ORAL PRESENTATIONS

Applied Mathematics and Physics

SERDAR BILGILI, ORLANDO UGARTE, and V'YACHESLAV AKKERMAN, Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506.
Acoustical coupling of Kelvin-Helmholtz instability in reacting viscous potential flows.

Hydrodynamic instabilities play a profound role in the evolution, stabilization and control of fluid flows and flames. In this respect, the Kelvin-Helmholtz (KH) instability is an important trigger to induce turbulence within a single fluid by means of a velocity shear, or along the interface of multiple fluids. This mechanism was widely studied by Funada and Joseph for the surface separating two fluids within the approximation of inviscid and viscous potential flows [Journal of Fluid Mechanics 445 (2001) 263]. In the present work, the Funada-Joseph formulation is extended to incorporate the effect of imposed sound waves. The KH-sound interaction is investigated by modifying the Bychkov formulation on the acoustic coupling to the Darrieus-Landau combustion instability [Physics of Fluids 11 (1999) 3168]. Analytic formulae for the dispersion relations, growth rates and neutral curves describing the perturbed interface are derived. Namely, the limits for stable/unstable regimes as a function of hydrodynamic and acoustic parameters are determined considering a linear dispersion relation for the perturbed interface. Two interacting modes are of particular interest: resonant and parametric, characterized by their frequency in relation to the disturbance oscillation. Overall, a comprehensive parametric study of the results demonstrates that while the acoustics of relatively low amplitude shows a promising contribution to stabilize the KH instability, those of high amplitude can excite the parametric instability as well.

DARRYL JOHNSON, QING WANG, ZHIJUN WANG, Department of Computer Sciences, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443; DAVID J. KLINKE, Department of Chemical Engineering and Department of Microbiology, Immunology and Cell Biology, West Virginia University, Morgantown, WV 26506. **Modeling the mechanism of oxaliplatin and IL-12 cooperation.**

Oxaliplatin, a chemotherapeutic agent, has been shown previously to cooperate well with interleukin 12 treatments of colorectal cancer liver metastases in mice. Experiments show that not only does this treatment eliminate the tumor present, mice treated with this form of immuno-chemotherapy have also shown a resilience to tumor re-challenge. This research proposes a mathematical model that attempts to explain the mechanism by which this cooperation and increased resilience are brought about. A Markov Chain Monte Carlo algorithm is used to find the probable regions of parameter space that fit the proposed model and a bifurcation analysis is performed to demonstrate how treatment brings subjects to a stable, tumor-free equilibrium.

This project was supported by the NIGMS of the NIH grant as part of the West Virginia INBRE (P20GM103434).

DARRYL JOHNSON and RALPH WOJTOWICZ, Department of Computer Sciences, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443. **Analysis of logical structure of topos quantum mechanics.**

The Kochen-Specker (KS) theorem, proved in 1967, asserts the impossibility of a deterministic quantum mechanics that simultaneously assigns a value to every classical variable. This proved that hidden variable theories were fundamentally inadequate for explanation of quantum phenomena and spelled the final blow towards realist approaches. In 1998, Isham and Butterfield proved that KS is equivalent to a statement about the structure of a certain presheaf topos. In 2008, Doring and Isham developed a schema by which physical theorems may be treated as representations of an appropriately-typed formal language into a topos. This work seeks to survey the logical structure induced by the presheaf over the category of contexts proposed by Doring and Isham. We list and prove various tautologies in the semantics of such topos representations and offer physical interpretations on such tautologies.

EMILIE PIATEK, Department of Computer Science, Mathematics and Engineering, Shepherdstown, WV 25443. **Applications of big data technologies to bio-informatics.**

Big Data Concepts: The digital universe has experienced a rapid expansion over the past decades due to growth of the Internet, the evolution of social media, the availability of electronic images, video and audio, the ubiquity of sensor data such as GPS, and scientific data efforts including the human genome project, the Large Hadron Collider and the Sloan Digital Sky Survey. Increases in the capacity of electronic storage devices have helped support the growth of digital data in science, business and in our personal lives. Data access rates of these devices, however, have not kept pace. In 1990, for example, the entire contents of a typical 1.4 MB hard drive could be read in about five minutes at 4.4 MB/s. Currently, it takes more than 2.5 hours to read the contents of a typical 1 TB drive at 100 MB/s. In response to this data access rate shortfall, researchers have developed techniques for analyzing data that is distributed across multiple storage devices located on a network of computers. The challenge is to operate on the data locally in order to (1) minimize the amount of data that must be transferred among machines, (2) overcome latencies of individual hard drives and (3) efficiently utilize data that is naturally collected in a distributed manner. The objective will be achieved through implementation of various algorithms such as Rabin-Karp, Knuth-Morris-Pratt, Finite automation and the Naïve string-matching algorithm.

Botany

HALLIE GUNNOE, LINDSAY MILLER, and DONALD TRISEL, Department of Biology, Chemistry, and Geoscience, Fairmont State University, Fairmont, WV 26554. **The science and folklore of using medicinal plants to treat diabetes mellitus.**

Type II diabetes mellitus is a chronic condition in humans resulting from insulin resistance in fat and muscle cells and impaired secretion of pancreatic β cells, which create insulin in the body. This resistance causes a chronic state of hyperglycemia and can be fatal without treatment. Glycemic homeostasis maintenance is the common objective for those who

have Type II diabetes. The goal of this research was to collect, cultivate, and study medicinal plants used historically or currently to treat diabetes mellitus. Extracts of barberry (*Berberis vulgaris*), ginseng (*Panax quinquefolius),* aloe vera (*Aloe barbadensis*), and ginger (*Asarum canadense)* are all classified as sulfonylurea derivatives and act on β cells to increase insulin release. Licorice (*Glycyrrhiza foetida*) has also been found to regulate insulin resistance by reducing blood pressure and blood glucose levels. Plants were grown in the green house, and five collecting trips to the northern West Virginia counties of Marion, Harrison, Randolph, Monongalia, and Lewis were taken to collect various specimens. A total of 96 plants were collected, mounted, and digitized to contribute to the Fairmont State University Herbarium (FVWA). New updates for the Checklist and Atlas of the Vascular Flora of West Virginia will be provided from the results of this study.

This research was supported by a Fairmont State University S.U.R.E. grant.

LINDSAY MILLER, HALLIE GUNNOE and DONALD TRISEL, Department of Biology, Chemistry and Geoscience, Fairmont State University, Fairmont, WV 26554. **Historical and current diabetes mellitus treatment using medicinal plants.**

Diabetes mellitus is a metabolic disorder that affects up to 20% of the population. Many medicinal plants have been studied and shown to treat symptoms of diabetes mellitus, such as *Panax quinquefolius* (ginseng), *Allium cepa* (onion), *Berberis vulgaris* (barberry) and *Trillium erectum* (red trillium). The objectives for this research were to cultivate and collect plants to treat symptoms of diabetes mellitus, document locations of the medicinal plants, and create/digitize specimens to add to the FWVA herbarium database. When this research began, FWVA held seven *B. vulgaris,* nineteen *T. erectum*, three *A. cepa*, and eleven *P. quinquefolius* specimens. Five trips were taken to collect plant specimens from five counties throughout West Virginia. Studies on certain alkaloids and flavonoids have shown hypoglycemic effects on diabetic patients. Specifically, berberine is an alkaloid found in *B. vulgaris* that has a potential glucose-lowering effect. Quercetin is a flavonoid found in *A. cepa* that has alpha-glucosidase inhibitory activity, which is important in controlling blood glucose levels. Results from this study will provide updates for the Checklist and Atlas of the Vascular Flora of West Virginia. In total, 96 medicinal plant specimens were collected and digitized in the FWVA herbarium for future studies and experiments.

This research was supported by the S.U.R.E. grant from Fairmont State University.

Cell Biology

MEGANN BOONE, KATHERINE VECCHIO, and BRUCE ANTHONY, Department of Chemistry / Biochemistry, West Virginia Wesleyan College, Buckhannon, WV 26201. **Alterations in DNA and RNA profiles from alcohol-exposed cortical stem cells relate a possible mechanism for slowed proliferation and increased apoptosis.**

Fetal Alcohol Spectrum Disorders (FASD) has become an ever-increasing health concern associated with consumption of alcohol during pregnancy. The mechanistic pathways under which alcohol slows cell growth and induces apoptosis are poorly understood, yet necessary to create possible treatments. Previous studies suggest that alterations in proliferation are

associated with the loss of cell cycle checkpoint regulation at both G_1/S and G_2/M. Our previous studies suggest major contributions from overexpression of proteins associated with late G_1 and the transcriptional induction of S-phase genes required for DNA synthesis. Cell growth was examined using BrdU incorporation over 36 hours and showed that G_1 and S phases are slowed due to alcohol exposure. Our interest with this set of experiments is to define the periods of slow growth in both phases.

