University of Pittsburgh, Pittsburgh, PA 15261; JOSEPH HORZEMPA, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **Identification of *Francisella tularensis* factors that mediate erythrocyte invasion: a novel feature of pathogenesis.**

Inhalation of the category A bioterrorism agent, *Francisella tularensis*, results in an acute, lethal pneumonia in up to 60% of individuals if left untreated. Recently, erythrocytes were identified as a novel intracellular niche for this bacterium. In this study, we sought to evaluate the role of erythrocyte invasion in *F. tularensis* pathogenesis, and identify bacterial components involved in this process. Invasion of erythrocytes enhanced virulence *in vivo* as mice inoculated with red blood cells infected with the virulent type A *F. tularensis* strain SchuS4 succumbed more rapidly than mice injected with lysed red blood cells and Schu S4. *In vitro*, immunogold transmission electron microscopy revealed that



*F. tularensis* secretes antigenic material into the cytoplasm of erythrocytes. *F. tularensis* possesses three different predicted protein secretion systems: types I, II, and VI. Mutation of various genes encoding components of the type II secretion system in the attenuated *F. tularensis* strain LVS did not alter invasion of erythrocytes. A reduction in erythrocyte invasion was observed, however, with a type I secretion system mutant,  $\Delta\text{EmrA1}$ , compared to wild-type LVS. Deletion of VgrG, a component of the type VI secretion system, and MglA, a transcriptional regulator of the type VI secretion system, also exhibited diminished invasion of erythrocytes. Investigation into the specific role VgrG and EmrA1 plays in *F. tularensis* infection of erythrocytes is ongoing.

This study was supported by NIH Grant 5P20RR016477 to the West Virginia IDeA Network for Biomedical Research Excellence, a grant from WV-INBRE (P20GM103434), and funding from NIH-NIAID (5K22AI087703).

### Psychology

SAMUEL A BROOKER and ALAN M. DANIEL, Dept. of Social Sciences Glenville State College, Glenville, WV 26351. **Isopod learning: you're going to need a smaller maze.**

It has been debated in the field of experimental psychology if S-R (response) or S-S (stimulus) learning occurs when something is learned. That is to say, is an action being performed for a reward or simply because it is the appropriate response for the given situation? This question can be approached using a simple nervous system and a simple apparatus. We have been refining a method for using isopods in a T-maze as a model to distinguish the conditions that generate S-R or S-S learning. Isopods learn to turn left or right, then the animal is started at a new location in the maze on occasional probe trials. Whether they go to the reward area or make the habitual turning response dissociates S-S and S-R learning, respectively. If successful, this model will establish a paradigm for understanding how S-R and S-S learning develop using neuroscience techniques.

JUDITH URBANIC and ALAN M. DANIEL, Dept. of Behavior Science, Glenville State College, Glenville, WV 26351. **To bee or not to bee? That is the depression.**

The present experiments explored situations that produce resistance to extinction such as the magnitude of reinforcement extinction effects (MREE) and partial reinforcement extinction effect (PREE), and the underlying mechanisms that control these effects in honey bees. In each experiment the honey bees were exposed to a reward (10% or 40% sucrose) in acquisition, and the reward was downshifted during extinction (0% sucrose). Smaller downshifts (experiment 1) and prior exposure to non-reward (experiment 2) both resulted in prolonged extinction. In experiment 3, exposure to isopentyl acetate (key component of alarm pheromone) also produced prolonged extinction, an effect which was blocked by the opioid antagonist naloxone. Together, these results parallel non-reward in vertebrates, and implicate an opioid mechanism much like that which is seen in mammals. This warrants further exploration of honey bees as a model of human anxiety.

This research was funded by WV Space Grant Consortium.

### Science Education

MATT GREATHOUSE and STEVEN ROOF, Dept. of Biology, Chemistry and Geosciences, Fairmont State University, Fairmont, WV 26554. **ExoLabs in high-resolution iPad camera in the Biology laboratory.**

This project was designed to investigate the effectiveness of using an ExoLabs high-resolution iPad camera for future laboratory experiments in courses such as Microbiology, Zoology, and Botany. The camera/iPad was used to observe bacterial growth through time-lapse photography. The camera was also used as a tool to save and annotate images seen through a microscope.

Trypticase soy agar plates were inoculated

with various bacteria, incubated at room temperature, and the growth of the colonies was recorded by the camera. Resulting images were used to determine bacterial growth rates. The camera was also attached to a microscope and images of slides were recorded. Using the ExoLabs application included with the camera, images were annotated and exported to create a sample digital lab notebook. The ExoLabs camera and application is easy to use and would assist in student learning.

PHILIP D. KAHLY and MAHMOOD HOSSAIN, Dept. of Computer Science, Fairmont State University, Fairmont, WV 26554. **A data mining approach for analyzing dependencies between course learning outcomes.**

Many educators today utilize an outcomes-based approach in their classrooms and maintain records of student performance on specific learning outcomes. However, extracting meaningful information from this ever-growing collection of data is a challenging task. The goal of this work was to develop a data mining tool to extract key learning patterns from student performance records accumulated by educational programs that employ an outcome-based instructional paradigm. In particular, we utilized “dependency mining” to determine whether the masteries of a set of course outcomes are dependent on each other. We generated multi-level dependency graphs to extract the dependencies between course outcomes. The dependency graphs allow us to extract both the forward dependencies and backward dependencies between course outcomes, i.e., we can determine if masteries of certain course outcomes are needed in order to achieve mastery of a given outcome, and also if the mastery of any given course outcome will influence the mastery of other outcomes.

EMILIE PLATEK and CAITLYN SHANE, Dept. of Computer Science, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443. **The Pythagorean propositions project.**

Every mathematical project includes proof,

but reproof is often overlooked as a vital method of mathematical research. Case in point: in 1799, the University of Helmstedt granted Gauss a Ph.D. in mathematics for a dissertation that gave a new proof of the Fundamental Theorem of Algebra. Another similarly fine example is the Pythagorean Theorem. The *Pythagorean Propositions* compiled by E. S. Loomis includes over 300 such proofs. The text is written to follow the manner of the original proof by authors such as Copernicus, Descartes, Euclid, Galileo, Gauss, Leibniz, Lobachevsky, Napier, Newton, Pythagoras, and Sylvester; thus, it is difficult to read in terms of the notation, not trivial in terms of the mathematical concepts, and the few illustrations that are included are primitive.

The Pythagorean Propositions Project digitally visualizes selected proofs of the *Pythagorean Propositions*. The project creates a web friendly environment upon which students construct and disseminate visually enhanced proofs. Each selected proof from Loomis is presented in a dual representation format: an enhanced mathematical argument on the left side reinforced by the corresponding geometric figure on the right. As the viewer “mouses” over the logical argument on the left, the corresponding image on the right will provide an immediate visualization of the concept. The outcome is an enhanced mathematical presentation of classic proofs that leads to improved understanding of the Pythagorean Theorem, as well as mathematics as a whole.

### Soil Science

MICHAEL B. HARMAN, West Virginia University Cooperative Extension Service, Kearneysville, WV 25430. **Identifying farmland of local importance in Berkeley and Jefferson Counties.**

The determination of farmland of local importance is a critical component in protecting local agricultural land. However, the initial responsibility for identifying this land falls upon

local units of government who are given limited guidance, direction, and support. As such, this can be a highly subjective process. The objective of this study was to systematically identify potential farmland of local importance in Berkeley and Jefferson Counties of West Virginia to facilitate a more informed and less subjective determination. To this end, I examined the definitions of other important soils, develop local criteria based on our specific regional agricultural community, and used GIS to identify potential farmland of local importance. I identified three map units in each county for further consideration. Following a closer examination of their extents, descriptions, and patterns of use, I provided the appropriate local unit of government the rationale for considering these soils, along with my own expert recommendations. The local unit of government was then able to objectively evaluate the data and make a more informed, less subjective decision, and chose to not submit any soil map units to the state conservationist for consideration as farmland of local importance in Berkeley and Jefferson Counties.

BOBBI PHILLIPS, COURTNEY SWIGER, DONALD TRISEL, Dept. of Biology, Chemistry and Geoscience, Fairmont State University, Fairmont, WV 26554. **Effects of MycoGrow™ For Vegetables on germination and overall growth of corn, bean and other vegetable species.**

Mycorrhizal fungi are root stimulators and soil conditioners that aid in a plant's overall health. These specific types of fungi have developed a symbiotic relationship with root systems of living plants. Systems of mycorrhizal filaments cover the seedling root structure, aiding in the plant's ability to utilize water and nutrients in the surrounding soil. This relationship allows for healthy, strong, and natural growth. MycoGrow™ For Vegetables is a specific planting supplement designed by Fungi Perfecti MycoGrow™, containing endomycorrhizal species selected specifically for vegetables. It contains concentrated spore mass for the following endomycorrhizal species: *Glomus intraradices*, *Glomus mosseae*, *Glomus aggregatum*, and *Glomus etunicatum*.

We began this project with the goal to assess the manufacturer's statements, with the hypothesis that the MycoGrow™ For Vegetables mycorrhizae supplement would increase the overall growth and health of plants compared to a sterilized soil control. The seeds of several different species of vegetables, along with transplants of corn and beans were planted in sterilized soil with or without the added supplement. Each plant was then observed and evaluated for total health and performance. When this experiment is completed, all roots will be examined for any signs of symbiotic relationships. In addition, dry weight biomasses of these roots will be calculated. Our final germination, growth, and health results will be compared between the treatments and also between the various vegetable species that were examined.

COURTNEY SWIGER, BOBBI PHILLIPS, DONALD TRISEL, Dept. of Biology, Chemistry, and Geoscience, Fairmont State University, Fairmont, WV 26554. **Effects of MycoGrow™ Soluble Mycorrhizae on germination and early growth of corn, bean and other vegetables.**

Mycorrhizal fungi have developed a symbiotic relationship with the root systems of living plants, from garden vegetables to the trees of the Old Growth forests. Networks of mycorrhizal filaments envelope the seedling root structure, supporting the plant's ability to utilize water and nutrients in the soil. MycoGrow™ Soluble Mycorrhizae is a planting supplement that contains endomycorrhizal fungi, ectomycorrhizal fungi, *Trichoderma* spores and beneficial bacteria that help plants to grow strong and healthy. This project was initiated to evaluate the manufacturer's claims, and we hypothesized that MycoGrow™ Soluble Mycorrhizae supplement would enhance the growth and overall health of the plants compared to a sterilized soil control. Seeds of several species and transplants of corn and beans were planted in sterilized soil with or without the added supplement. The plants were then monitored over time through growth phases and evaluated for overall health and performance. Upon completion of the experiment, roots will

be examined for signs of symbiotic relationships and dry weight biomass will be determined. Results of germination, growth, and health will be compared between treatments and between the vegetable species examined.

ADAM WILSON and DAVID O'DELL, Dept. of Science and Mathematics, Glenville State College, Glenville, WV 26351. **Transport of glutaraldehyde in packed and undisturbed soil columns.**

Glutaraldehyde (1,5-pentanedial) is an organic molecule used to inhibit microbial activity in applications such as cooling towers, hydraulic fracturing, and disinfection of medical equipment. The transport of glutaraldehyde in soil was investigated using both packed and undisturbed columns (30 cm length x 5 cm diameter) of Sensabaugh loam (fine-loamy, mixed, semiactive, mesic Dystric Fluventic Eutrudepts). Packed soil columns were made using soil taken from the A and portions of the B horizon and screened to particle sizes of less than 2 mm. Undisturbed columns were obtained by inserting PVC pipe into the soil profile and then extracting the intact column. To measure flow under unsaturated conditions, columns were maintained at a tension of 20 cm H<sub>2</sub>O. After establishing steady-state flow with a 0.01 M CaCl<sub>2</sub> solution, the columns were subjected to a continuous application of 1 mM glutaraldehyde and 0.01 M MgBr<sub>2</sub>, with Br acting as an unreactive tracer. Bromide and glutaraldehyde transport were modeled using the one-dimensional convective-dispersive equation.

### Stream Ecology

ERICA ADAMSKI and PETER VILA, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443. **Relationship between water quality in a tidal freshwater wetland and the presence of *Fundulus diaphanous* at Otter Point, Md.**

The *Fundulus diaphanous* (Banded killifish) population has been declining in Otter Point

Creek in Abingdon, Maryland. This objective of this study was to determine the relationship between physical and chemical variables and Banded killifish population density at four sites at Otter Point Creek. *F. diaphanous* densities were determined by seining for twelve weeks during the summer of 2013. Measurements of dissolved oxygen (mg/L and percent saturation), pH, salinity, temperature, nitrate, phosphate, and turbidity were recorded over the course of the 112 observation days. Dissolved oxygen was the only variable significantly correlated to male and female Banded killifish densities. However, dissolved oxygen was also significantly correlated with salinity, pH, phosphate, and turbidity at Otter Point Creek and further study is needed to elucidate whether interaction between these variables is contributing to the declining population of Banded killifish.

ELLIOTT ANTULOV and MARK FLOOD, Dept. of Biology, Chemistry and Geosciences, Fairmont State University, Fairmont, WV 26554. **Determining the effect of aluminum nitrate levels on *Rana pipiens* tadpoles' growth and development.**

Acidification of fresh water has increased in previous years, and its effect on amphibians is becoming a focus for research to determine long term consequences. This research project focuses on the effects aluminum nitrate has on the development and growth of grass frog, *Rana pipiens*, tadpoles. Aluminum nitrate is a salt of aluminum and nitric acid. It is a strong oxidizing agent and commonly used in tanning leather, antiperspirants, corrosion inhibitors, extraction of uranium, petroleum refining, and as a nitrating agent. The objective of this experiment was to measure the effects of chronic exposure to three levels of aluminum nitrate, 0 g/ml, 0.00048 g/ml and 0.00096 g/ml added to water samples collected from acid mine drainage areas. The hypothesis was that the higher concentration of aluminum would cause more adverse effects on tadpole development. A total of 54 tadpoles were exposed over a 6 week period to water from three different creeks that contained acid mine drainage.



Samples from each creek, Squires, Raccoon, and Birds, were taken above and below currently installed limestone dosers. Observations were recorded three times per week to document effects during the 6 week period. Mortality was observed to be the highest in the water samples taken above the dosers. This may have been due to the high acid content, and an increased toxicity of the aluminum in those samples. Future experiments are planned to investigate if different sources of aluminum, such as aluminum chloride, have the same toxic effects.

ZANE DENNISON, DUSTIN SPENCER, and MARK FLOOD, Dept. of Biology, Chemistry, and Geoscience, Fairmont State University, Fairmont, WV 26554. **Using aquatic organisms to assess the effectiveness of acid mine drainage remediation in the Three Fork Creek watershed.**

The recent waning of the West Virginia Coal Industry has resulted in abandoned mines. Several of these mines, particularly in North-Central West Virginia, have negatively impacted local streams and rivers due to the toxic effects of acid mine drainage (AMD). This project's main objective was to assess if the recent installation of three limestone dosers were positively impacting stream health. Data collected during the summer of 2013 were compared to previously-collected samples above and below where the dosers were installed. Water quality was assessed using a YSI multi-probe that measured the pH, temperature (°C), conductivity ( $\mu\text{S}/\text{cm}^2$ ), dissolved oxygen (mg/L), total dissolved solids (g/L), salinity (ppt), oxidation reduction potential (mV), and turbidity (NTU) of the stream water. In addition, native aquatic macro-invertebrates were sampled and longevity of *Daphnia magna* (water flea) was analyzed after exposure to water samples gathered from above and below doser sites. Data indicated that the three limestone dosers were producing a positive impact on overall water quality. For example, increased pH values and increased survivability of *Daphnia magna* over time when exposed to below doser water samples verified the presence of stream remediation. Continued monitoring of AMD remediation in Three Fork Creek and its tributaries will be important to make

sure that stream health continues to improve.

This project was supported by the NASA West Virginia Space Grant Consortium.

DUSTIN REVELL and CAROL Z. PLAUTZ, Dept. of Biology, Shepherd University, Shepherdstown, WV 25443. **Molecular investigations into the genome of a non-model organism, *Lymnaea palustris*.**

The pond snail *Lymnaea palustris* has been a useful model for studying aquatic toxicology and the effects of contaminants on aquatic invertebrates. Previous studies have demonstrated that Roundup and some of its constituents disrupt embryological development, reproduction, and learning and memory formation in *L. palustris*, likely through mechanisms disrupting Steroidogenic Acute Regulatory Protein (StAR) and Protein Kinase C (PKC). In order to determine if these disruptions are direct effects, and whether they are caused by changes in gene transcription or post-transcriptional regulatory mechanisms, the genetic sequences of *L. palustris* StAR and PKC mRNAs are required. However, as none of the genome has yet been published, it is required to clone these genes from the pond snail.

To clone these *L. palustris* genes, we designed degenerate primers via homology at the amino acid level with genes in a variety of phyla, and performed RT-PCR with RNA isolated from embryos as well as from adult cerebral ganglia. Amplicons of appropriate size were then purified, cloned into an appropriate vector, sequenced, and compared to homologues in other species in GenBank. Analysis of the sequences generated and future directions with these new reagents will be presented.

DUSTIN SPENCER, ZANE DENNISON, and MARK FLOOD, Dept. of Biology, Chemistry, and Geoscience, Fairmont State University, Fairmont, WV 26301. **Does local Marcellus well drilling impact water quality of nearby streams?**

Water quality in local areas is not at its highest



here in West Virginia. This is apparent when examining the streams feeding into the larger rivers such as the Tygart and Monongahela. The danger of Marcellus wells lies in the method used to dig them and the disturbances they cause to the surrounding well pad. Data collected during the summer and fall of 2013 compared water quality above and below several Marcellus well sites in Harrison and Doddridge counties. Water quality was assessed using a YSI multi-probe that measured the pH, temperature ( $^{\circ}\text{C}$ ), conductivity ( $\mu\text{S}/\text{cm}^2$ ), dissolved oxygen ( $\text{mg}/\text{L}$ ), total dissolved solids ( $\text{g}/\text{L}$ ), salinity (ppt), oxidation reduction potential (mV), and turbidity (NTU) of the stream water. In addition, native aquatic macro-invertebrates were sampled. Results showed that total dissolved solids (TDS) were higher below the wells for all streams except one. Water quality, according to the FBI index, was healthy overall with the exception of Cherry Camp. Cherry Camp water quality above was in good condition while below was in fairly poor condition. Turbidity was also higher below the well sites in three of the streams. Monitoring is needed to continue to assure that contamination of water surrounding Marcellus well sites does not occur in the future.

This project was supported by the NASA West Virginia Space Grant Consortium.

KALYN WALKER and MARK FLOOD, Dept. of Biology, Fairmont State University, Fairmont, WV 26554. **Effects of nonylphenol on development of the Grass frog tadpole (*Rana pipiens*).**

Nonylphenol is a toxic chemical commonly used in industrial surfactants, plastic food packaging, household cleaners, fracking solution, and many others. Through pollution, this chemical is appearing in bodies of water throughout the globe and interfering with the natural development of the organisms living there. At sublethal concentrations, this chemical is an endocrine disruptor capable of interfering with the hormonal system of the organisms

that come into contact with it. In amphibian metamorphosis, hormone balance is very important for successful development. In this experiment, grass frog tadpoles were exposed to varying molarities of nonylphenol solutions to study the chemical's effect on the development of the tadpole. Five groups were set up, including a control group exposed to only distilled water, and four treatment groups where tadpoles were exposed to 0.425nM, 0.850nM, 1.275nM, and 1.7nM nonylphenol solutions. Three replicates per treatment were performed. Physical and behavioral changes were observed every other day, and weight and measurement were taken once a week. Initial results showed that tadpoles exposed to the higher concentrations of nonylphenol gained weight and grew in length more quickly than the control. Average growth rate increased as molarity of nonylphenol solution increased. No behavioral or physical differences between the subjects were observed with initial results. Future experiments will attempt to verify if this trend is observed in limb development, as well as early tadpole development.

KATELYN WALTERS and CAROL Z. PLAUTZ, Dept. of Biology, Shepherd University, Shepherdstown, WV 25443. **The effects of the water quality at Harper's Ferry National Historic Park on the development of *Xenopus laevis* and *Lymnaea palustris* embryos.**

This investigation sought to determine the presence of bromide, chloride, nitrate and phosphate pollutants in the Potomac and Shenandoah rivers near Harpers Ferry National Historical Park, and to determine if these could be a potential developmental detriment to embryos of native aquatic species by testing varying concentrations of these ions on two comparable organisms with well documented development, *Xenopus laevis* and *Lymnaea palustris*.

Chronic and pulse tests were conducted on each species with varying concentrations from 1/4x to 100x, with the 1x values of each ion representing maximum contaminant level standards (MCL) or goals (MCLG) set by the

EPA. The nine-week water quality testing revealed that neither river exceeded the drinking water MCLs for chlorides or nitrates; however, the MCLG for phosphate was exceeded repeatedly in both rivers (unambiguous testing for bromides was unavailable). Statistical analysis of chronic embryological testing showed that *X. laevis* were unaffected by all concentrations of tested ions, though wide variation among clutches warrants further investigation. Developmental abnormalities were confirmed in *L. palustris* in chronic bromide and nitrate treatments at all concentrations and chlorides at the highest concentration. Chronic phosphate treatment had no effect on *L. palustris*. The 24-hour pulse exposures revealed no significant sensitive periods.

Future research will test these ions in combination and investigate factors that may alter susceptibility of embryos of the same species to pollutants. Finally, year round monitoring of the rivers and streams would provide a better picture of ion fluctuations and potential high-risk periods that could harm the native species.

## Zoology

ERIC TENNANT, LORI HENRY, and HEATHER KALB, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **Effect of UVB radiation and different temperatures on growth in 500 day old Malayan box turtles (*Cuora amboinensis*).**

We compared growth in hatchling Malayan box turtles raised with or without UVB light. We wanted to know if UVB radiation in the form of special lights was necessary for the successful rearing of Malayan box turtles when they were consuming a diet rich in Vitamin D3 (Reptomen pellets). Sixteen hatchlings were exposed to UVB radiation from 5.0 Reptisun lights with a minimum level of 20 mW/cm<sup>2</sup> for 12 hours per day for about 500 days. Another 16 turtles had the same UVB lights, but with a protective UVB sleeve that reduced the UVB output to 0. No significant differences were observed in growth

rates for carapace length, plastron length, shell width, shell height, weight, or density (weight/scl) ( $p>0.05$ ). All turtles had firm solid shells.

Turtles were housed on four vertically stacked shelving units. Each shelf housed turtles from both study groups. The higher shelves were warmer, resulting in larger, hungrier turtles than the lower shelves. There were no significant differences in turtle morphology between adjacent shelves, however the top shelf (1) and the next lowest (2) had turtles significantly longer (CL), heavier, or wider (just tank 1 vs. 4) turtles than the turtles on the lowest shelf (4). The presence or absence of UVB radiation in this study had no effect on growth rates, while warmer temperatures caused an increase in growth rates and abnormal curling of the carapace.

This research was financially supported by a faculty development grant from West Liberty University.

## POSTER PRESENTATIONS

**Aquaculture**

HEATHER DAILEY and PETER VILA, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443. **Analysis of growth rates for Walleye with fishmeal and zero fishmeal diets.**

The objective of this study was to determine the growth rates of Walleye fed fishmeal and zero fishmeal diets. The Walleye were stocked within Recirculating Aquaculture Systems, and each tank was custom made to accommodate the Walleye so that the water and the lighting are environmentally stable for each Walleye. There was no difference between the growth rates on the first two sampling dates. However, diet did impact growth rates by the last sampling date, although final weights were similar. This experiment showed that Walleye that consume a zero fishmeal diet can grow at the same rate as Walleye that consume a fishmeal diet. These results are significant as the use of zero fish-meal has a significantly lower environmental impact.

**Cell Biology**

ANDY ABRAHAMIAN and WILLIAM WONDERLIN, Dept. of Biochemistry, Robert C. Byrd Health Science Center, West Virginia University, Morgantown, WV 26505. **Which type of aggregate of alpha synuclein increases the permeability of the rough endoplasmic reticulum to small molecules?**

The protein alpha synuclein (AS) has been observed to increase the permeability of the rough endoplasmic reticulum (RER) to small molecules. This increase could result in a loss of calcium homeostasis. This mechanism of cell death in neurons is believed to contribute to neurodegenerative diseases. The toxicity effect of AS is commonly believed to result from the formation of one or more types of aggregates. The goal of this research was to test the hypothesis that

stimulation is caused by the colloidal aggregate. We expressed both a wildtype and A53T mutant strand of AS in BL21 cells, which favor colloidal and amyloid aggregates, respectively. We then isolated the protein from the periplasm, via permeabilization, centrifugation and column chromatography. Fluorescence was then performed on permeabilized CHO-K1 cells to measure the effect of the protein on RER permeability. Assays were performed using concentrated fractions of both types of AS, certain fractions were heated for various periods to stimulate wild type colloidal aggregation and mutant fibrillar aggregation. AS was observed to cause sizable stimulation, but there was no difference in stimulation between either type of AS. We will continue with biochemical assays in order to verify which aggregates were formed from each strand.

This study was supported by NIH Grant 5P20RR016477 to the West Virginia IDeA Network for Biomedical Research Excellence.