We used flow cytometry to examine RNA synthesis (Pyrinin Y staining representative of G_1 progression) and DNA synthesis using 7-AAD. Each staining was done independently with one set in tandem. We used rat cortical neuronal stem cells which are progenitors of neural crest cells. Analysis included DNA, RNA and apoptosis profiles from both control and alcohol exposed cells. We suggest that a population of cells show alterations in G_1 phase progression, induced early entry to S phase, and increased apoptosis. This research is important in understanding the mechanism in alcohol induced proliferation and apoptotic changes associated with alcohol exposure and allows insight into plasticity changes in FASD.

ADAM P. FISCHER and SARAH L. MILES, Department of Biochemistry and Microbiology, Joan C. Edwards School of Medicine, Marshall University, Huntington, WV 25755. **Vitamin C…not just for sailors: Examining ascorbate-mediated down regulation of hypoxia-inducible factor-1 in metastatic melanoma.**

Ascorbic acid (AA) is a simple, yet essential compound for multiple biological functions. The potential use of ascorbic acid as an effective non-toxic adjuvant treatment to enhance chemotherapy is supported by the discovery that many patients with advanced cancer, including melanoma, are vitamin C (ascorbic acid) deficient. Ascorbic acid acts as an important cofactor for HIF hydroxylase enzymes that regulate the oxygen sensitive degradation of hypoxia-inducible factor (HIF-1α). Overexpression of the HIF-1α transcription factor has been linked to the progression of several cancer types, including melanoma. Previous studies in our lab show a correlation in melanoma progression and stabilized HIF-1α protein expression under normoxic conditions, with the highest expression found in metastatic cells. In these studies, our aim was to determine the ability of WM9 metastatic melanoma cells to accumulate ascorbic acid following exposure to various ascorbic acid derivatives, as well as to determine the ability of ascorbic acid to effectively inhibit normoxic HIF-1α protein stabilization, accumulation and transcriptional activity by supporting the function of HIF hydroxylases.

Our results demonstrate that not only is ascorbate preferentially transported/accumulated by WM9 cells over dehydroascorbate (DHA; oxidized ascorbate), it is more effective in attenuating HIF-1 function by significantly reducing both HIF-1α protein accumulation and transcriptional activity. Furthermore, treatment of WM9 cells with ascorbate 2-phosphate (A2P; non-oxidizible AA) decreased their invasive potential. These studies suggest the addition of ascorbic acid could be a beneficial adjuvant therapy in melanoma treatment, in addition to other malignancies, particularly in types expressing high HIF-1α expression/stabilization and warrants further investigation.

CORYNN McATEE, MARIA WEBBER, Department of Biological Sciences, Marshall University, Huntington, WV 25755; ANISHA VALLURI, Cabell Midland High School, Ona, WV 25545; LOGAN LAWRENCE, Department of Biological Sciences, Marshall University, Huntington, WV 25755. **3D tumor model for testing anticancer drugs.**

The purpose of this research was to study a simple three-dimensional (3D) spheroid model to test cytotoxic effects of anticancer drugs for Glioblastoma Multiforme (GBM), a primary brain tumor. The 3D spheroid cell culture is recognized as a suitable model to study tumor biology, because of the biological similarities shared with solid tumors *in vivo*.

Methods: GBM cancer cell lines T98G, BNC6, and C2 were seeded in a 96-well Perfecta 3D Hanging Drop Plate in 8 replicates (n=8) in RPMI medium and cultured in the dark at 37 °C in a 5% CO_2 water-jacketed incubator. On day 7, the spheroids were exposed to a panel of standard-of-care anticancer drugs for treatment of GBMs. Each anticancer drug was tested at the clinically relevant dose. Cell viability and cytotoxicity assessment of spheroids was performed using Trypan blue exclusion and MTT assay. Cells were immunophenotyped for CD133 cancer stem cell marker by flow cytometry.

Results: Cells in the Perfecta 3D Hanging Drop Plate formed single spheroids within 4 days, and spheroid growth was observed for 7 days. Cytotoxic death resulting from drug treatment was observed in the peripheral cells, while internal cells remained alive. This was measured by MTT cell viability assay and (RSIM) regional spheroid integrity measurements.

Conclusion: With the ability to directly observe the cytotoxicity of an anti-cancer drug on a spheroid, the Perfecta 3D system may be applicable for rapid screening of anti-cancer drugs on the entire population of a tumor with relation to its internal structure and composition.

Chemistry

JESSICA GEIERMANN, Department of Biological Sciences, Shepherd University, Shepherdstown, WV 25443; JORDAN MADER, Department of Chemistry, Shepherd University, Shepherdstown, WV 25443. **The synthesis of polystyrene foams via HIPE for arsenic remediation.**

Arsenic is relatively abundant in the earth's crust, yet removing it from water sources is still an issue in many places. Even in the United States, some wells contain far above the World Health Organization's 10 µg/L standard (World Health Organization, 2012). Using polystyrene foams synthesized via HIPE, a thiol functional group was added to the polymer in order to bind arsenic as contaminated water passes through the polymer. During the course of this research, it was found that by adjusting the methods in Dujardin, Cazé, and Vroman (2000), the thiol group can be added to the polymer. Arsenic concentrations were lowered from 400 ppb to 175 ppb with a 120 mg/cc density foam. Further testing will be completed to refine the process of functionalizing these polymers, as well as testing for the presence of a thiol group and quantifying arsenic removal.

This work was supported by the West Virginia Higher Education Policy Commission Division of Science and Research SURE Grant Program, the Shepherd University Chemistry Department, and the Shepherd University School of Natural Sciences and Mathematics.

DANIEL LUKICH, NICOLE TURNER, THEUNIS VAN AARDT, and ROGER SEEBER, Department of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **Chemical analysis of American ginseng's ginsenoside content from two sources.**

The genus *Panax* is a group of herbs that are widely used for alleged medicinal purposes. Plants from *Panax* have been used medicinally for over a thousand years. Ginsenosides are compounds that are found in plants of the genus *Panax*, and much research has already been done investigating their potential medicinal value. The purpose of this study is to determine if ginsenoside content varies between different sources of American ginseng (*Panax quinquefolius*) by comparing the results of several extractions of ginseng from capsules and from dried, cultivated root. This investigation utilizes gas chromatography-mass spectroscopy (GC-MS) to chemically analyze the results of the extractions. In addition, it's also hoped that the actual effectiveness of hot water extraction of ginsenosides will be evaluated by this study. Preliminary GC-MS results indicate the possible presence of free phenolics. Phenolic protection employing methylation and acetylation will be completed to allow for greater differences in Rf values, thus allowing for clearer analyses of the constituent products.

SARAH METZ, ZACHARY FERGUSON, STEVEN ROOF, Department of Biology, Chemistry and Geoscience, Fairmont State University, Fairmont, WV 26554. **Determining the retention factor of ink to develop a laboratory to be used in an introductory non-science major's class.**

Paper chromatography is used to separate mixtures of substances into their rightful components. The purpose of this research is to further involve non science major students in applications of Forensic Biology and help them to gain interest in the biology field while learning. Chromatography takes place by the substance being placed on paper and introduced to a solvent; as the solvent moves up the paper, the different components separate into various colored spots. In this experiment three solvents, 70% ethyl alcohol, 90% ethyl alcohol, and tap water were used determine the components of the ink(s)used. Previously-prepared inks were utilized, as well as food coloring mixtures, to simulate ink compounds. Some of the compounds in the mixtures traveled almost as far as the solvent did, whereas some remained closer to the base line. The Rf values were calculated to help determine the distance traveled relative to the solvent. The structure of the paper used in chromatography is made of cellulose fibers; cellulose is a polymer of glucose. Complications may arise due to the fact that cellulose fibers attract water vapor from the atmosphere when the paper is made. This interaction with water is one of the most important effects during chromatography. From the results found, it is apparent that ethyl alcohol is the best solvent to be used when separating the ink compounds; however, the majority were water soluble, so the results were not as ideal. When using tap water, the individual colors did not separate as efficiently.