MEGAN BEHRMANN, LOGAN LYDA, Dept. of Chemistry, Shepherd University, Shepherdstown, WV 25443; BRITTANY POLLING, BURTON LIDGERDING, Dept. of Biology, Shepherd University, Shepherdstown, WV 25443; DENISE M. GIPSON, Jefferson High School, Shenandoah Junction, WV 25442; QING WANG, Dept. of Computer Sciences, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443; DAVID J. KLINKE, Dept. of Chemical Engineering, and Dept. of Microbiology, Immunology and Cell Biology, West Virginia University, Morgantown, WV 26506. **Cell culture of S91 melanoma cells in three-dimensional space.**

When researching drugs and methods for eradicating cancer, the standard practice is to culture the cancer cells *in vitro* on a two-dimensional surface. However, cancer cells in

the living host grow in three dimensions. This is a concern because cells frequently behave differently when grown in three-dimensional space versus grown flat on a surface. In this study, S91 mouse melanoma cells were cultured in a three-dimensional matrix (ECM) and compared to cells grown traditionally. The growth in the two formats was compared to determine if culturing in ECM matrix culturing was successful using an MTT assay. The data shows that S91 cells can be grown successfully on an ECM simulating the conditions *in vivo*. The possible differences between behaviors of cells grown in three- versus two-dimensional culture could have a significant effect on the ability of drugs to treat cancer cells and on the ability of cytotoxic T cells to eliminate cancer cells.

The project has been supported by the NIGMS of the NIH grant as part of the WV-INBRE (P20GM103434) and SOARS.

AMY FARSON, CORNELIUS HOLYFIELD, ALICE MAGRO and ALBERT MAGRO, Dept. of Biology, Fairmont State University, Fairmont, WV 26554. **Induction of apoptosis in human glioblastoma cells by staurosporine as compared to temozolomide and the natural products epigallocatechin gallate and thymoquinone.**

Apoptosis, the major mechanism of non-necrotic cell death, occurs in the drug treatment of malignant tumors. Chemotherapeutic treatment of a tumor creates a complex mixture within the tumor. This mixture consists of apoptotic cells that are susceptible to the drug treatment along with viable non-apoptotic cells that are drug resistant. The effectiveness of staurosporine as an apoptotic inducing agent was compared to the effectiveness of temozolomide, epigallocatechin gallate and thymoquinone. Staurosporine is a protein kinase inhibitor. Temozolomide is the leading compound in a class of chemotherapeutic agents that enter the cerebrospinal fluid and do not require hepatic metabolism for activation. Temozolomide is one of the current drugs of choice for primary treatment and adjuvant therapy for recurrent glioblastoma. Epigallocatechin

gallate and thymoquinone are natural products isolated from green tea and black bean oil, respectively. Both natural products have been reported to have anti-cancer properties. Various apoptotic assays were used including dot plots, changes in mitochondrial potential and *Terminal Uridine Nick-End Labeling* (TUNEL). A variety of glioblastoma cell lines were used including U87-MG, U118-MG, LN18, MO59-J and T98-G. Staurosporine effectively induced apoptosis in all five cell lines at concentrations of 0.5  $\mu$ M and 1  $\mu$ M. Overall, the data show that staurosporine is much more effective as an apoptotic inducing agent in all cell lines as compared to the chemotherapeutic temozolomide and the natural products epigallocatechin gallate and thymoquinone.

This study was supported by NIH grants P20RR016477-12 and P20GM103434-12 awarded to the West Virginia IDeA Network for Biomedical Research Excellence.

PATRICK GUE, COLIN WINKIE and BRUCE ANTHONY, Dept. of Chemistry, West Virginia Wesleyan College, Buckhannon, WV 26201. **Protein-protein interactions for cell cycle proteins with fetal neural stem cells exposed to alcohol.**

Fetal alcohol spectrum disorder (FASD) is a syndrome phenotypically expressed among children whose mothers consumed varying quantities of alcohol during the fetal development period. While symptoms of FASD, such as growth retardation and central nervous system damage, have been attributed to alcohol's ability to promote disjointed DNA synthesis and cellular apoptosis, the molecular mechanisms through which alcohol causes such actions are still only partially explored. Understanding these molecular mechanisms could provide the potential for the development of treatments that prevent FASD, and even anti-cancer treatments which take advantage of the molecular pathways through which alcohol induces apoptosis. Therefore, this experiment focused on the protein-protein interactions within fetal stem cells exposed to alcohol. Specifically, the



interactions of the proteins pRb, E2F1, and DP-1 were observed due to previous evidence found linking the regulation of these proteins to disjointed DNA synthesis and apoptosis. This was accomplished by isolating non-denatured protein from fetal mouse neural stem cells exposed to alcohol for eight hours at a concentration of 400 mg/dL. The pRb and associated proteins were then isolated from all other proteins using co-immunoprecipitation. Obtained protein was then subjected to immunoblotting analysis. The presence of pRb was confirmed, and the presence of E2F1 and DP1 was then examined with the use of primary and secondary antibody markers. No E2F1 or DP1 was found bound to pRb, suggesting that either E2F1 and DP1 are free from pRb after alcohol exposure, or that pRb blocks the antigenic sites of E2F1 and DP1 when bound.

CORNELIUS HOLYFIELD, AMY FARSON, ALICE MAGRO and ALBERT MAGRO, Dept. of Biology, Fairmont State University, Fairmont, WV 26554. **Inhibition of *in vitro* invasiveness in human glioblastoma cells by staurosporin as compared to temozolomide and the natural products thymoquinone and epigallocatechin gallate.**

Inhibition of invasiveness in the glioblastoma cell lines LN18, U87-MG, MO59-J, U118-MG, and T98-G was tested using a matrigel three dimensional spheroidal assay. Each cell line was treated with the protein kinase inhibitor staurosporine. The cell lines were also treated with temozolomide (TMZ). Temozolomide is the leading compound in the imidazotetrazine class of chemotherapeutic agents, and is the current drug of choice for primary treatment and adjuvant therapy for recurrent glioblastomas. The cell lines were treated with similar concentrations of thymoquinone (a bioactive derivative of black seed oil *Nigella sativa*) and epigallocatechin gallate (the major polyphenol component of green tea). Both of these natural products are reputed to have anti-cancer properties. The effect of these products upon cell growth and invasiveness was measured by changes in the radius and area surrounding the spheroids as well as the degree

of invasiveness of the extended invadopodia. Cell lines LN18, U87-MG, MO59-J, U118-MG, and T98-G showed complete inhibition of invasiveness at 0.1 $\mu$ M and 1.0 $\mu$ M concentrations of staurosporine. This was made apparent by the lack of invadopodia extending from the spheroids. When the spheroids were treated with 10 $\mu$ M, 50 $\mu$ M, and 100 $\mu$ M of TMZ, all showed lengthening invadopodia as compared to the non-treated control spheroids. At the doses of 10 $\mu$ M, 50 $\mu$ M, and 100 $\mu$ M, thymoquinone and epigallocatechin gallate showed little inhibition of invasiveness, with very similar invadopodia as compared to the non-treated control spheroids.

This study was supported by NIH grants P20RR016477-12 and P20GM103434-12 awarded to the West Virginia IDeA Network for Biomedical Research Excellence.

LOGAN LYDA, Dept. of Chemistry, Shepherd University, Shepherdstown, WV 25443; TIMOTHY HOOVER, BURTON LIDGERDING, Dept. of Biology, Shepherd University, Shepherdstown, WV 25443; QING WANG, Dept. of Computer Sciences, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443; DAVID J. KLINKE, Dept. of Chemical Engineering, and Dept. of Microbiology, Immunology and Cell Biology, West Virginia University, Morgantown, WV 26506. **Cell culture of B16 melanoma cells in various environments.**

During the growth of melanoma cells in the mouse, cells grow in a three dimensional state. Understanding the behavior of B16 cells, a mouse melanoma cell line, in a more natural state could lead to better understanding of how these cells can grow and at what rate. These experiments will show the differences between two dimensional cell culture, cell culture in extracellular mouse matrix and cells cultured by the hanging drop method. The hopes are that the hanging drop method will provide a more realistic environment for cell growth in a three dimensional culture *in vitro*. The growth of the cells will be determined using a MTT assay, which we can then compare the rate of growth of

both processes and allow us to better understand these cells in their natural environment. This data will then be provided as a parameter in the growth model of tumor cells *in vivo*.

The project has been supported by the NIGMS of the NIH grant as part of the WV-INBRE (P20GM103434).

AESHA PETERS and SARA SAWYER, Dept. of Science and Mathematics, Glenville State College, Glenville, WV 26351. **Investigating the timing of the onset of apoptosis and the alteration of integrin distribution during heat stress in the sea anemone, *Aiptasia pallida*.**

Temperature-induced cnidarian bleaching is becoming an increasing problem on coral reefs, threatening the health of coral ecosystems, but the cellular mechanisms that lead to collapse of the cnidarian-algal symbiosis are not well understood. Studies have shown that increased water temperature induces apoptosis in host and algal cells, and this is correlated to the loss of algae, but how temperature triggers apoptosis is not clear. To investigate this, we temperature shocked from 25 C° to 30 C° both symbiotic and aposymbiotic *Aiptasia pallida* for 0, 6, or 12 hours. After temperature shock, anemones were preserved in 4% paraformaldehyde, embedded in paraffin, and sectioned. Sections were stained using either an anti-integrin antibody to show the distribution of integrins or using the TUNEL assay to determine apoptosis. Previous work has shown that the distribution of the cell-substrate adhesion molecule, integrin is altered after a 12 h heat shock from 25 C° to 30 C° in symbiotic *Aiptasia pallida* but not in aposymbiotic anemones. Using the TUNEL assay to detect apoptosis, we show that this loss of integrin staining in symbiotic anemones is preceded by the initiation of apoptosis after 4 to 6 h of heat shock. Apoptosis is also seen in aposymbiotic anemones after a 4 to 6 h heat shock as well. These results suggest that temperature-induced loss of integrin staining is a symbiotic phenomena, but temperature-induced apoptosis is not. The signaling pathways that link apoptosis and integrin expression are being investigated.

EMILY RAMEZAN, MORGAN SCARPELLINI, and SARA SAWYER, Dept. of Science and Mathematics, Glenville State College, Glenville, WV 26351. **The effects of water temperature on early response gene c-Jun in the sea anemone *Aiptasia pallida*.**

Temperature-induced Cnidarian bleaching results from the loss of the symbiotic dinoflagellate algae from their animal host. The underlying cellular mechanisms causing this bleaching are not well understood, but bleaching is correlated with increased apoptosis in both the algae and host cells. We are investigating whether increased temperature changes expression of c-Jun, an early response gene and a feature of the transcription factor AP-1. AP-1 is a transcription factor whose expression is activated through the MAP kinase signaling pathway, and together with c-Jun controls the balance between cell survival and cell death. We are investigating whether increased water temperature affects the expression of c-Jun in the tropical sea anemone, *A. pallida*. Anemones were heat shocked from 25 C° to 30 C° for periods of 1, 6, and 12 hours, then the expression levels of c-Jun were determined by rt-qPCR. Our results indicated an approximately 2-fold increase in c-Jun expression after heat shocking, suggesting this as a possible player in coral bleaching. These results could aid in our understanding of the underlying cellular processes that result in temperature-induced coral bleaching and make predictions of how different species will respond. In addition, we are investigating whether temperature affects matrix metalloproteinase (MMP) expression, as altered MMP expression can cause apoptosis.

ALEXANDRA ROBERTS, DAVID RUSSELL and BRUCE ANTHONY, Dept. of Chemistry and Biochemistry, West Virginia Wesleyan College, Buckhannon, WV 26201. **Alcohol-induced changes in transcription factors associated with cell cycle regulation.**

The range of dysmorphology seen in fetal alcohol spectrum disorders (FASD) is in part

associated with alterations in cell cycle regulatory proteins at key checkpoints, including G1/S and G2/M. Micro array data from alcohol-exposed embryos demonstrate mRNA alterations to this set of proteins and a set of transcriptional activators that may dictate transcriptional changes to these genes. The objective of this research is to identify conical consensus sequences for a set of transcription factors that are altered from 400 mg/dL alcohol exposure. The consensus sequences are examined on genes known to show both transcriptional and translational changes from a similar alcohol exposure. By the basic local alignment search tool (BLAST) method, the consensus sequences or their complement sequences were identified within the promoters of cell cycle genes of interest, signifying an interaction. BLASTing was conducted, and promoters with consensus sequences correlating to altered transcription factor expression were reported.

RANDY SMITH and GARY MORRIS, Dept. of Science and Mathematics, Glenville State College, Glenville, WV 26351. **Determining if AHR regulates histone H3 methylation in breast cancer cells using immunoblot analysis.**

Adipocytes may increase human cancer risk by secreting paracrine factors termed adipokines that stimulate signaling pathways in cancer cells that induce proliferation. The aryl hydrocarbon receptor (AHR), a ligand-activated transcription factor that plays roles in tumorigenesis, is regulated by exogenous lipophilic chemicals, and has been explored as a therapeutic target for cancer therapy. Evidence suggests that the AHR, when activated by an exogenous ligand such as TCDD, alters the expression of tumor suppressor genes, and thus reduces cancer cell proliferation. This counters the increased proliferation that results from adipokine signaling. Histone H3 tri-methylation at lysine 27 is a known regulator of key tumor suppressor genes. We attempt to provide evidence, using immunoblot analysis, that treatment of breast cancer cells with TCDD alters histone H3 tri-methylation at lysine 27, thus providing a better understanding of the mechanism by which AHR decreases cancer cell proliferation.

RACHEL WHITE and BRUCE ANTHONY, Dept. of Chemistry and Biochemistry, West Virginia Wesleyan College, Buckhannon, WV 26201. **Comparison of cell cycle-specific mRNA variant changes after alcohol exposure to embryonic neural stem cells.**

There is a range of developmental abnormalities resulting from alcohol consumption during pregnancy, termed fetal alcohol spectrum disorders (FASD). In particular, studies have revealed that alcohol exposure to neuronal stem cells alters proliferation, differentiation and migration of this cell population and likely induces cellular apoptosis. Exposure of embryonic neuronal stem cells to alcohol demonstrates alterations in G1 to S phase cell cycle regulatory proteins that may play a significant part in altered mechanisms of proliferation and apoptosis. The purpose of this set of experiments is to investigate the mRNA variants associated with these proteins including; Retinoblastoma (Rb), E2F1, DP1, Cyclin D1, Cyclin Dependent Kinase (CDK) 4, and CDK 6, after alcohol exposure. The results may determine changes in transcription of mRNA isoforms associated with protein expressional changes. Embryonic neuronal stem cells were exposed to 400mg/dL alcohol for an eight hour period. Purified mRNA were used for PCR with primers designed to span the full coding sequence. Changes in isoforms suggest a possible mechanism for alcohol-induced proliferation changes in stem cell populations during development.

## Chemistry

BRYAN FOLEY, CHRIS MATHENY and ANDREAS BAUR, Dept. of Biology, Chemistry, and Geoscience, Fairmont State University, Fairmont, WV 26554. **Fluorescence quantification of rhodamine B, 6G, and 110 in ransom note ink samples through high performance liquid chromatography.**

Three fluorone dyes (rhodamine 110, 6G, and B) were extracted from pen ink and analyzed using high performance liquid chromatography.



The method parameters consisted of a Waters Symmetry C-18 column (3.5  $\mu\text{m}$ ; 4.6 x 150 mm) with fluorescence detection (ex: 518 nm, em: 577 nm) and a mobile phase (isocratic: 50% acetonitrile, 35% 5mM 1-heptanesulfonate [pH 4.65], 15% methanol) with a 0.8 mL/min flow rate. Calibration standards were prepared in water or methanol. All rhodamine compounds adhered very strongly to glassware as shown by HPLC analysis of methanol washings.

Ink from eight sample pens was applied to filter papers. Once dried, these inks were extracted with methanol. Percent rhodamine content for the sample pens included: Bic 0-G-05 (red ink) ( $1.9 \pm 0.1\%$ ), Pilot USA C53 (red ink) ( $3.0 \pm 0.1\%$ ), and Sharpie fine point marker (black ink) (no rhodamines); Papermate Inkjoy 300 RT (red ink), Papermate M 10 (red ink), Avery eGel (blue ink), Bic Round Stic (blue ink), and a Pilot G-2 (blue ink) gave inconclusive data.

VANESSA FURBY, Shepherd University, Shepherdstown, WV 25443; KATHERINE HICKEY, CHRISTOPHER BOSTICK, ANDREW BIUNDO, PETER GANNETT, Pharmaceutical Sciences Dept. of the Health Science Center, West Virginia University, Morgantown WV 26506. **Nano enzyme systems: developing an artificial liver for modeling protein-protein interactions.**

Determining precise drug dosages to give patients is a difficult problem for pharmaceutical companies. Researchers generally use solution-based methods to determine the amount of metabolite formed from cytochrome P450 mediated metabolism; but soluble P450s can aggregate, affecting the amount of metabolite formed. Our lab immobilized three major isoforms of cytochrome P450, CYP2C9, CYP2D6, and CYP3A4, in order to reduce or eliminate P450 aggregation. These were incubated with their respective substrates in the presence of other soluble P450s to determine the effect aggregation has on the amount of metabolite formed, as measured by HPLC. It was discovered that immobilized P450-mediated metabolism was affected by the presence of other P450s in

solution, due to aggregation. For example, the presence of soluble CYP3A4 tended to inhibit the metabolism of dextromethorphan mediated by CYP2D6. These tests show the importance of using a non-aggregating system in determining the metabolism profiles for new and existing drugs.

TIMOTHY HOOVER II and JORDAN MADER, Dept. of Chemistry, Shepherd University, Shepherdstown, WV 25443. **Development and characterization of H.I.P.E. foams for removal of groundwater contaminants.**

The objective of this project was to optimize the synthetic conditions for high internal phase emulsion (H.I.P.E.) polymer foams. The aim of this project is to use functionalized polymer foams as a potential solution to the problem of arsenic pollution in ground water. The purpose of this research is to develop monomers for a novel polymer system. The initial phase of the project began by experimenting with various foam densities (30, 60, 90, 100, 120, and 500 mg/cc) to achieve robust foams. These foams were created via gas tight syringe or an overhead mechanical stirrer. Each of the foams was characterized for stability and structure.

Thermogravimetric Analysis (TGA) was used to study foam thermal stability properties. TGA was used to compare foams before and after the surfactant (a reactant in the polymerization process) was removed. The TGA results clearly indicated that Span 80 (surfactant) significantly reduces the stability of the foams at temperatures below approximately 300 °C, and that the foams are highly unstable at temperatures over 350 °C. Several trials of thionation using poly (4-vinylphenol) as a reactant were conducted, but the reaction was ultimately unsuccessful. As the next phase of research continues, alternative methods of thionation are being explored.

This work was supported by a NASA West Virginia EPSCoR Space Grant Consortium Research SEED award, SOARS student fellowship,



and the Shepherd University Chemistry Department and School of Natural Sciences and Mathematics.

HAYLEY MADEIRA and DAN DILELLA, Dept. of Chemistry, Shepherd University, Shepherdstown, WV 25443. **Presumptive identification of drug diluents and adulterants using various color test reagents.**

Presumptive tests such as chemical spot tests (also referred to as color tests) are amongst the first steps used to determine if unknown substances contain drugs and/or poisons. These tests are most commonly applied to pharmaceuticals and to scene residues, but are also used occasionally to test biological fluids. Test results are well characterized for treatment of the pure analyte, but little testing has been done on common cutting or diluting agents. Common cutting agents for a variety of drugs were tested using several different color testing reagents. Only a select few of the cutting agents tested gave a positive result for each of the reagents. It was determined that cutting agents such as sugars, quinine, aspirin, and Excedrin may cause a problem in the test for opiate alkaloids when working with the Marquis reagent or the Mecke reagent. Although DXM also gave a positive result, it will most likely not cause a problem during the analysis of barbiturates because it is not commonly used as a cutting agent for those drugs. A possible critical position for the reaction of barbiturates and the Dille-Koppanyi reagent was also determined. The results will be discussed in terms of the known or proposed mechanisms of the tests.

CHRIS MATHENY and ERICA HARVEY, Dept. of Biology, Chemistry, and Geoscience, College of Science and Technology, Fairmont State University, Fairmont, WV 26554. **Assembling the Solar Army in West Virginia: the search for improved metal oxides for water splitting.**

To find the most stable and inexpensive metal oxide semiconductor that can efficiently photoelectrolyze water into a usable fuel,

different ratios of iron, copper, and nickel were oxidized onto fluorine-doped tin oxide (FTO) conductive glass plates in a kiln, and analyzed using a Solar Hydrogen Activity research Kit (SHArK) and the Solar Energy Activity Lab (SEAL). Both kits were obtained and assembled (and beta tested, for SHArK) through Fairmont State University's participation in the "Solar Army", organized by Caltech and University of Wyoming. A 60/10/20 ratio of Fe/Cu/Ni gave the highest photocurrent measured to date in our lab. However, the photocurrent observed from this ratio was lower than that of the iron oxide and copper oxide standards and was not efficient at photoelectrolyzing water.

STEVEN PIFER, NATHAN LILLY, DYLAN TOMBLIN and KEVIN L. EVANS, Dept. of Science and Mathematics, Glenville State College, Glenville, WV 26351. **Novel synthesis of alkyl bromides.**

Alkyl bromides are key intermediates in organic synthesis. Electrophilic addition of hydrobromic acid to alkenes is a fundamental organic reaction to synthesize alkyl bromide. In 1870, Markovnikov was the first to publish an explanation for the observed regiochemistry of the addition. While Markovnikov provided the fundamental understanding of the reaction, the efficient synthesis of alkyl halides with specific regiochemistry is a more difficult synthesis than organic texts lead one to believe. One major challenge is the use of anhydrous hydrobromic acid. This research focuses on developing a method to synthesize alkyl bromides using surface mediated reactions to generate hydrobromic acid from phosphorus tribromide on silica gel. The synthesis can be controlled to produce either the Markovnikov or the anti-Markovnikov product as the major products.

BRYCE WILLIAMS, BRANDON SHERANKO, CASSANDRA MYERS, NATALIE WASSON and DAN DILELLA, Dept. of Chemistry, and RUTH CONLEY, Dept. of Biology, Shepherd University, Shepherdstown, WV 25443. **Solid**

### **phase extraction as a pre-treatment method for the determination of biogenic amines by HPLC-ECD.**

High performance liquid chromatography with electrochemical detection (HPLC-ECD) is a very sensitive technique for the quantification of biogenic amines. The amines can be detected at picogram levels and, because the electrochemical detector only responds to molecules that can be easily oxidized, the chromatogram can be greatly simplified. However, there are hundreds or thousands of compounds in a typical biological fluid, and there are some cases where another electro-active species will co-elute with the compound of interest. To address this problem we have developed a method to selectively remove some potentially interfering compounds by pre-treating the sample by solid phase extraction. We have found that a weak cation exchange column is most effective for removing interfering compounds for octopamine, a biogenic amine that affects insect behavior. The column is pretreated with a pH = 7 buffer that deprotonates the resin resulting in negatively charged groups. When a sample is passed through the column, the amines which are protonated at this pH are retained while neutral or negatively charged species pass through. A pH = 3 buffer is then passed through the column, which forces the release of the amines since the charge on the resin is neutralized. This pretreatment was found to be quite effective for selective removing many interfering peaks. A DHBA internal standard was added before pre-treatment to quantify the recovery of amine from the column.

### **Computer Science**

AUSTIN GRUBBS, WEIDONG LIAO, Dept. of Computer Science, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443. **Big data analytics over the cloud computing environment.**

In this research, comprehensive studies are conducted over two converging computing areas: big data and cloud computing. The emphasis

is on how cloud computing may be employed as an enabling platform to deliver efficient and cost-effective computing paradigms for big data analytics. The research starts on a discussion about what big data analytics is, and investigates what feasible data models and tools there are in supporting big data analytics. We then describe why and how cloud computing would be the driving factor for big data analytics, and its security aspects regarding big data analytics. We conclude our research with the future of big data analytics and its impact on the computing areas.

This research is supported by student fellowship from NASA WV Space Consortium Grant.

REBECCA HERBERT and OSMAN GUZIDE, Dept. of Computer Sciences, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443. **Accessing a car's computer for personalization.**

Cars are usually used as-is, without any modifications. With modifications, however, users can get a lot more functionality out of their cars. In this project, research will allow the manipulation of a Toyota Prius, and allow modifications to improve the function and user-friendliness of the car. This will be completed by hardware interfacing, and software creation to manipulate the interior data of the car. Ideally, this will create a way to optimize gas mileage, as well as inserting several other features for automation of some functions on start-up. In so doing, the use and tinkering of cars will be advanced, and a user's experience will be optimized for better interfacing with the car.

KIRSTEN LOGSDON, ALEXANDRA KEZMAN, WEIDONG LIAO, Dept. of Computer Science, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443. **Designing and implementing an automatic proctoring and audit system for web-based tests through facial biometrics.**

Distance learning has gained its increasing popularity in this technology and web-driven

world. Both students and educators are given great flexibility to take and offer classes online. Paper supplies are diminished, saving money and preserving the environment's natural resources. However, a few disadvantages exist for distance learning. One of them is the lack of a method to verify the identities of students, besides the basic username and password. This becomes an even more significant problem for tests and examinations, in which teachers are more concerned about the identity of students to ensure educational outcomes being indeed achieved.