STEVEN PIFER and KEVIN EVANS, Department of Science and Mathematics, Glenville State College, Glenville, WV 26351. **Anti-Markovnikov hydrobromination of alkenes.**

Alkyl bromides are key intermediates in numerous multi-step organic syntheses and are commonly synthesized from the hydrobromination of alkenes. In the late 1920s, Kharasch published a mechanistic explanation for the regiochemistry of the hydrobromination of alkenes that was first observed by Markovnikov in 1870. In the absence of radicals, an electrophilic addition mechanism yields predominately the Markovnikov product. The addition of peroxide into the reaction mixture generates radicals and results predominately in the anti-Markovnikov alkyl bromide. The objective of this research is to develop an efficient synthesis of the anti-

Markovnikov alkyl bromide by generating hydrobromic acid *in situ* by the hydrolysis of phosphorous tribromide. The reaction of 1-octene with phosphorous tribromide, silica gel, and benzoyl peroxide in hexanes has been studied with varying reaction conditions in an effort to optimize the yield of 1-bromooctane (anti-Markovnikov product). The roles of the silica gel have been investigated and the percent conversion of 1-octene to either alkyl bromide with varying quantities of silica gel and peroxide and the addition of water will be presented. Current optimized conditions result in 90% conversion of 1-octene to 1-bromooctane.

Computer Science

CORY S. CRAMPTON and OSMAN GUZIDE, Department of Computer Science, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443. **802.11ax HEW.**

For my project, I will be researching the new wireless protocol of 802.11ax. From what I have researched up to this point, this new protocol is capable of achieving new vast speeds. These speeds have the capacity to reach up to 7 gigabytes per second. AX is simply taking the current 802.11ac, which operates solely on 5 GHz, and allowing the system to operate on both 2.4GHz and 5 GHz. Other new features of AX are the Full Duplex capability, the Uplink MU MIMO which is the counterpart to ac's Download MU MIMO, along with many other new advancements.

MAURO DOZA, HANS VOMEND, ZHIJUN WANG, QING WANG, Department of Computer Sciences, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443; DAVID J. KLINKE, Department of Chemical Engineering and Department of Microbiology, Immunology and Cell Biology, West Virginia University, Morgantown, WV 26506.
Immunotherapy treatment strategies of cancer via impulsive control.

Cancer has been one of the leading causes of death. Although traditional treatments have been developed to deal with cancer, new methods have been investigated to prevent and successfully treat cancer. Immunotherapy is one of such treatments against tumor cells. Unlike the aggressive approach of chemotherapy and radiotherapy, immunotherapy enhances the body's own immune system to eliminate the tumor cells. We revised the Kirschner-Panetta model (J. Math. Biol. 1998) that used the LAK therapy in conjunction with the TIL therapy to control tumor growth. The therapies were implemented by the injection of cultured immune cells that have anti-tumor reactivity into a tumor-bearing host where cytokine IL-2 was used as an enhancer to the effector cells. The modified version used an impulsive ODE system to allow for a more realistic model of injections of IL-2 and effector cells at discrete times. Based on the revised model, we tested the effect of dose and timing of the combined immunotherapy treatments by impulsive control depending on the scale of the tumor cells to develop an optimal solution scenario.

This project was supported by the NIGMS of the NIH grant as part of the West Virginia INBRE (P20GM103434).

RACHELLE HUFF and OSMAN GUZIDE , Department of Computer Science, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443**. Robotic operating system (ROS) used for swarm technology.**

My project is to research applications of ROS for autonomous swarm robots with a focus on navigation capabilities, as well as to look into new methods, or simply better methods, of developing an operating system for swarms to allow a more robust network that permits the swarm to have a variety of capabilities. The idea is basically to look into ways of making a system that supports a multitude of more "intelligent" robots, having them be more versatile and be able to act as a group or as completely separate individuals while still connected.

DESIRE MILLER and OSMAN GUZIDE, Department of Computer Science, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443. **Heartbeat sensors.**

In the virtual video game, Call of Duty: Modern Warfare 2, there exists an accessory that can read heartbeats and display on the output screen, whether the heartbeat is that of a friend or an enemy. Although this exact device does not currently exist in the real-world, there have been other innovations, such as the use of infrared imaging and microwaves, that lead to the potential creation of the heartbeat sensor accessory as shown in the video game, or close to it. There are already signs that changes will have to be made to the accessory, such as being able to tell the difference between heartbeats of friends and enemies. For this, additional technology will be needed, such as the use of a microchip, GPS, etc. However, with enough research, one could clear the path for this new innovation.

ANDY SHTANKO and OSMAN GUZIDE, Department of Computer Science, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443. **Indoor GPS systems.**

Most people are familiar with the Global Positioning System (GPS) as used in personal technology, which determines the exact location in order to provide directions from users' current locations to a new destination. More often, the term GPS describes a device capable of determining the absolute position of a person or object on the surface of Earth, the initial step of determining the exact location featured in the personal GPS. This step does not work correctly in certain scenarios. For example, when GPS is used in an indoor environment, exact location may be extremely inaccurate or entirely impossible to determine. This is because GPS uses satellites to send and receive a signal to determine location. In indoor environments, the signal becomes scattered and distorted, often losing contact with the satellite entirely. The goal of this project is to develop an alternative to GPS for use in indoor environments, using RF and Infrared tags within a certain range to map specific locations and be able to find them within the environment. Following the initial mapping process, the mapped tags will be used to create a grid system with absolute coordinates, referenced in the future to determine exact location. Uses of this system could include, but are not limited to, the automation of robots, indoor robotic sensor networks used for temperature or humidity control, navigation to specific offices within buildings, and navigation to products within warehouses.

NIRMAL SINGH, Department of Computer Science, Fairmont State University, Fairmont, WV 26554; MAHMOOD HOSSAIN, Department of Computer Science, Fairmont State University, Fairmont, WV 26554. **A prototype for health care document fusion.**

Most healthcare facilities compile patient data into their respective Electronic Health Record (HER) systems adhering to the *Continuity of Care Document* (CCD) standard that is governed by a health care standards institution called HL7. By definition, CCDs do not contain complete information, they only contain the critical information required for continuity of care for the patient. Different health care providers generate separate documents with separate details for a patient receiving care. Furthermore, there can be separate “providers” of such documents with their own EHR systems, which in turn gives rise to a slightly different document. There is clearly a lack of open-source tools for integrating health care data into one consolidated document for an individual. We propose the framework of a prototype for such a tool that employs a "fusion" technique. The prime idea is to build on top of previous efforts which are also open-source. Our framework will address two issues: (a) A document generated by a provider may change at a later time and (b) There could be a new document provider which could have same data or could have additional information which maybe in the same general format or may be more complex. With the existence of such a consolidated document, an individual's future health can be analyzed and timely alerts can be generated.

Ecology

KATELYN AMSPACHER, Department of Biology, Shepherd University, Shepherdstown, WV 25443. **Ecology of the invasive cereal aphid, *Metopolophium festucae cerealium*, in the Pacific Northwest.**

Metopolophium festucae cerealium (MFC) is an invasive cereal aphid in the Pacific Northwest USA. The species has become widely distributed in the region only in the past four years, so this study aims to learn more about its general ecology. In its native habitat in the UK, the species lives on wild grasses, however no MFC was found on wild grasses of the Palouse prairie in the Pacific Northwest. The genus *Metopolophium* overwinters on roses, but no MFC was found on roses in the Palouse. A positive correlation was found in average abundance of MFC and *Sitibion avenae*, suggesting a "hot spot" theory of species abundance. MFC is a host to parasitoids of genera *Praon* and *Aphidius*, which are natural enemies controlling population growth and invasion. The phytotoxic saliva of the species is enough to kill wheat in the greenhouse, so an economic threshold will be produced to aid farmers in the decision to treat for aphids.

SHELBY HAYES, Department of Biology, Shepherd University, Shepherdstown, WV 25404; JEFFREY R. GROFF, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25404. **Assessment of a model population’s sensitivity to collapse and extinction due to generational variance in adult survivorship.**

Populations of organism subjected to unsustainable human harvest may collapse or become extinct. The purpose of this investigation is to study how generation-to-generation

variability in harvest size, or more specifically adult survivorship, affects the susceptibility of a model population to collapse and extinction. The study utilized a modified logistic map-model of population change and the MATLAB programming environment to simulate a population subjected to proportional harvest over many generations. While the adult survivorship is a beta-distributed random variable that changes from generation-to-generation, the populations intrinsic growth rate was assumed to be constant during any individual simulation for simplicity. Our results indicated that for an adult survivorship of fixed mean, the sensitivity of our model population to collapse often increased, and the expected number of generations until collapse decreased, as the variance in adult survivorship from generation-to-generation increased. These results indicate that managers of populations subjected to human harvest should strive to reduce generation-to-generation variability in adult survivorship. Thus, harvest sizes should be dynamically set to smooth out fluctuations in adult survivorship instigated by other natural or man-made causes. At the same time, our results suggest that maximizing generation-to-generation variability through artificial means may be a successful strategy for mitigating nuisance and invasive species.