In this research, we design and implement an automatic proctoring and audit system for web based tests by utilizing facial biometric. At first, the architecture of an authentication system based on facial biometrics is designed, which ensures secure and reliable data storage and transmission of facial biometrics data. The first phase of our multi-step project will be designing the architecture. The second phase of the project is the design of a web application module that allows web developers or online curriculum designers to easily integrate our biometrics-based proctoring and audit functionalities into their system. The final phase consists of the development and implementation of a prototype web portal. The web application module will be tested through this prototyping portal. Our implementation is based on an open-source facial recognition API.

CHRISTOFF LOZANO, WEIDONG LIAO, Dept. of Computer Science, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443. **Web browser security versus web application security: what is the difference?**

Many people think web browser security and web application security are the same thing, although in fact they are quite different. Web browser security mostly refers to security implementation using two protocols: Secure Socket Layer (SSL) and TSL (Transport Layer Security). On the other hand, web application security deals with security issues related to web applications and web services. In this research,

we give a detailed, comparative study over these two categories of web-related security fields.

STEVEN SHILEY, SPENCER FRASER, and WEIDONG LIAO, Dept. of Computer Science, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443. **Modern viruses, worms, and trojans and computer security.**

Computer viruses, worms, and trojans are legitimate security concerns on modern computers, and new forms and variations of them are created every day. Many times, they are used in one form or another in cyber-attacks over computer networks. Huge amounts of resources are spent every year in the security industry to detect, mitigate, or remove them from computer systems, some of which may be vital systems. If one is not on guard in attempting to prevent one's system from being exploited, confidentiality, integrity, or availability of data can be hampered or even destroyed. Understanding the reasoning or motivation that their creators have in creating them can prove instrumental in defensive measures. In this research, we focus on the recent occurrences of viruses, worms and trojans, and the mechanisms used to defend against them.

CHAD VANORSDALE, Dept. of Computer Science, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443. **Internet of things: interconnected devices using Node.JS.**

The internet currently relies on people in order for it to obtain and exchange data. Soon, this will change and due to the rapid expansion of mobile computing it already is. The Internet of Things is quickly becoming a reality, which entails Machine to Machine (M2M) communication. The Internet of Things will bring about a reality where machines begin to fade into the background and are able to collect, analyze, and make educated guesses based off data collected in the physical world. This will allow devices to become more intelligent and more interactive. For example, sensors may be able to detect movement as

you wake up, and based on previous morning patterns be able to guess what you will do. Using this data, your coffee may already be started and your car may have automatically warmed up as you prepare to start the work day. While there are many interesting developments to be made using the Internet of Things, it will be many years before we see it mature. The architecture and software standards still must be developed in order for the Internet of Things to really take off. In my research, I explore how JavaScript microcontrollers and Node.JS can be utilized as standard technology to make the Internet of Things a reality. Also presented is how an application can be developed to better facilitate the exchange of data between devices and Node.JS in order to better interact with and observe the Internet of Things.

### Ecology / Environmental Biology

CARRIE DREWRY and PETER VILA, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443. **Non-native vegetation and avian communities at Antietam National Battlefield.**

The purpose of the study was to monitor avian species in managed grassland communities at Antietam National Battlefield in Sharpsburg, Maryland to determine a relationship between non-native vegetation and avian species abundance and diversity. The park spans over 3,250 acres and serves as an important corridor for many types of wildlife. No significant difference was found for the diversity of birds present between sites with different amounts of non-native cover. Moreover, no significant difference was found between relative area (acres) to avian counts.

The survey provided valuable information about avian species and grassland communities at Antietam. There were many confounding variables that could not be accounted for in the parameters of this study: herbicide use, repeated plowing at sites over the season, human traffic in or near the areas, and limited observers in the

field. Broad categories such as total diversity and percent invasive cover may obscure distinctions at a finer scale. Future research should examine the interactions between one or two species of birds and non-native vegetation utilizing nesting habits, foraging habits and breeding success.

KELLI THOMAS, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443; DANA BERNER, MICHAEL McMAHON, and EMILY SMALLWOOD, USDA ARS Foreign Disease-Weed Science Research Unit, Frederick, MD 21702; PETER VILA, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443. **Evaluating the optimum amount of the rust fungus, *Puccinia punctiformis*, inoculum to achieve successful biological control of Canada thistle, *Cirsium arvense*, using a Western blot assay.**

The objective of this study was to evaluate the control of the noxious invasive weed Canada thistle (*Cirsium arvense*) utilizing the rust fungus, *Puccinia punctiformis*, as a control agent. Specifically, this study examined the optimum inoculum of rust for infection on the Canada thistle. Only one Canada thistle out of the 30 inoculated in 2012 showed systemic disease above-ground symptoms. However, additional plants were found to contain below-ground rust infections. A Western dot blot assay was used to test for *P. punctiformis* in the roots of Canada thistle plants a year after they were inoculated with ground-up diseased leaf material. This study provides evidence for a successful *P. punctiformis* infection of Canada thistle and further work will focus on the mechanism of how it spreads to Canada thistle roots as well as by spores on the leaves. This study also demonstrates how new assay methods like the Western dot blot can be used to determine *P. punctiformis* infection in root systems.

### Engineering

MURAT DINC, DONALD D. GRAY, JOHN M. KUHLMAN, NICHOLAS L. HILLEN, KRISHNA



T. MEDAM, and J. STEPHEN TAYLOR, Statler College of Engineering and Mineral Resources, West Virginia University, Morgantown, WV 26506. **Exploratory simulations of full-cone water spray cooling.**

Spraying a liquid directly onto electronic components or other high energy density devices can effectively remove waste heat, allowing them to operate at optimal temperatures. Despite many previous studies, a practical spray cooling model valid for different liquids, nozzles, environmental conditions, and boiling regimes remains elusive. The WVU spray cooling group is using computational simulations and laboratory experiments to upgrade a previously developed Monte-Carlo-based spray cooling model so that it can be used as a quantitative design tool for a wide range of conditions. This poster presents results of preliminary three dimensional spray cooling simulations obtained using the commercial Computational Fluid Dynamics (CFD) code FLUENT (version 14.5). These simulations employ a k-epsilon turbulence model for air flow calculations; the Discrete Phase Model (DPM) for the full-cone water spray formation and the trajectories of discrete water droplets; and the Eulerian Wall Film (EWF) model for the flow of the liquid film on the impact surface, including its interactions with the spray drops. Inertial, gravity, surface tension, and viscous forces are accounted for. Two different heat transfer boundary conditions are imposed at the impact surface: a uniform surface temperature 20 °C above the boiling point, and a uniform surface heat flux. Results are presented for the impacting drop sizes and velocities; the liquid film thickness, velocity, and temperature; as well as the heat flux and temperature variation on the impact surface. These preliminary results suggest improvements to the present model to achieve greater physical realism.

This work is supported by NASA EPSCoR.

CHRISTINE SNYDER, NATHAN DEPRIEST and LESLIE HOPKINSON, Dept. of Civil and Environmental Engineering, West Virginia

University, Morgantown, WV 26506. **Sizing ponds for a surface mine reclamation valley fill.**

West Virginia is the largest coal producing state in the eastern United States, with much of the extraction completed by surface mining (roughly 42%). The process of surface mine extraction, however, leads to environmental concerns related to filling headwater streams during valley fill reclamation. The goal of this work is to identify the potential for recreating streams buried due to mining operations. To aid in the objective, guidelines will be developed for sizing wetlands in reclaimed surface mine sites which will supplement an existing, conceptual geomorphic landform design. The pond under consideration is from a conceptual reclamation design that includes three ponds total within a watershed located in southern West Virginia. The pond will be appropriately sized to promote streamflow at baseflow levels with a complementing outflow structure. The alterable parameters for the given pond include the outflow structure (e.g., orifice and spillway) and the size. Pond outflow will be evaluated for 2-, 10-, and 100-yr design storms. The proposed pond would provide streamflow, potentially mitigating stream loss on site. The results are expected to provide support that the stream channels can be included in a valley fill design.

The project described in this publication was supported by Grant/Cooperative Agreement Number G12AP20156 from the United States Geological Survey. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the USGS.

XINYANG WANG and YI LUO, Dept. of Mining Engineering, West Virginia University, Morgantown, WV 26506. **Experimental and theoretical studies in quantifying seal-heating propensity of coal.**

Spontaneous combustion is one of the most important safety issues in the global coal industry. It is not only a source of combustible gas evolution, but also an associated trigger for gas explosions



in underground mines, especially for gassy mines. This thermal event is not easily detectable in gob and sealed area due to the inaccessibility of those regions. Admittedly, determination of the propensity for spontaneous combustion before mining activity is necessary for initial risk assessment for new mine development.

Many methods and techniques have been developed for studying self-heating of coal. Each of the methods has its unique characteristics and indices for assessing the propensity of self-ignition. However, all the reasonable candidate components causing spontaneous combustion could not be examined thoroughly by any single method. In this respect, a coal spontaneous combustion testing facility that features adiabatic self-heating, thermogravimetric analysis (TGA) and self-heating temperature methods in our ventilation laboratory has been established. The certainty for accurate measurements of spontaneous combustion behavior is greatly improved by using a combination of various methods.

On the other hand, a theoretical model has been developed for quantifying the self-heating potential of coal based on those three experimental methods. This model is capable of quantifying the effects of sulfur, fixed carbon, volatile matter and moisture contents on self-ignition of coal, and can assist the adiabatic self-heating test to determine the self-heating rate when the testing period becomes impractically long.

### Forest Ecology

JESSE ALBORANO, CHAD INGRAM, and RICO GAZAL, Land Resources Dept., Glenville State College, Glenville, WV 26351. **The effect of precipitation on diameter growth of Tree-of-heaven in an oak hickory forest.**

Tree-of-heaven (*Ailanthus altissima*) was brought over from Asia, and has since become an invasive species, filling niches of native species and keeping the native species out. Tree-of-heaven is a prolific grower, even in poor sites. It is one of

the fastest-growing trees in North America. It can reproduce by seeds and clones. These clones can crowd out other species. They also have allelopathic properties, which inhibit the growth of plants around them. This is partially how it became an invasive species. Tree-of-heaven can reach 33 to 49 ft. in height and 3.7 to 4.3 in. in DBH in 30 years. The tree can be shrubby if pruned often or suppressed by the canopy. One of the most important climatic factors that determine forest growth and productivity is precipitation. The competitiveness of native species depends on their ability to take advantage of available water to produce growth. Due to the aggressive nature of invasive species, they are known to be more efficient in using available resources (water, nutrients and light) to their own advantage. Dendrochronology dates events and environmental changes using annual growth rings in trees. To determine the responses of Tree-of-heaven to precipitation, we will sample trees from different locations around Gilmer County. We will set up plots with similar size and species composition and on areas with different slopes and aspects. From these sample trees, we will be collecting cores using an increment borer. Precipitation amounts and other climate data will be collected from NOAA and relationship between precipitation amounts and diameter growth will be determined.

SCOTT FLEMING and PETER VILA, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443. **The effect of White-tailed deer (*Odocoileus virginianus*) density on forest regeneration and exotic species at Catoclin Mountain Park, Thurmont MD.**

Intense browsing by an overabundant white-tailed deer population (*Odocoileus virginianus*) threatens forest regrowth at Catoclin Mountain Park, Thurmont MD. This study examined forest reproduction for native woody and herbaceous seedlings as well as exotic vegetation across nine years of deer management in an eastern deciduous forest. The experiment consisted of six enclosure and open paired plots throughout different regions

in the park. In each plot, a vegetation analysis was conducted to determine reproduction of seedlings and exotic species abundance. It was hypothesized that a lower deer population would allow the forest to regenerate, and that exotic species would decrease with more abundant native vegetation. Deer management began in 2009 by the use of U.S.D.A. sharpshooters as a direct method to decrease the herd. Vegetation analysis for these plots has been monitored on a three-year rotation since 2004. A statistical analysis was performed for each open plot prior to herd reduction (2004; 123 deer\*mi<sup>-2</sup>) and post reduction (2013; 36 deer\*mi<sup>-2</sup>), which resulted in a significant difference (Kruskal-Wallis rank test, n=6, p=0.0063) of total native seedlings in the open plots. There was no significant difference in invasive vegetation between 2004 and 2013 plots. This study suggests that this type of forest has the ability to rebound after intense deer browsing.

JONATHAN RHODES and RICO GAZAL, Glenville State College, Land Resources Dept., Glenville, WV 26351. **Assessment of carbon storage in different forest cover types.**

With everything going green, major companies are looking into carbon sequestration environments. These carbon sequestration environments are popular among high carbon-producing companies. Carbon sequestration is important in mitigating the amount of carbon dioxide in the atmosphere. Carbon sequestration is the act of removing carbon dioxide from the atmosphere and holding it in a liquid or solid state. By measuring the above-ground biomass, the amount of above-ground sequestration can be calculated. The total amount of sequestration of the carbon varies between the different types of canopy cover or forest type.

The measurement of the above-ground biomass will show the difference of the amount of carbon each forest cover type can sequester. The comparison of each type can be used to see which forest type can sequester the most carbon. This can be used by major companies to help find areas that have the highest sequestration

potential. Companies can in turn buy less land to sequester their carbon by buying land with the higher sequestration. This allows more land to be kept by private land owners. The companies can produce more profit without the environmental impacts that too much carbon can create.

The objective of this study is to assess carbon storage in different forest cover types in Glenville, WV. Plots / transects will be established in different forest locations following the standard protocol in carbon storage assessment. Maps will be made using ArcGIS to determine exact locations of plots / transects. The above-ground biomass and its equivalent carbon storage amounts will be determined and compared among different forest cover types.

### Genetics

TRICIA GILSON and JOSEPH HORZEMPA, Dept. of Biology, West Liberty University, West Liberty, WV 26074. **Deletion mutation of the IglC gene in *Francisella tularensis* through homologous recombination.**

*Francisella tularensis* is a gram negative bacterium whose virulence has been associated with the organism's ability to replicate within phagocytic cells of the immune system, such as macrophages. More recently, it has been observed that *F. tularensis* is able to infect erythrocytes, which seemingly increases resistance to aminoglycoside antibiotics. Unpublished studies from our laboratory indicate that the protein VgrG, located at the tip of the *F. tularensis* type VI secretion system (T6SS), is required for red blood cell invasion. In other T6SS, VgrG is brought to the surface by polymerization of Hcp. *F. tularensis* lacks a clear homolog to Hcp. However, structural predictions reveal that IglC shares protein domain structures with Hcp of other bacteria. To determine if IglC is required for surface localization of VgrG and erythrocyte invasion, we are generating a null deletion mutant of IglC. Once generated, this mutant will be tested for its ability to invade erythrocytes and surface-express VgrG.

## Health Sciences

LEAH CYRUS and MATTHEW ZDILLA, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **Bilateral carotico-clinoid foramina with a unilateral double optic canal.**

The sphenoid contains numerous foramina which transmit a variety of important nerves and arteries. Anatomical variations among these foramina may have serious clinical consequences. Anterior clinoidectomy, a neurosurgical procedure utilized to access paraclinoid aneurysms and neoplasms, is often complicated by the presence of anatomical variants, including the carotico-clinoid foramen and the accessory optic canal. A case study is presented of a sphenoid bone which was observed to have three variant structures; an accessory optic canal and bilateral carotico-clinoid foramina. The report emphasizes the possibility for these clinically important variant structures to occur simultaneously, each with the potential to masquerade as the other radiographically. Although this variant is rare, failure of radiologists and surgeons to recognize this unique anatomical variation could have severe surgical consequences for the patient, including blindness and death.

HANNAH SOLONINKA and MATTHEW ZDILLA, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **An unusual anterior digastric variant with clinical importance.**

The report outlines a unique asymmetrical digastric muscle variant. The muscle gave rise to two smaller accessory bellies which, likewise, gave rise to another two smaller accessory bellies supported by a fascial sling. Although variant anatomy of the anterior belly of the digastric is common, this structural presentation has yet to be described. Understanding the diverse anatomical variety among digastric muscles is particularly important with regard to differential diagnosis of space-occupying lesions in the submental

triangle. Likewise, variant anterior digastric anatomy is important for the reconstructive surgeon. Variant anterior digastric musculature has the potential to be utilized in muscle transfer surgery for marginal mandibular branch of facial nerve palsy.

## Mathematics

DARRYL JOHNSON, CHRISTIAN SHIMER, QING WANG, ZHIJUN WANG, Dept. of Computer Sciences, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443; DAVID J. KLINKE, Dept. of Chemical Engineering, and Dept. of Microbiology, Immunology and Cell Biology, West Virginia University, Morgantown, WV 26506. **Stability and bifurcation analysis of a three-compartment tumor model.**

Developing a simple yet accurate differential equation model for tumor growth is an important topic in the study of cancer treatment. A decent model for the proliferation of tumor cells allows for interactions of the various effects incited by chemotherapeutic and immunotherapeutic treatments to be predicted and controlled. There is vast literature on the differential equations modeling the tumor microenvironment, taking into account variables such as angiogenesis, natural killer cells, mutation, etc. We consider a three-compartment model that examines the variables of an injected adenovirus, naïve and activated T-cells and their proliferation/decay in the lymph nodes, blood, and tumor microenvironment. In addition, our model considers two classes of tumor cells: those that display the Major Histocompatibility Complex Class I (MHCI) and those that do not. Tumors that do not display MHCI are able to escape immune system surveillance, and thus analysis of classes of tumor is important in the analysis of immunotherapy. With the differential equations proposed, we offer a routine bifurcation and stability analysis of the system and give a biological explanation of the results. Bifurcation analysis allows us to interpret the general behavior of a system differential equations and how certain parameters

affect outcomes. Bifurcation allows us to predict at what parameters stable zero or low tumor equilibria are possible and how treatments could be proposed to assure favorable outcomes.

This project has been supported by the NIGMS of the NIH grant as part of the WV-INBRE (P20GM103434).

### Microbiology

JESSE HALL, SAMANTHA KNOWLTON, KATHLEEN LOUGHMAN, JAMES BIRCH, LEANNE MAZZELLA, TARA GAJTKA, HANNAH MASON, C.J. HESTER, JENNA INGRAM, MACKENZIE DAVIS, BRIANNA COWAN, DEANNA SCHMITT, and JOSEPH HORZEMPA, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **The temperature-dependent antibiotic resistance of pathogenic bacteria.**

The World Health Organization estimates that approximately 14,000 deaths each year are due to antibiotic-resistant microorganisms. Because of the prevalence of antibiotic resistance, it is essential that we understand the mechanisms behind this phenomenon. Our laboratory has shown that various opportunistic pathogens such as *Staphylococcus aureus* are more resistant to antibiotics at mammalian body temperature. These organisms can normally be found in or on the body. Soil microbes such as *Listeria monocytogenes* and other environmental microorganisms are more resistant to antibiotics at ambient body temperature. Our hypothesis was that the antibiotic resistance phenotypes are linked to the bacterial metabolic rates. In previous experiments bacteria were grown in broth culture at 37 °C, and then the bacteria were suspended in PBS with or without antimicrobial agents. These were then incubated at 37 °C or 26 °C, then diluted and plated to count the colonies. One possible explanation for the increased resistance at 26 °C is that the shifting of temperatures from 37 °C to 26 °C may have caused the bacteria to enter a dormant state. The same microbes were grown at 26 °C, then suspended in PBS, with or without

antimicrobial agents at the 37 °C or 26 °C. This was followed by dilutions and enumeration of colony forming units. Kirby Bauer assays at both temperatures were also conducted using different antimicrobial agents. Results showed that the opportunistic pathogens were more resistant at the mammalian body temperatures, while the environmental microbes were more resistant at the ambient temperatures. Future investigations will focus on determining whether mutations in the temperature dependent regulatory system contribute to antibiotic resistant factors.

JOHN C. LANDOLT, Dept. of Biology, Shepherd University, Shepherdstown, WV 25443; JAMES C. CAVENDER, Dept. of Environmental and Plant Biology, Ohio University, Athens, OH 45701; MARIA ROMERALO, Dept. of Systematic Botany, Uppsala University, Uppsala, Sweden; EDUARDO M. VADELL, UBA, CS. Exactas y Naturales, PHRIDEB. PAB. II, Cd. Universitaria, (1428) Buenos Aires, Argentina; STEVEN L. STEPHENSON, Dept. of Biological Sciences, University of Arkansas, Fayetteville, AR 72701. **Possible new species of *Polysphondylium* from Madagascar.**

In 2009, a number of soil/leaf litter samples collected from a variety of vegetation types present on the island of Madagascar were examined for the presence of dictyostelid cellular slime molds. The samples yielded clones of over a dozen recognized species, as well as clones of as many forms that did not seem to fit any described species. The latter included 13 varieties of light-spored members of the dictyostelid genus *Polysphondylium*. Fruiting bodies of species in *Polysphondylium* are characterized by having whorls of lateral branches, with each branch bearing a terminal cluster of spores. Spores are ellipsoid and have unconsolidated polar granules. Aggregations of amoebae that form fruiting bodies are typically radiate and produce single or loose clusters of fruiting bodies. The 13 *Polysphondylium* isolates appear to have some divergent and somewhat unique characters in comparison with each other and with described forms. We are in the process of describing and



proposing, for peer acceptance, each of these as a species new to science. We present here some of the preliminary descriptive information on these potential new species. Comparative analyses of DNA sequence characters is on-going.

EVAN LAU, JOSEPH NOLAN, RYAN DAGUE, ZACHARY DILLARD and WENDI WENTZELL, Dept. of Mathematics and Natural Sciences, West Liberty University, West Liberty, WV 26074. **Methanotrophic bacterial diversity and abundance in peat, moss and soil from Cranesville Bog and adjacent temperate forest using Illumina MiSeq multiplex sequencing.**

Northern sphagnum-dominated peatlands and temperate forest soils play an important role in the carbon cycle, in particular, as a major source and sink of methane ( $\text{CH}_4$ ), a greenhouse gas. However, bacterial diversity and abundances in these ecosystems remains poorly described. Methane produced in the decomposing anoxic peat and forest soils can be removed by methanotrophic bacteria, which are found mainly in (i) the oxic upper peat layer of peatlands, (ii) submerged sphagnum moss tissues, and (iii) the oxic organic layer of forest soils. Here, we compared the bacterial community composition of three sites (aerated peat, submerged moss tissue and organic layer of forest soil) from Cranesville Bog and adjacent temperate forest using Illumina MiSeq high-throughput multiplex sequencing of partial 16S rRNA genes. Our denoised sequences (average length ~200 bp, nearly 1 million reads) comprised over 550,000 OTUs (Operational Taxonomic Units) from over 25 bacterial phyla, constituting over 200,000 unique taxa. Methanotrophic bacteria constitute < 2% of microbiota in these environments. Even though we were unable to detect sequences closely related to known methanotrophic bacteria from the family Methylococcaceae, placed within the Verrucomicrobiaceae, we detected and described over 800 sequences closely related to known groups of methanotrophs in the Alphaproteobacteria, Gammaproteobacteria and Beijerinckiaceae for phylogenetic analyses, abundance and statistical assessments. Our analyses indicate some taxa of

methanotrophs may be ubiquitous in the three environments (peat, Sphagnum moss tissues and forest soil), while others may be found in one or two environments, and hence may be niche specialists.

XIANG LI and JENNIFER WEIDHAAS, Dept. of Civil and Environmental Engineering, West Virginia University, Morgantown, WV 26505. **A new high-density microbial source tracking (MST) cDNA microarray for detecting pathogens in environmental samples.**

Water bodies can be contaminated by feces from both humans and animals. The feces can introduce pathogenic bacteria, protozoa and viruses into the receiving water, which could cause disease in humans. Current regulatory strategies for water quality require culturing of fecal indicator bacteria (FIB), which are surrogates for pathogens. Culture-based or even quantitative polymerase chain reaction methods for detection of FIB have numerous drawbacks, including poor correlation with pathogens, limited information on fecal sources, and long analytical turnaround times. Our high-density MST microarray offers improved water quality evaluation methods compared to culture-based FIB detection. The microarray allows for rapid detection of FIB, pathogens, and viruses present in environmental samples, while simultaneously providing evidence of fecal sources. The MST microarray contains DNA oligonucleotide targets for most FIB, MST human and animal fecal markers, mtDNA, human pathogens, protozoa and viruses (317 targets).

The microarray detected 87% of targets in the positive control samples. Human and animal fecal samples queried revealed unique pathogen, virus and MST marker detection profiles. For instance, in raw sewage the microarray detected viruses (Adenovirus), human specific *Bacteroides*, *Giardia lamblia*, *Salmonella enterica*, *Enterococcus* and *Escherichia coli*. Each of the microarray results showed the detection of at least 80 of 317 targets.



In summary, our new microarray has high density and can detect thousands of waterborne pathogens and MST gene targets simultaneously. This MST cDNA microarray could help in identification of the source of fecal contamination in a water body and elucidating the risk of human exposure to fecal pathogens.

WENDI WENTZELL and JOSEPH HORZEMPA, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **Occurrence of *Mycobacterium ulcerans* in *Naucoridae* of West Virginia.**

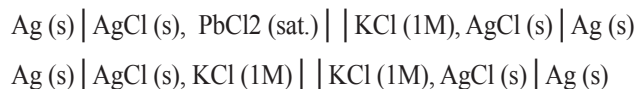
*Mycobacterium ulcerans* is an emerging pathogen that causes a severe skin and soft tissue disease known as Buruli ulcer. Aquatic insects, specifically *Pelocoris femoratus*, have been identified as possible vectors of *M. ulcerans*. *M. ulcerans* infections are endemic to tropical countries, with 30-33 °C being the ideal temperature for growth. Such temperatures are not uncommon in the United States, including West Virginia. Additionally, *P. femoratus* is commonly found in lakes, bogs, and ponds throughout this state. In this study, *P. femoratus* and *Lethocerus americanus* were collected from Green Bottom Wildlife Management Area in Cabell County, West Virginia. The DNA was extracted from *P. femoratus* and *L. americanus* and was subjected to PCR using primers specific for *Mycobacterium* sp. This analysis revealed a putative positive reaction for the presence of *Mycobacterium* sp. in the *P. femoratus* sample. To further delineate this bacterial DNA, sequencing of the positive amplicon is currently underway.