Funding supporting this project was received from West Virginia Higher Education Policy Commission Division of Science and Research SURE Grant Program.

THOMAS JONES, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25443; JEFFREY R. GROFF, Institute of Environmental and Physical Sciences, Shepherd University, Shepherdstown, WV 25404. **Comparing the accuracy of polygon versus point classification training in Google Earth Engine.**

This study was undertaken to optimize the process of mapping mountaintop mining, which will allow for the production of an updated map of the mining sites in West Virginia. To undertake this study, a classifier, which assigns types of land cover to a designated category, was trained on 2009 Landsat-5 imagery. The classifier was trained twice, once using points and a second time using polygons, in order to see which training method performs best at identifying mountaintop-mining sites in West Virginia. This study was performed at SkyTruth in Shepherdstown, WV. After the training of the two classifiers was completed in Google Earth Engine (GEE), they were then imported into Quantum Geographical Information Systems (QGIS). In QGIS, twelve chosen mine boundaries had been drawn using 2009 National Agriculture Imagery Program (NAIP) imagery as a reference in order to compare the accuracy of the two classifiers against the digitized mines. The results of a Paired Sample T-Test yielded a significance of .006 and a t value of 3.417, which meant that the first variable, point areas, had a significantly higher mean than the second variable, polygon areas. Despite the greater concentration on perfecting the polygon trainer, the point trainer classifier turned out to be more accurate in identifying mountaintop removal area. For future research, giving equal attention to perfecting both training methods would be the next step in discovering if the point method of training actually is more accurate than the polygon method.

BEN M. STOUT III, Department of Biology, Wheeling Jesuit University, Wheeling, WV 26003. **The Wheeling, West Virginia experience with frackwater: what "brinewater" and "residual waste" trucks are really carrying.**

Brinewater trucks were sampled by the West Virginia Department of Environmental Protection. Of 13 trucks sampled, 5 (38%) would be considered to be carrying hazardous waste if not for exemptions from federal laws. One truck carried approximately 5,000 gallons of pH 1.5 liquids. Three trucks exceeded hazardous waste standards for radiation, and another had benzene at 1320 ug/L. A WVDEP investigation led to a consent decree with a $400,000 fine levied against the City of Wheeling, WV. Since then, another application for a frackwater treatment plant was received by the City. This plant, 2 km upstream of Wheeling's Ohio River water intake, is purported to "recycle" frackwater, thus requiring no air or water quality permits. Frackwater samples compared with primary drinking water standards revealed 1 of 13 samples (8%) met standards. Standards were exceeded 30 times in 12 samples, including arsenic (2 samples), barium (7), selenium (1), benzene (4), gross alpha (7), and radium (9). Trucks carrying frackwater labeled "brinewater" and "residual waste" often contain hazardous waste and toxic substances. Local ordinances may be the only means of preventing communities from becoming hazardous waste destinations.

Engineering

SERDAR BILGILI, BERK DEMIRGOK, and V'YACHESLAV AKKERMAN, Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506; DAMIR VALIEV, Department of Physics, Umea University, Umea, Sweden. **Effect of Lewis number on flame acceleration scenario through channels.**

The role of Le in the flame acceleration scenario is investigated by means of direct numerical simulations of the complete set of combustion equations, including fully-compressible hydrodynamics, transport properties (viscosity, diffusion, thermal conduction) and chemical kinetics modelled by one-step Arrhenius reactions. We have identified a threshold Lewis number, Le_t, such that the thermal-diffusive effects do not appear for $Le > Le_t$ and Le_t varies with the channel width. For $Le < Le_t$ flames, the flamefront segment at the centreline is "retarded" as compared to the flame segments at the walls, thereby forming a cusp, followed by the cavities and pockets. Amazingly, a globally-convex flamefront splits into two or more "fingers", accompanied by a drastic increase in the flame surface area and associated enhancement of flame acceleration. This picture is limited to the initial stage of acceleration. Later, the flame fingers meet, promptly consuming the cavities and pockets. This is accompanied by a substantial decrease in the flame surface area and associated moderation of flame acceleration. Eventually, this results in a single, globally-convex flamefront that keep accelerating. Overall, the Le-effects substantially facilitate the flame acceleration scenario, thereby advancing a potential deflagration-to-detonation transition. The effects promote with the decrease in Le and with the increase in the channel width.

SRI HARI RAMAKRISHNA CHALAGALLA, SINAN DEMIR, V'YACHESLAV AKKERMAN Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506; ALI S. RANGWALA Department of Fire Protection Engineering, Worcester Polytechnic Institute, Worcester, Massachusetts 01609; VITALY BYCHKOV Department of Physics, Umea University, Umea, Sweden. **Predictive scenario for premixed methane-air flame spreading and explosion triggering in a mining passage.**

To reveal the inner mechanism of gas explosion, the entire scenario of premixed flame front evolution within an accidental fire is prescribed, quantitatively, with the situation of a methane-air explosion in a mining passage as the primary application. Specifically, the key stages of flame evolution are scrutinized. First, a globally-spherical expansion of a centrally-ignited, embryonic flame, with a possibility of self-similar acceleration caused by the hydrodynamic (Darrieus-Landau) instability occurs. This stage provides an order of magnitude increase in the flame speed in realistically large mining passages. Second, a transition from a globally-spherical front to a finger-shaped one happens when a flame starts approaching the passage walls. While this acceleration is extremely strong, it stops as soon as the flame touches the passage wall. This mechanism is Reynolds-independent; being equally relevant to micro-channels and giant tunnels. The flame speed increases by one more order of magnitude during this stage. Eventually, a flame may accelerate due to wall friction as well as in-built obstacles and wall roughness. While this scenario could be dominant at micro- and mesa-scales, it appears negligible in a mining passage because the influence of wall friction decreases, drastically, with the Reynolds number, and wall-attached obstacles are small in mines.
Overall, we have identified the key characteristics of all stages such as the timing for each stage as well as the flame shapes, propagation speeds, acceleration rates, and flame-generated velocity profiles. The flame speed rises by orders of magnitude. Starting with laminar homogenously-gaseous combustion, the analysis is subsequently extended to dusty-gaseous environments.

SINAN DEMIR, HAYRI SEZER, West Virginia University, Morgantown, WV 26506; ALI S. RANGWALA, Worcester Polytechnic Institute, Worcester, MA, USA; VITALY BYCHKOV, Umea University, Umea, Sweden; V'YACHESLAV AKKERMAN, West Virginia University, Morgantown, WV 26506. **Theory and modeling of flame acceleration mechanisms for spatial variations of planar flame speed.**

While a planar pre-mixed flamefront propagates with a speed, S_L, that depends on the thermal-chemical properties of the fuel mixture only, irrespective of the configuration and hydrodynamics, such a flame occurs extremely seldom in practical reality. Indeed, the majority of industrial and laboratory flames are corrugated, due to turbulence, acoustics, shocks, combustion instabilities, wall friction, in-built obstacles, etc. The majority of theories associated with the variety of flame acceleration scenarios are based on the "geometrical formulation": namely, the wrinkled-to-planar flame speeds ratio, S_W / S_L, which is evaluated as the scaled increase in the flame surface area, while the entire combustion chemistry is immersed in S_L, which is assumed to be constant. However, in practical reality, S_L may experience spatial and temporal variations, due to the associated pressure and temperature distribution within a combustor, and their evolution during burning.

In the present work, we initiate the systematic study of a much more intriguing situation: when variations are externally imposed in a manner being a free functional of the formulation. This is especially relevant to multi-phase combustion in a dusty environment, with a non-uniform distribution of combustible and/or inert dust, as well as to the event of spatial variations of the equivalence ratio. First, the variety of spatial distributions are incorporated into the Bychkov theories of flame acceleration due to wall friction [Physical Review E 72 (2005) 046307] and "finger" flame shape [Combustion and Flame 150 (2007) 263]. Second, we develop the Dust and Gas Explosion Model (D-GEM), a computational platform capable of

quantifying the mining fire hazards, namely, the probability of spontaneous ignition, the evolution of a flame front, and the likelihood of a deflagration-to-detonation transition. A backbone for the platform is a fully-compressible, finite-volume Navier-Stokes code solving for the hydrodynamics and combustion equations in a homogenously-gaseous, laminar environment. Specifically, the dust (combustible or inert) is implemented into the theory and solver by means of thermal-chemical parameters of particle-air flames, tabulated as functions of particle type, size and concentration. In particular, the classical Seshadri formulation [Combustion and Flame 89 (1992) 333] for the laminar premixed particle-cloud flame speed is employed. The variety of gradient forms for dust distribution is investigated.