### Physics

KEVIN DUDLEY and MATTHEW SCANLON. Dept. of Chemistry, Fairmont State University, Fairmont, WV 26554. **Electrochemical determination of the enthalpy and entropy of the ionization of  $PbCl_2$  in water.**

The enthalpy and entropy changes for the reaction  $PbCl_2 (S) \rightleftharpoons Pb^{+2} (aq) + 2Cl^{-1} (aq)$  were

determined from the temperature dependence of the electrochemically measured equilibrium constant. Activity effects were minimized by comparing the voltage difference between the following electrochemical cells.



$\Delta H^\circ$  and  $\Delta S^\circ$  were found to be 22.1 kJ/mol and -2.6 J/mol $^\circ$ K respectively. The literature values are  $\Delta H^\circ = 23.380$  kJ/mol and  $\Delta S^\circ = -12$  J/mole K.

### Psychology

ADAM FULLER and ALAN DANIEL, Dept. of Social Science, Glenville State College, Glenville, WV 26351. **Isopods and invertebrate anxiety.**

The focus of research in our lab is anxiety and specifically anxiety as it relates to invertebrates. Anxiety has been shown in vertebrates to a great extent, but there has been very little research on invertebrates and anxiety. When testing for anxiety, the standard method is to use an elevated plus maze with two of the arms closed and two of the arms open. The vertebrate, let's say in this case it's a rat, is placed in the maze and is allowed to explore the maze. Rats, as well as other vertebrates, show a tendency to spend more time in the closed arms than they do in the open arms. This preference disappears if you administer an anti-anxiolytic. This shows that the rats experience anxiety when on the open arms and therefore they spend more time in the closed arms.

For our research we will be using isopods, a order of terrestrial crustaceans that includes the commonly-known pill bug or roly poly. By placing the isopods in an elevated plus maze, we will be able to observe in which arms they spend more time. If isopods do, in fact, exhibit characteristics of anxiety, we will move forward with more in-depth research. Through our research we hope to determine the existence of anxiety in isopods and, more generally, in invertebrates. If anxiety does, in fact, exist in invertebrates, the use of

invertebrates as a model for anxiety would be very feasible. This would provide numerous avenues for future research on anxiety.

ALLISON P. TAYLOR and ALAN M. DANIEL, Dept. of Social Science, Glenville State College, Glenville, WV 26351. **Crustacean frustration investigation: isopods and the partial reinforcement extinction effect.**

Invertebrate models of behavior can lead to insights into behavior in more complex nervous systems. For example, animal models of loss have established the pharmacology of loss and similarities with physical pain. Isopods are terrestrial crustaceans with a simple nervous system; they are ubiquitous in gardens across the United States, and they are inexpensive and easy to rear in a laboratory setting. Despite their practicality as an animal model, the existence of loss-related behavioral phenomena in isopods has been completely unexplored. The present study explores whether isopods exhibit the partial reinforcement extinction effect (PREE) in an instrumental runway task. Prolonged extinction after partial reinforcement training, compared to a group receiving continuous reinforcement, would provide the first evidence that isopods experience an emotion-like reaction to loss.

### Science Education

ERIN SHAW, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443; KEITH ALEXANDER, Department of History, Shepherd University, Shepherdstown, WV 25443; CLARISSA MATHEWS, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443. **The effect of environmental conditions on exhibit materials at the U.S. Fish and Wildlife Service National Conservation Training Center.**

This study compared environmental conditions at three exhibit sites within the US Fish and Wildlife Service National Conservation

Training Center (Shepherdstown, WV), and explored the effects of environmental factors on artifact preservation. Three artifact materials, oil paintings, photographs and newsprints, were evaluated and placed in each of the three exhibit sites being tested: the building entryway, the archive and a control case covered to minimize air and light entry. Relative humidity (%), temperature (°C), visible light (lux) and ultraviolet light (lumens) were measured three times daily over 30 days (June-July, 2013) within each site. At the start and end of the study, a degree of damage was established for each artifact, and change in damage over time was calculated. Statistical analyses tested for differences in environmental conditions between exhibit sites (one-way ANOVAs for relative humidity and temperature, Kruskal-Wallis tests for visible and UV light). Temperature, visible light and UV light were significantly different between the exhibit sites ( $P < 0.05$ ), but there was no statistical difference in relative humidity between sites. Daily average temperature, visible light and UV light levels were significantly higher at the building entryway than the other sites, and a higher degree of artifact damage was found at the entryway site. Artifacts at the archive and control sites did not sustain damage over time. Based on these findings, the facility should adopt additional measures to ensure the preservation of exhibit materials on display in its entry building, specifically limiting light levels and controlling humidity.

QING WANG and ZHIJUN WANG, Dept. of Computer Sciences, Mathematics, and Engineering, Shepherd University, Shepherdstown, WV 25443. **Increasing, retaining and supporting students in computer science, mathematics and engineering through the Shepherd CME S-STEM program.**

The Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) Program of the Shepherd CME department has been funded by the NSF since June 2013. The overall goal of the program is to increase the number of STEM graduates by providing financial, academic, and social supports, thereby

enabling qualified students to overcome some of the barriers that prevent them from meeting their educational goals. The program has supported 11 students during the first year. In this poster, major activities, experiences, and results will be discussed along with initiatives that increase, retain, and support students in the computer science, mathematics and engineering fields.

### Social Sciences

CHRIS DEJULIS and PETER VILA, Institute of Environmental and Physical Science, Shepherd University, Shepherdstown, WV 25443. **Understanding the relationship between brownfield development and new economic development in Wisconsin.**

The main emphasis in redeveloping brownfields has focused on the most profitable sites, usually found in the healthiest of metropolitan areas. Many cities are turning idle and abandoned sites into potential productive properties. Not all sites are being remediated, nor is there enough government money or private finances to make it happen. Moreover, there has not been a systematic study to determine whether or not significant capital infusion results in viable economic growth in a brownfield area. This study focuses on the redevelopment of brownfields in Wisconsin and looks at whether the development of these sites spurs any secondary building in the area. Undeveloped controls and redeveloped sites were categorized by area and number of structures utilizing geographic information systems (GIS). No significant difference between the number of new structures and new area of redeveloped and control undeveloped brownfields was found. However, there was a significant difference between redeveloped and control undeveloped brownfields with respect to median house value ( $P = .005$ ). These results suggest that site location is not the only determining factor in brownfield remediation.

### Soil Science

HANNAH BILLIAN, ALISON SEARS, and LESLIE HOPKINSON, Dept. of Civil Engineering, West Virginia University, Morgantown, WV 26506. **Evaluating the effects of geomorphic landform design on erosion potential.**

Concerns of detrimental environmental impacts originating from mountaintop mining and valley fill construction have created constant debate throughout Central Appalachia. Potential for unfavorable environmental impacts dictates the importance of modeling land use changes to predict soil degradation. The intention of this project is to evaluate, through the use of the revised universal soil loss equation (RUSLE), the effects of geomorphic landform design (GLD) on erosion potential in surface mining reclamation. The RUSLE is utilized to determine the sediment load from an undisturbed watershed, as well as a conceptual GLD reclamation site for comparison. Transects were selected in the undisturbed topography and in the GLD design; transect location was selected by geographic locations within the watershed and elevation variances. Data for the derivation of RUSLE parameters were determined for each hill slope transect by means of soil survey data and transect hillslope parameters, and erosion rates were calculated accordingly. Results will indicate if this alternative method of valley fill design presents an erosion risk greater than that of the original topography. Analyzing the differences in erosion rates between these topographies can lead to the formation of better valley fill designs, as well as the determination of better land use practices.

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DENNIS HARVEY and DAVID O'DELL, Dept. of Science and Mathematics, Glenville State College,

### Glenville, WV 26351. **Quantitative extraction and analysis of glutaraldehyde in soil.**

Glutaraldehyde (1,5-pentanedial) is a relatively common antimicrobial agent, but little data is available regarding its behavior in soil systems. The objective of this study was to develop an analytical method for the extraction and quantification of glutaraldehyde in soil. Samples of Sensabaugh loam (fine-loamy, mixed, semiactive, mesic Dystric Fluventic Eutrudepts) were spiked with known concentrations of glutaraldehyde and then incubated at room temperature for 24 hours. Glutaraldehyde was extracted by equilibration of the samples with various solvents, and analyzed colorimetrically after complexation with ethanolic phenol in sulfuric acid. Of the extractants examined, a solution of 50% methanol in 0.01 M aqueous  $\text{CaCl}_2$  gave the greatest extraction efficiency, resulting in approximately 50% recovery from the spiked samples.

#### **Stream Ecology**

JAMES EDDY, Dept. of Civil and Environmental Engineering, WVU, Morgantown, WV 26506; LESLIE HOPKINSON, Dept. of Civil and Environmental Engineering, WVU, Morgantown, WV 26506. **Characterizing selenium leaching from southern West Virginia valley fills.**

Selenium is found in southern West Virginia coal seams and overburden. Overburden is used for constructing mountaintop removal valley fills. This selenium is leached into watersheds and is toxic in excessive concentrations. The objective of this study was to characterize leaching of mobile selenium from two West Virginia valley fills.

Unsaturated column leaching tests were performed on coal overburden samples from two southern WV surface mines. Duplicate 15.2 cm diameter columns containing each soil were periodically leached with simulated rain water (1,010 mL) similar in pH (~5.2) to southern West Virginia rainfall. Leachate water was tested

for dissolved selenium, dissolved metals, pH, conductivity, sulfate, acidity, and alkalinity.

Saturated jar tests were performed by filling a series of 3.8 L jars with each soil, saturating the jars, and collecting water samples after certain time intervals. The samples were tested for the same parameters as the unsaturated test. The desorption coefficient was calculated for each soil.

Preliminary results indicate that conductivity ranges were 100-1132  $\mu\text{S}/\text{cm}$  and 503-2940  $\mu\text{S}/\text{cm}$  for the unsaturated and saturated tests, respectively. Maximum selenium concentrations occurred in the unsaturated tests during the first two pours (0.071-0.185 mg/L). The desorption coefficient varied by soil type but was consistent between replicated samples. Results from this work will be used in contaminant modeling.

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AUBREY E. HARRIS, LESLIE HOPKINSON, Dept. of Civil and Environmental Engineering, West Virginia University, Morgantown, WV 26506; DANIEL SOEDER, National Energy Technology Lab, Morgantown, WV 26507. **An evaluation of continuous field-monitoring in detecting surface water pollution events (research in progress).**

The fluids used and produced in the hydraulic fracturing process pose a potential risk to surface water systems. Detection systems are needed to identify risks and to reduce the impacts of fracturing. The objective of this study is to determine whether commercially available in-stream sensors are effective in detecting pollution events.

This is a study in progress. The first step in the study is to identify pollution events that have occurred in monitored watersheds. The Pennsylvania Department of Environmental



Protection publicly reports volume and types of spills that reach surface waters. The Susquehanna River Basin Commission has provided continuous water quality measurements for sub-watersheds in Pennsylvania and New York. ArcGIS and Visual Basic will be used to determine the travel time and the concentration of pollution events to one of these in-stream monitoring devices.

The second step is to simulate the pollution event in a well-mixed closed system, and to evaluate how water quality monitoring instruments respond to low concentrations of pollutant. The results of the simulation will be compared to the field-data to determine if pollution events can be detected by current methods of field-monitoring.

The study is supported by the EPACT Task 14 of the National Energy Technology Lab of the Department of Energy and the Civil and Environmental Engineering Department of West Virginia University.

NATHANIEL P. HITT, U.S. Geological Survey, Aquatic Ecology Branch, Leetown Science Center, Kearneysville, WV 25430; KATHERINE E. COOPER, Dept. of Biology, Shepherd University, Shepherdstown, WV 25443. **Environmental quality relation to oocyte size in stream fish populations.**

Oocyte size can affect juvenile survivorship in stream fishes, but the effects of environmental quality on oocyte size remain poorly understood. We evaluated oocyte size across developmental stages for a widely distributed freshwater fish species (Creek Chub, *Semotilus atromaculatus*) in streams exposed to mountaintop mining (MTM) and reference conditions in West Virginia. We sampled Creek Chubs using backpack electrofishing techniques in seven MTM-exposure sites and four reference sites during spring months of 2010 and 2011 (n = 58 individuals). Fishes were euthanized and samples of egg/ovary tissue were preserved in 10% formalin. Fixed tissues were stained with hematoxylin and eosin and cut into 5  $\mu\text{m}$  sections. Oocyte developmental stages were classified as immature (stage 1-2), cortical

alveolar (stage 3), or vitellogenic (stage 4). For cross-sections that revealed nuclear material (i.e., not edge-cuts), oocyte diameters were measured on a micrometer scale using image analysis software (n = 5909 eggs). We evaluated years separately to control for differences in sample timing (i.e., earlier in 2010 than 2011). Sizes of early-stage oocytes (stages 1-3) were not significantly different between exposure and reference sites in either year. However, late-stage oocytes (stage 4) were significantly smaller in fish from exposure sites than reference sites in 2010 (Mann-Whitney and t-test,  $p < 0.0001$ , respectively) and 2011 (Mann-Whitney and t-test,  $p < 0.03$ , respectively). Our results suggest that nutritional limitations downstream of MTM may limit oocyte size in stream fishes, and this may affect population dynamics as a function of increased juvenile mortality.

This work was supported by the U.S. Geological Survey's Youth Initiative Funding Program.

## Zoology

SARAH BARRY, Department of Chemistry, Shepherd University, Shepherdstown, WV 25443; CLARISSA MATHEWS, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443. **Effects of botanical capsaicin spray on eggs and third instar nymphs of the Squash bug (Hemiptera: Coreidae).**

The Squash bug (Hemiptera: Coreidae) is an agricultural pest causing significant economic losses in summer squash (Cucurbitaceae) due to high feeding damage to fruits and stems and reduced plant productivity. Levels of naturally-occurring biological control often are insufficient to keep damage levels beneath the economic threshold. We investigated the effects of capsaicin, a botanical material derived from hot pepper plants, on squash bug egg masses and nymphs that were obtained from plots of summer squash ('Zephyr' and 'Patty Pan' varieties) at a USDA-certified organic farm (Redbud Farm,



LLC) in Berkeley County, WV. Third instar nymphs and egg masses were sprayed with either reversed osmosis water (control) or hot pepper wax repellent (0.00018% AI capsaicin and other capsaicinoids, 99.99982% food grade wax and other ingredients) diluted to 1/32 with reversed osmosis water, and held in a growth chamber (25 °C, 14:10 L:D photoperiod) with unlimited squash and water provisions. A total of 66 replicates was performed. Mortality rates (% per stage) were compared for the two groups (control versus capsaicin) using independent t-tests. The capsaicin spray significantly reduced mortality of the bugs in the nymphal stage, but there was no significant effect for the eggs. Our results suggest that capsaicin as a repellent of squash bugs should be further explored in the field setting. With a restricted entry interval of zero hours after drying, this botanical material could be useful in sustainable operations aiming to reduce dependency on synthetic chemical pesticides.

NATALIE BOHN, VICTORIA HUMPHREY, and NATALIA OMELCHENKO, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **Effects of nicotine on chicken embryonic development.**

A large proportion of the United States population has been exposed to maternal smoking *in utero*. Mounting data suggests that nicotine can have a negative impact on neural system development. There is a known list of negative consequences of nicotine exposure, including learning disabilities, attention deficit/hyperactivity disorder, and behavioral problems. The early chick embryo is an established model of the first month of embryonic development in mammals. The goal of this study was to evaluate effects of nicotine exposure on chicken development. To this end, nicotine (nicotine hydrogen bitartrate) or vehicle (sodium bitartrate monohydrate) solutions were injected in eggs prior to incubation to match blood plasma levels observed in heavy smokers. Three cohorts of 24 eggs distributed between treatment groups were generated. After injections, eggs were sealed and placed in the incubator (35.5 °C). Embryos were

harvested on day 5 after injections. Our data indicates that the nicotine treatment does not affect viability, weight, or length of the embryos. Nonetheless, nicotine notably affects the axial rotation of the embryos. Axial rotation is defined as a change in the dorsoventral orientation of the head during development (“head turning”). In our study, excessive axial rotation (>90°) was observed in nicotine treated groups 5 times more often than in controls. In order to elucidate the mechanism of such changes, the animals were embedded in paraplast, sectioned, and stained with hematoxylin and eosin for histological analysis. The development of progenitor layers is currently being evaluated using modern techniques of stereological analysis.

PATRICK CARVER and RUTH A CONLEY, Dept. of Biology, Shepherd University, Shepherdstown, WV 25443. **Behavioral characterization in same-sex pairs of *Aeluropoda insignis*, the “Flat-horned” hissing cockroach.**

Many species of cockroach produce a variety of hisses for different social contexts; for example, broadband hiss production in *Gromphadorhina portentosa* can be elicited by agonistic behavior (Nelson and Fraser 1980) and *Elliptorhina chopardi* emit whistles during courtship interactions (Sueur and Aubin 2006). Agonistic behaviors reported for these species include head butting and tail-wagging. Another species, *Aeluropoda insignis*, also produces hissing signals as reported in preliminary research (Kanneh and Conley 2013) and males have been observed to produce hisses during agonistic head-butting (Conley, personal communication). To examine behavioral contexts affiliated with these hisses, same-sex pairs of *A. insignis* were placed in a small 9” x 6” plastic container, and behavior was recorded audiovisually for 30-60 minutes. These animals were socially isolated in individual 4” x 6” plastic home cages with ample food and water. Behavioral interactions were recorded and analyzed for seven pairs of *A. insignis* males and 10 pairs of females. Both sexes produced signals similar to those previously described, yet purely agonistic hisses were unobserved, since

these animals did not display agonistic behaviors in this context; standing, walking, grooming and antennae movement was observed in this scenario. A previously uncharacterized signal (a “chortle”) was produced during both male-male and female-female interactions. Chortles have a series of harmonic frequency modulated steps with short interruptions, essentially making the chortle a combination of a rattle and a whistle. Quantitative analysis of *A. insignis* hisses includes Weiner’s entropy, continuity of frequency and continuity of time using Signal Analysis Pro software.

LAKEN GIBSON, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074; ALICIA HUNT, Sarah Whitaker Glass School of Dental Hygiene, West Liberty University, West Liberty, WV 26074; MATTHEW ZDILLA, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **The sexual dimorphism of vallate papillae: an *in vivo* study.**

Vallate papillae (VP) are important gustatory organs located on the posterior dorsum of the tongue that house a large number of taste buds along their perimeters. While VP are macroscopic structures, there is little detailed documentation regarding their gross anatomical characteristics. The researchers utilized endoscopy among 79 volunteers between the ages of 18 and 26 to assess the morphology of VP. Vallate papillae characteristics were measured with ImageJ software. Normative morphology is presented. Also, the number of VP, mean perimeter of VP per person, and mean diameter of VP per person were all found to be significantly different between males and females. Vallate papillae appear to be sexually dimorphic.

The research was made possible by a Human Anatomy and Physiology Society grant.

KATHERINE LAMBERT and PETER VILA. Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443. **Effects of tide line on the location of nests of the**

### **Leatherback sea turtle (*Dermochelys coriacea*) in Limon, Costa Rica.**

Populations of the largest sea turtle, the leatherback (*Dermochelys coriacea*), have declined drastically in the last 25 years, and the leatherback is currently on the endangered species list. Leatherbacks migrate from tropical to sub-tropical beaches to lay their eggs. The number and distribution of nests laid during a nesting season provides vital information on various aspects of marine turtle ecology and conservation. Understanding the environmental variables that affect nesting location is needed in order to optimize beach conditions to maximize leatherback nesting. The objective of this study was to determine whether leatherback nest location was related to environmental factors such as tide line (high or low), vegetation, or the weather: warm, cold, or rain. Nesting surveys for the months of March, April and May in 2012 and 2013 found that nesting choice was significantly greater for the high tide line in March only. Longer-term data is needed on the nesting behavior of the leatherback in order to determine the significance of specific environmental variables on nest site selection.

OLIVIA LANE, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443; TRACY LESKEY, USDA-ARS Appalachian Fruit Research Station, Kearneysville, WV 25443; CLARISSA MATHEWS, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443. **Capture rate of Spotted wing drosophila, *Drosophila suzukii*, using a visual attractant.**

The spotted wing drosophila (SWD) is an invasive emerging pest that is causing crop loss and economic hardship to soft fruit growers across the U.S. This study explored the use of visual attractants coupled with sticky trap material as a means of modifying SWD behavior and potentially trapping the pest out of fruit crops. Two separate field studies were used to

evaluate eight colored spheres (black, red, orange, yellow, green, blue, purple and white) that were coated with Tangle Trap sticky material. The spheres (three spheres/color) were deployed in established plots of raspberries and peaches at the USDA Appalachian Fruit Research Station (Kearneysville, WV) between July and August (2013). The spheres were placed within the canopy, and lab-reared SWD adults (15 male, 15 female) were released at the center of each plot. After 48 h, the spheres were retrieved, and the number of SWD trapped on each was determined. The study was repeated for three consecutive weeks. In both the raspberry and peach plots, a significant effect of sphere color was found for the SWD capture rate ( $P < 0.05$ ). On average, the colors red and black captured the greatest amount of SWD in both fruit types. No difference in capture rate due to SWD sex was detected. The results suggest that a visual attractant trap could be effective in managing SWD in peach and raspberry. This management technique could offer an ecological approach to decreasing crop loss by SWD without applying insecticides.

LEANNE MAZZELLA, DEANNA SCHMITT and JOSEPH HORZEMPA, Dept. of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **Erythrocyte invasion by *Francisella tularensis* increases colonization of ticks.**

*Francisella tularensis* is a highly infectious bacterium that causes the severe disease tularemia. Humans acquire tularemia through inhalation, oropharyngeal exposure, or tick bites. A unique feature of *F. tularensis* is its ability to invade erythrocytes. In this study, we investigated if red blood cell invasion enhances colonization of ticks, which could lead to increased transmission of disease. To test this, we initially used the predominant vector for this bacterium, *Dermacentor variabilis*. Ticks become infected with *F. tularensis* as nymphs and the bacteria are maintained until adulthood. Subsequently, *F. tularensis* is transferred to humans during a blood meal. First, we sought to inoculate *D.*

*variabilis* nymphs and adults *in vitro* through capillary feeding. Our experience was consistent with reports that indicate that these ticks do not actively feed from capillary tubes, and require a live animal host to initiate feeding. Therefore, an alternative tick species, *Ixodes scapularis*, was used as a model for this experiment, since these ticks can also transmit *F. tularensis* and actively feed from capillary tubes. Preliminary studies indicate that red blood cell invasion increases bacterial colonization of *I. scapularis*.

RACHEL RICHARDSON and PETER VILA, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443. **Effect of light sources on Leatherback sea turtles (*Dermochelys coriacea*) nest densities on Moin Beach, Costa Rica.**

Human's activities are impacting beaches where thousands of sea turtles go each year to lay hundreds of thousands of eggs. Impacts on sea turtle nesting grounds include beach development for resorts, hotels, and boardwalks to increase tourism. Artificial lighting and noise can be a major problem to sea turtle nesting. The objective of this study was to determine the relationship between light and number of nests. In this study, Leatherback sea turtles were observed and documented on Playa Moin located in Limon, Costa Rica during the months of March-May 2012 and March-April 2013. A significant negative correlation was found between the distances of the nests from the lights of Puerto Limon and the number of nests. Other studies have also found similar results, and the evidence suggests that the expansion of the port with an even greater amount of light would have detrimental effects on the Leatherback population nesting on Playa Moin.

TYLER TURNER, ROSS CONOVER and SARA SAWYER, Dept. of Science and Math, Glenville State College, Glenville, WV 26351. **The effects of haemosporidian endoparasite loads on life-history characteristics (age, sex, reproduction success, territories, body mass) of Mountain**

**white-crowned sparrows (*Zonotrichia leucophrys oriantha*).**

There are life-history tradeoffs for organisms that are related to immunological efforts. This study is being conducted to test the effects of haemosporidian endoparasite loads on life-history characteristics (age, sex, reproduction success, territories, body mass) of Mountain White-crowned Sparrows (*Zonotrichia leucophrys oriantha*). We collected 126 blood samples from live Mountain White-crowned Sparrows in the summer of 2013 at the Rocky Mountain Biological Laboratory in Gunnison County, CO. These samples were preserved as blood smears and microscopically surveyed to identify six different parasite species: *Leucocytozoon fringillinarum*, *Leucocytozoon majoris*, *Haemosproteus coatneyi*, *Plasmodium caughni* and *Trypanosoma avium*. Parasite loads will be calculated as the number of parasites/1250 erythrocytes. We hypothesize that bird body condition and reproductive success will negatively correlate with endoparasite load. Our understanding of bird response to parasite load will provide insight on the relationship between environmental conditions and avian physiology, which may assist future management decisions.