MAURO DOZA, Department of Computer Science, Mathematics and Engineering, Shepherd University, Shepherdstown, WV 25443. **Harnessing electrical energy from the body using thermoelectric energy and other methods.**

Technological advancements have made it possible to miniaturize our technology, whether it is our powerful smartphones, health monitors, or implantable medical devices. Pacemakers relieve arrhythmia victims of the abnormal heart rhythms and allow them to lead a better lifestyle. Cardioverter defibrillators are also an implantable technology. These help victims with tachycardia, which is a fast heart rhythm, to be able to prevent heart attacks. About every five years, these victims have to proceed with yet another invasive surgery, which further weakens their bodies, in order to be able to replace the batteries. Bringing attention to the battery power, this research will look at viable ways to harness energy produced from the body in order to power the wearable and implantable technologies currently available. Taking the models and information given by Seebeck (1821), thermoelectric energy will be a focus on this research. It has been around for a while, but has never really caught on because of its inefficiency issues. With new technologies in the nanotech field, we will explore the materials used, such as etched nanowires. Attempting to maximize the power output to be able to power our devices is the main objective.

DONALD D. GRAY, Department of Civil and Environmental Engineering, West Virginia University, Morgantown WV, 26506. **Three dimensional visualization of the specific head function of open channel hydraulics.**

In 1912 the Russian hydraulic engineer Boris Bakhmeteff (1880-1951) introduced the specific head, a new quantity for use in the analysis of open channel flow. Specific head is the total head with respect to the invert of an open channel. It is the sum of the integrated velocity head and the depth of flow at a given cross section. Specific head (a.k.a. specific energy) has proved to be a key to understanding the energetics of open channel flow. It is discussed at length in every open channel book. Usually the discussion is illustrated by two dimensional plots of depth vs. specific head with flowrate as a parameter and/or depth vs. flowrate with specific head as a parameter. Obviously these graphs depict slices through a surface in a three dimensional space whose coordinates are depth, flowrate, and specific head. The plots are almost invariably displayed only for rectangular cross sections, and the three dimensional specific head surface is rarely shown. Using modern graphical software, this presentation will display the specific head function as a surface in three dimensions for rectangular cross sections. For the first time, the

specific head function will also be visualized for triangular, trapezoidal, parabolic, and circular cross sections, revealing some unexpected features.

SEUNGHO HONG, Department of Civil and Environmental Engineering, West Virginia University, Morgantown, WV 26506. **Scour downstream of a spillway.**

The consequences of climate change cause historically unprecedented flood stages in major rivers and their tributaries. To bring water security and flood protection, weir control structures are typically used in the river. However, structural stability of weirs because of scour downstream of the spillway has become the object of heated debate at several locations. For example, drought conditions in South Florida during 2007 and 2008 induced extremely low tailwater stages downstream of Structure 65E on the Kissimmee River, and the low tailwater stages downstream of the spillway resulted in swept-out hydraulic jumps that enhanced scour downstream of the structure. A hydraulic model study and a field study were conducted simultaneously in Georgia Tech and in the South Florida Water District Managements (SFWDM) to further investigate the hydrodynamics of the flow downstream of the structure during conditions of low tailwater. As a part of projects, two methods that can be used for securing the safety of structure were tested in the field and in the laboratory. In the field, new tailwater weirs were constructed with earthfill materials and sheet files about 1.5 km downstream of an existing spillway, and used to investigate any additional scouring action or not during the drought season. In the laboratory, 1:30 scale hydraulic model of the gated spillway was constructed, and the effect of riprap apron length on the stability of the bed immediately downstream of a weir structure was tested. Both methods successfully reduce the scour depth and move maximum scour depth further downstream.

JAD SADEK**,** Department of Mechanical and Aerospace Engineering, West Virginia University Morgantown, WV 26506; VITALY BYCHKOV, Department of Physics, Umea University, Umea, Sweden; V'YACHESLAV AKKERMAN, Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506. **Theory of flame acceleration in open/vented obstructed pipes**.

Obstructed pipes are presumably the most relevant configuration for extremely fast pre-mixed flame acceleration and deflagration-to-detonation transition. While the flame propagation through obstacles is often associated with turbulence and/or shocks, Bychkov *et al*. [*Physical Review Letters 101 (2008) 164501*] have revealed a shockless, conceptually-laminar mechanism of ultra-fast flame acceleration in semi-open pipes (one end of a pipe is closed; a flame is ignited at the closed end, propagating towards the open one). Namely, the acceleration is devoted to a powerful jet-flow produced by delayed combustion in the spaces between obstacles. This mechanism is Reynolds-independent (say, scale-invariant, in some respect), with turbulence and flame turbulization playing only supplementary roles. In the present work, this formulation is extended to open or vented pipes, keeping in mind to fulfill the industrial needs, and to describe the ongoing experiments in Karlsruhe Institute of Technology. For simplicity, we started the analysis with the geometry of a two-dimensional channel, but then extended the formulation to an axisymmetric cylindrical tube, which is closer to the experimental configuration. It is demonstrated that flames accelerate strongly in open channels and tubes with obstacles, and the tubes provide stronger acceleration than the channels. The acceleration mechanism is the same

as that for the semi-open pipes with the ignition at the closed end: namely, it is shockless, conceptually-laminar and Reynolds-independent, being associated with the delayed burning in pockets between the obstacles. Although the acceleration rate is large enough in the open obstructed pipes, it is nevertheless less than that in the semi-open ones. Starting with inviscid approximation, we subsequently incorporated the viscous forces (the hydraulic resistance) into the formulation in order to compare their role with that of the jet-flow driving the acceleration. It is shown that the hydraulic resistance is not required to drive the flame acceleration. In contrast, this is a supplementary effect, which actually moderates the acceleration. Besides, the hydraulic resistance can be responsible for the initial delay, before the flame acceleration onset, observed in the experiments.

MATTHEW S. THOMPSON, SUSHANT AGARWAL, Department of Chemical Engineering, West Virginia University, Morgantown, WV 26506; XUEYAN SONG, Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506; RAKESH K. GUPTA, Department of Chemical Engineering, West Virginia University, Morgantown, WV 26506. **Effects of extensional flow cells and surface-modified nanoparticles on the morphology of immiscible polymers.**

To fulfill the property requirements for a specific application, a polymer engineer will often blend multiple polymers together with hopes of exploiting the attractive attributes of each and compensate for the unfavorable properties of each. When blended, most polymers form a two-phase microstructure, or morphology, which greatly affects the mechanical and flow properties and subsequent application areas of the blend. The development of this morphology follows the balance of drop deformation and breakup, which tend to decrease the dispersed-phase size, and drop coalescence, which tends to increase size. Extensional flow fields are known to promote drop deformation and are more efficient for drop breakup than shear flow fields, which most polymer processing equipment utilize; in addition, extensional flow fields are especially important for dispersion in blends of high viscosity ratio, the ratio of dispersed-phase viscosity to matrix-phase viscosity. Coalescence is usually minimized using compatibilizers which modify the interface between the polymer phases. Nanoparticles with tuned surface chemistry may also be used for this purpose to stabilize the morphology from coalescence.

In this work, blends of high-density polyethylene (HDPE) dispersed in polystyrene (PS) with viscosity ratio > 4 were subjected to extensional flow by forcing them through converging flow dies, which resulted in decrease in the volume-average diameter of the drops. Addition of fumed nanosilica to the blends was also found to decrease the volume-average diameter, despite the nanoparticles localizing exclusively in the PS matrix phase rather than at the HDPE/PS interface, which is predicted to be the optimal localization.

ORLANDO UGARTE, BERK DEMIRGOK, V'YACHESLAV AKKERMAN, Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506; DAMIR VALIEV, Department of Applied Physics and Electronics, Umea University, Umea, Sweden. **Flame propagation in micro tubes considering various constant wall temperatures.**

Flame propagation in pipes has been studied since the middle of the 1900s, with a particular progress circa 2000. The reasons making attractive this configuration can be

summarized in two: first, large aspect ratio allows a deflagration (flame) front to accelerate so rapidly that it can convert into a detonation wave; second, turbulence plays a secondary role in the flame dynamics in pipes, which simplifies the analysis. However, most studies in tubes have considered the pipe walls to behave adiabatically, restricting the attention to the effect produced by the momentum transferred at the boundaries only. In this investigation, numerical simulations of premixed flames have been performed considering micro tubes with walls preheated to a constant temperature. The obtained flame front propagation characteristics are contrasted to those observed in adiabatic conditions, aiming to identify the effect produced by the heat exchanged at the walls. Results show two qualitatively different effects in the preheated configuration: an initial stage of burning where the hot walls facilitate the combustion process by preheating the fuel mixture, and a later stage where heat exchanged by the warm walls, after reducing the thermal expansion ratio, decelerates the flame propagation and postpones (or even suppresses) any detonation triggering. For this purpose, a parametric study provided by extensive fully-compressible numerical simulations of the combustion and hydrodynamic equations has been performed. The cases investigated change with the tube and channel widths, boundary conditions and fuel mixture, described by the thermal expansion coefficient and laminar flame speed.

ORLANDO UGARTE, BERK DEMIRGOK , V'YACHESLAV AKKERMAN, Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506; VITALY BYCHKOV, Department of Physics, Umea University, Umea, Sweden; DAMIR VALIEV, Department of Applied Physics and Electronics, Umea University, Umea, Sweden.
Flame propagation dynamics observed in obstructed micro tubes.

A spontaneous deflagration-to-detonation transition (DDT) can be attained as a result of sustained flame acceleration, as it has been widely discussed in fire safety and combustion technology venues, which makes the ability of enhancing or diminishing the acceleration rate of great importance. The effect can be particularly strong in combustion chambers with obstructed walls. In this work, we focus on a "tooth-brush"-like array of long and narrow obstacles, a geometry associated with enormous flame acceleration. In this configuration, the acceleration is produced by an intense jet-flow generated by the delayed combustion occurring in the spaces between obstacles. The acceleration is unlimited in time, provided long enough channels; it is Reynolds-independent and conceptually laminar, with turbulence playing only a supplementary role. The acceleration rate is very strong, and the detonation can be attained in a very short time interval. In the present work, this mechanism is compared to other conventional scenarios of flame acceleration, including those driven by wall friction and the so-called "finger" flame shape. For this purpose, an extensive parametric study is undertaken by means of numerical simulations of the fully-compressible hydrodynamic and combustion equations. Two-dimensional channels and cylindrical tubes of various radii are considered. The fuel variety is represented by the variation of the thermal expansion coefficient and the laminar flame speed. A threshold blockage ratio, at which the obstacle-based mechanism dominates, is investigated and it is shown how such a cutoff depends on the variety of combustion and flow parameters.

Microbiology

DEANNA M. SCHMITT, TRICIA GILSON, LEANNE MAZZELLA, MATTHEW FORD, REBECCA BARNES, TAYLOR ROGERSON, ASHLEY HAUGHT, JAMES BIRCH, and JOSEPH HORZEMPA, Department of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. ***Francisella tularensis*, a bacterium that's no-bloody-good.**

Francisella tularensis is among the most virulent organisms on the entire planet. Fewer than 10 of these bacteria are capable of initiating a disease that causes death in 60% of untreated patients. *F. tularensis* bacteria are notorious for replicating in host macrophages and neutrophils, cells that normally phagocytose and kill squatting bacteria. Unlike phagocytic cells, erythrocytes (red blood cells) are normally incapable of engulfing extracellular material, including bacteria. At a low frequency, *F. tularensis* can invade erythrocytes, suggesting that these bacteria induce a change in non-endocytosing cells to allow for translocation into the red blood cell cytosol. This manipulation of the erythrocyte is mediated by effector molecules of two distinct protein secretion systems. These effectors likely modulate spectrin, a major component of the erythrocyte cytoskeleton, to facilitate bacterial entry. *F. tularensis* bacteria residing within erythrocytes are more resistant to antibiotics. Moreover, intra-erythroctyic bacteria are better at colonizing *Amblyomma americanum* and *Ixodes* sp. ticks, blood sucking arthropods capable of transmitting *F. tularensis* to humans. Erythrocyte invasion seemingly protects or allows for *F. tularensis* bacteria to better adapt to the low pH associated with the tick gut. Interestingly, other bacteria recently discovered to invade erythrocytes also use ticks as arthropod vectors for transmission. We speculate that, like *Francisella*, these other bacteria gain access to the intracellular space of erythrocytes to enhance tick colonization.

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RYAN HOUSER, MARK FLOOD, and TONY MORRIS, Department of Biology, Chemistry and Geoscience, Fairmont State University, Fairmont, WV 26554. **Determining the mutagenic effects of bromoform and its impact on the environment as a carcinogenic substance.**

The Ames Test is a simple test for mutagenic properties of different chemicals upon a special strain of *Salmonella*. They require the amino acid histidine for growth, as they are auxotrophic. The test relies upon mutations that would revert the bacteria to forms that are able to self-produce histidine (prototrophic). The levels of bromoform have been rising in the environment, due to the increased level disposal of fracking fluids into the West Virginia watersheds. The objective of the experiment was to determine if concentrations of bromoform that have been documented in the environment and in drinking water are mutagenic. The mutagenic effect was tested using bromoform in concentrations of 1.0 mg/L, 0.1 mg/L, and 0.001 mg/L. Preliminary results are pending, but the expectation is that the highest concentration of bromoform will generate the most mutations in the Ames Test. Further rounds of testing are expected after the results of the initial experiment are collected.

ADAM KENNEY, AUSTIN CUSICK, JESSICA PAYNE, ROGER SEEBER, and JOSEPH HORZEMPA, Department of Natural Sciences and Mathematics, West Liberty University, West

Liberty, WV 26074. **Colonization of mosquitoes by *Francisella tularensis* via a nectar reservoir.**

Although mosquitoes have been responsible for some of the largest arthropod-borne tularemia outbreaks reported, little is known about mosquitoes' interaction with *Francisella tularensis* in nature. Mosquitoes likely acquire *F. tularensis* by taking a blood meal from an infected animal. Between blood meals, these insects feed from flower nectar. We hypothesize that colonized mosquitoes are able to inoculate flower nectar with *F. tularensis* during these intermittent meals. The aim of this research project is to reassess the role that mosquitoes play in the spread of *F. tularensis*, as well as to evaluate the possibility of flower nectar to act as a reservoir for *F. tularensis*. To test this, mosquitoes are reared and fed a nectar substitute inoculated with *F. tularensis*. Preliminary results show that *F. tularensis* can be isolated from the remains of mosquitoes subjected to inoculated nectar substitute. Moreover, results confirming that *F. tularensis* can survive in a nectar substitute over time have been collected, asserting the plausibility that nectar may act as a natural reservoir for *F. tularensis*. Future endeavors of this study include observing where in the mosquitoes' body *F. tularensis* resides, with the ultimate goal of gaining a firmer grasp of how mosquito-borne tularemia infections arise.

EVAN LAU, E. JOSEPH NOLAN, HANNAH E. CREWDSON, ZACHARY W. DILLARD, MARCUS A. KINKER, Department of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074; HONGWEI YU, Department of Biochemistry and Microbiology, Marshall University, Huntington, WV 25755. **Microbial *algU* and *mucA* genes in contrast to Pseudomonad 16S rRNA gene diversity and abundances in patients with Cystic Fibrosis using Illumina MiSeq multiplex sequencing.**

Pseudomonas aeruginosa is the major cause of both morbidity and mortality in patients with Cystic fibrosis (CF), which is the most common genetic disease among individuals of European ancestry. It is believed that the conversion from non-mucoid to mucoid Pseudomonad strains (regulated by Pseudomonad *mucA* gene mutations) in the lungs of CF patients leads to the overproduction of microbial alginate and mucus, which lead to chronic cardio-respiratory-associated deaths. In this study, we used multiplex sequencing of Pseudomonad *algU* and *mucA* genes and concurrent 16S rRNA genes to contrast genes associated with alginate and mucus with Pseudomonad diversity and abundance in younger CF human sputum (age 10-16). Although the Pseudomonads were not as abundant as the pathogenic *Staphylococcus aureus*, we detected more diverse populations of Pseudomonads in relatively significant numbers, based on multiplex sequencing of the 16S rRNA gene. It appears that only a small number of these Pseudomonads have undergone mutations to the *mucA* gene in younger CF patients, which may explain the lack of severe respiratory infections in these patients. Our results correspond with previous work based on microbial cultivation and laboratory observations. Further work is underway to sequence the *mucA* and *algU* genes in more CF patients to test our hypothesis that *mucA* gene mutations only occur in a relatively small number of Pseudomonads in CF patients in early stages of infection.

KARA McCULLOUGH and DONALD TRISEL, Department of Biology, Fairmont State University, Fairmont, WV 26554. **The science of medicinal plants used in treating fungal infections (*Candida albicans*) in humans.**

Due to the rise in the development of drug resistance in human pathogens, there is a need for more research and finds of new antifungal agents by using natural products. The frequency of life-threatening infections caused by pathogenic microorganisms has increased worldwide, becoming an important cause of morbidity and mortality in immunocompromised patients in developing countries. *Candida albicans* is known for causing the disease candidiasis. In order to improve the problem of reduced availably of drugs needed to treat candidiasis, traditional medicines derived from plants are still being used throughout the world. The objective of this experiment was to screen a variety of natural products for anti-fungal properties. The plants in this study included, basil (*Ocimum basilicum*), mint (*Mentha*), oregano (*Origanum vulgare*), thyme (*Thymus vulgaris*), parsley (*Petroselinum crispum*), rosemary (*Rosmarinus officinalis*), onion (*Allium cepa*), and hardneck garlic (*Allium sativum*). Extracts of the plants were made by blending 10 grams of plant material in 100 mL of methanol. Extracts were administered using a series of assays, including a paper disk diffusion assay and an agar well assay. Initial results for both disk assay and the agar well assay showed inconclusive results for *C. albicans*. Additional trials will be performed on these and other extracts in an attempt to find natural plant products that can treat *C. albicans*.

DEANNA M. SCHMITT, TRICIA GILSON, and JOSEPH HORZEMPA, Department of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **Characterization of resazurin derivatives as novel antimicrobial agents against *Francisella tularensis* and *Neisseria gonorrhoeae.***

Inhalation of the Category A bioterrorism agent, *Francisella tularensis*, results in an acute pneumonia with a 30-60% mortality rate without treatment. *Neisseria gonorrhoeae* is the second most common sexually-transmitted infectious bacterium, with over 100 million cases of gonorrhea reported annually. Due to the prevalence of antibiotic resistance and the potential use of *F. tularensis* for bioterrorism, there is a strong need for new antibacterial drugs targeting both of these organisms. Resazurin is a compound commonly used to measure cell viability through its reduction to the fluorescent product resorufin. Previously, we demonstrated that resazurin and resorufin exhibit a potent bactericidal effect against *F. tularensis* and *N. gonorrhoeae.* The antimicrobial activity of resazurin and resorufin is comparable to gentamicin and ampicillin, antibiotics used to treat tularemia and gonorrhea, respectively. Based on these results, we tested the therapeutic efficacy of resazurin in a mouse model of tularemia. While resazurin exhibited potent *in vitro* antimicrobial activity, *in vivo* resazurin did not reduce bacterial burden or prolong survival in mice infected with *F. tularensis*. A possible explanation for the ineffectiveness of resazurin *in vivo* is its metabolism by the host into a pharmacologically inactive form.

Therefore, we sought to evaluate the antimicrobial activity of modified resazurin compounds that could be less likely to undergo biotransformation. Various resazurin derivatives have been tested and three exhibit a bactericidal effect against *F. tularensis* and *N. gonorrhoeae in vitro*. In the future, these compounds will be tested for *in vivo* efficacy using a mouse model of gonorrhea.

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Psychology

CAITLYN BURT and TIFANI FLETCHER, Department of Social and Behavioral Sciences, West Liberty University, West Liberty, WV 26074. **Framing effects and the influence of social cues on decision making.**

When given choices, a person must use reasoning and judgment to make a decision. How the choices are stated, known as framing, can influence a person's cognitive process when a forced decision is presented. However, it is currently unclear if framing or social cues presented are more influential on decision making. A convenience sample of 106 undergraduate students was given one of four hypothetical scenarios in which they had to make a forced choice between a risky or safe program. Two of the scenarios were framed in a positive way in which the amount of "lives saved" was presented, while the other two scenarios were framed in a negative way in which the amount of "lives lost" was presented. The scenarios were further divided using a social cue, with an inclusion of either relatives' lives at risk, or strangers' lives at risk (four scenarios: positive/relative, positive/stranger, negative/relative, negative/stranger). Using chi-squared analyses, results indicated that regardless of which social cue was presented, participants who read the negative framing scenario were more likely to choose the riskier program, while the participants who read the positive framing condition were slightly more likely to choose the safer program. Participants who read a scenario with a stranger were much more likely to choose the riskier program in both the positive and negative frames, while the relative scenario risky choice was more likely only in the negative frame. These results indicate that negative framing is much more influential in decision making, compared to social cues.

MARQUEZ GIBSON, ANDREW LEICHLITER, ALICE MAGRO and ALBERT MAGRO, Department of Biology, Fairmont State University, Fairmont, WV 26554. **Evolutionary basis for exaggerated anatomical proportions in artistic renditions of human form.**

An aim is to provide an evolutionary perspective with regard to the aesthetic appreciation of human form. Representations in art and pop art and also in fashion and cosmetics illustrate a correlation between hominin evolution and our sense of beauty of human form. A comparison of the fossil record of hominins with our sense of beauty of anatomical proportions indicates that ancestral (plesiomorphic) traits are considered unattractive while more recently-evolved (apomorphic) anatomical traits are considered attractive. In artistic renditions of humans and in fashion and cosmetics, we tend to exaggerate differences between us and closely-related species. We refer to this phenomenon as Cross-Species Avoidance, which is a form of sexual selection leading to the adaption of our current anatomical proportions. As an exaptation, we find artistic renditions that exaggerate facial and post cranial anatomical proportions aesthetically appealing. Visual cues allow us to distinguish between us and closely-related species, thus avoiding sterile offspring or no offspring at all. As a result, modern *Homo sapiens* exist with a host of derived anatomical traits including: long neck and legs, straight fingers, full lips, V-shaped torso and

large eyes as just a few examples of apomorphic traits resulting from Cross-Species Avoidance. Despite our propensity to emphasize derived traits, there are art works which exaggerate both plesiomorphic and apomorphic traits. This disproportionism is aesthetically appreciated and can be quite dramatic. Fundamentally, Cross-Species Avoidance provides an evolutionary rationale for our appreciation for exaggerated traits in artistic representations of human form.

TIFFANIE WILSON and TIFANI FLETCHER, Department of Behavioral and Social Sciences, West Liberty University, West Liberty, WV 26074. **Priming and altruism behaviors: A replication-based study.**

The current study attempted to replicate the findings from the survey-based altruism investigation of Howard, Nelson, and Sleigh (2011). One hundred and twenty five undergraduate students from a Northern West Virginia University were given one of three priming conditions in which they had to write a brief story about helping behaviors, and one control group that wrote about what they did that day. Following the writing activity, participants answered an altruism behavior (AB) questionnaire and a question on if they would help the research investigator on another short project at a later time without any incentives (helping behavior). Corroborating previous results, there was no significant differences found between the four scenario conditions and AB scores, and no differences on priming and helping behaviors. This supports the idea that this type of priming does not have an influence on altruism scores or helping behaviors. Also, similar to Howard *et al.*, higher empathy scores were significantly related to higher AB scores, and no significant gender differences were found on AB scores. Only 33% of participants exhibited a helping behavior, and unlike Howard *et al*., there was no significant relationship between AB scores and helping behavior, although, empathy scores were significantly related to helping behaviors. Interestingly, while females were significantly more likely to report helping behaviors compared to males, there were no gender differences found on empathy scores. Overall, the majority of findings were replicated, and it is suggested that other forms of priming should be investigated to influence AB scores and helping behaviors.

Science Education

ZACHARY FERGUSON, SARAH METZ, STEVEN ROOF, Department of Biology, Chemistry and Geoscience, Fairmont State University, Fairmont, WV 26554. **Determining the retention factor of ink to develop a laboratory to be used in an introductory non-science major's class.**

Paper Chromatography is used to separate mixtures into their rightful components. In this research, the purpose is to additionally involve students with non science majors in forensic biology. Chromatography samples have a stationary phase in which a solid or liquid is supported on a solid. As the solvent moves up the paper, the different components of the mixtures separate into multiple colored spots. Ethyl alcohol (70%), ethyl alcohol (80%), and tap water were used as the solvent to determine the varying components of the ink(s) used. Previously-prepared inks were applied, as well as food coloring mixtures, to help stimulate the ink compounds. Some of the compounds in the mixtures traveled nearly as far as the solvent did, while others remained

near the base line. Rf values were calculated to help determine the distance traveled compared to the solvent. The structure of the paper used chromatography is made of cellulose fibers, which is a polymer of glucose. Difficulties arise due to the cellulose fibers attracting water vapor in the process of the paper being manufactured. This interaction with water is one of the most important effects during chromatography. From the results obtained, it is apparent that ethyl alcohol is the best solvent, 80% ethyl alcohol being the most efficient. However, the majority were water soluble and the results were not ideal. When using tap water, the individual colors did not separate as efficiently.

EMILY GRANT and STEVEN ROOF, Department of Biology, Chemistry, and Geoscience, Fairmont State University, Fairmont, WV 26554. **Osmosis investigations for elementary education majors.**

The objective of the project was to develop a simple laboratory exercise for elementary education majors that would allow them to investigate the concept of osmosis. The major goals were to create the exercise using basic scientific equipment, collect data from multiple replications, and analyze data collected using Excel software. The reagents needed to be inexpensive, easy to obtain, and safe, while the laboratory portion of the exercise needed to be completed within a two-hour time block. Small pieces were cut from different fruits and vegetables that weighed 1-2 g, soaked in six well culture plates with various concentrations of sodium chloride, and then reweighed. Reasonable data were obtained when the fruits and vegetables were soaked for an hour in the salt concentrations that ranged from 1 to 6%. The analysis of the data required basic Excel software skills to determine the percent change in weight, preparation of graphical representations, and addition of a linear trend line. Basic algebra was also required to determine concentrations of salt that would be isotonic to the vegetable or fruit used. The laboratory exercise can be extended to facilitate more open-ended student experimentation by using different salts and/or the additional fruits or vegetables.

Stream Ecology

ELIZABETH ARNOLD, DEVIN HEITZ, TYLER MURPHY, PHILLIP YEAGER, and MARK FLOOD, Department of Biology, Chemistry and Geoscience, Fairmont State University, Fairmont, WV 26554. **Assessing the impact of Marcellus shale drilling on stream health using *Daphnia magna* and benthic macroinvertebrates.**

To compare the quality of stream water above and below hydraulic fracturing drill sites in Doddridge, Wetzel, and Harrison Counties in West Virginia: 1) benthic macroinvertebrates were collected from 11 sites in order to calculate the Hilsenhoff Index values and 2) the freshwater crustacean *Daphnia magna* was used in a bioassay. Invertebrates were identified, counted, and categorized based upon their pollution tolerance level. This information was used to obtain the Hilsenhoff Index value for each location. *Daphnia magna* were placed in water samples from the locations above and below drilling sites and survival was monitored over the course of two weeks. Physical and chemical measurements were also obtained using an SYI Multi-Parameter Data Collection System (650 MDS) and a DREL 2400 portable quality laboratory. Hilsenhoff Biotic Index values decreased downstream of well sites at Frank Run 1, Frank Run 2, and Cherry

Camp by 0.36, 0.23, and 0.14, respectively. No significant correlation was observed between sample location and *Daphnia magna* survivability. Total dissolved solids (TDS) measurements were higher at below sampling points for Cherry Camp, Smithton, Pike Fork, and Franks Run 1. Pike Fork below exhibited the highest TDS value at 0.336 ± 0.002 g/L. Though TDS isn't considered a primary pollutant, it is often used as an indicator of the presence of chemical contaminants. While most chemical parameters showed no substantial discrepancies, further research is needed to determine the cause of increased TDS values.

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DEBORAH K. BEUTLER, Department of Biology, West Virginia University Institute of Technology, Montgomery, WV 25136**. Effects on benthic macroinvertebrates of limestone sand addition to Morris Creek to mitigate the damage caused by acid mine drainage.**

Limestone sand (also known as limestone fines) has been used to treat streams that are vulnerable to acidic precipitation. In the Morris Creek Watershed, we are using limestone sand to pre-treat a stream that is under a continuous inflow of acid mine drainage (AMD) from several sources. Beginning in 2011, several tons of limestone sand have been dumped twice a year on the bank of the creek upstream of the outflows of two acid mine treatment facilities. Conductivity and pH data of the stream were collected before and after the dumping of the sand. Benthic macroinvertebrates were sampled using kick nets at two sites near the limestone fines. There was a "dead zone" with no macroinvertebrates found immediately downstream from the pile of sand. However, in the stream between the AMD treatment facilities, macroinvertebrates, particularly mayflies, increased. We also conducted pebble counts that demonstrated that after the sand was dumped into the stream, there was an increase in embeddedness, with the sand filling in the spaces between the rocks, immediately downstream of the pile. The effect decreased with distance downstream of the pile. Embeddedness also decreased after high water from large rainstorms washed the sand out of the creek.

SHENA EYE and MARK FLOOD, Department of Biology, Chemistry and Geoscience, Fairmont State University, Fairmont, WV 26554. **Effects of prolonged exposure and short term exposure of different concentrations of bromoform on *Daphnia magna*.**

Bromine, a concern for drinking water, is a chemical found in flowback water resulting from hydraulic fracturing. As illegal dumping and spills of this water occur, bromine ions enter the groundwater. At water treatment facilities, bromine ions replace chlorine ions forming bromoform and other potentially dangerous disinfection byproducts. The EPA issued a maximum contaminant level for total contaminants in drinking water of 0.1 mg/L. The effects of this level of bromoform on *Daphnia magna* were observed in this study. Concentrations of 0.01 mg/L and 1.0 mg/L were also evaluated. The hypothesis was that higher concentrations of bromoform would decrease *Daphnia magna* population growth faster than lower concentrations. By exposing *D. magna* in spring water to these concentrations of bromoform, prolonged exposure observations were obtained. A group with no added bromoform served as the control. Data were collected based on population size for two weeks. Organisms were also viewed under a dissecting microscope to observe morphological features such as longer limbs. Short-term exposure involved exposing organisms to different concentrations for one hour. The heart rate was examined through a dissecting microscope. Preliminary long-term exposure results show an

unexpected large decrease in population for the control group. Current experiments are investigating the effects of different water sources on population growth, before repeating the bromoform exposure experiment.

DEVIN HEITZ, DANNIE ARNOLD, TYLER MURPHY, PHILLIP YEAGER, and MARK FLOOD, Department of Biology, Chemistry and Geoscience, Fairmont State University, Fairmont, WV 26554. **Microbial testing of water quality near Marcellus shale drilling.**

In recent years, the integrity of water quality near Marcellus drill sites has been questioned. Microorganisms are typically the first organisms to react to chemical and physical changes in any given environment, and it is for this reason that chemical and physical properties as well as microbial activity within the water were tested. Water samples were taken from above and below well sites at seven different locations. While there was not an overall consistent pattern for other chemical properties measures, total dissolved solid levels were noticeably higher below well sites in comparison to above. The microbial testing that was conducted included the use of EcoPlates and coliform plates (using Coliscan Easygel) so that both environmental change and bacterial diversity could be measured. The data collected from the EcoPlates concluded that most of the sites differed between their above and below locations in terms of microorganismal diversity. Immense differences were observed at the Franks Run and Lewis Wetzel sites. The Coliscan Easygel plates showed that there were significant differences in the amount of bacterial colonies above and below some of the sites; two of the more noticeable differences occurred between the above and below sites of Cherry Camp Road and Franks Run ponds. Further monitoring needs to be expanded to determine the exact cause of each difference in bacterial diversity.

This research was funded by a Fairmont State University SURE grant.

TIMOTHY PRACHT and MARK FLOOD, Department of Biology, Chemistry, and Geosciences, Fairmont State University, Fairmont, WV 26554. **Determining the impact of Marcellus well drilling on stream ecology in Randolph County, West Virginia.**

Water is vital to all living organisms and plays a principal role in the maintenance of ecosystems, especially within West Virginia. Hydraulic fracturing methods to extract natural gas have become highly prevalent throughout the entire state. The methods of disposal of the hydraulic fracturing fluids have come under scrutiny, with chemicals potentially leaching into nearby waterways. The objective of this experiment is to analyze the effects of Marcellus well drilling on stream water quality. Water quality was assessed with a YSI Multiprobe that measured the temperature (°C), pH, conductivity (mS/cm), dissolved oxygen (mg/L), total dissolved solids (g/L), salinity (ppt), oxidation reduction potential (mv), and turbidity (NTU) of the stream water. Benthic macroinvertebrates were also sampled from the stream. Data collected upstream from the drilling site was compared to data that was collected downstream of the site. Overall, the results indicated that Marcellus well drilling had some negative effects on the water quality measurements that were collected. Further study is needed to determine the precise cause of the differences that we discovered.

NICOLE SADECKY, SPENCER BELL, ZACHARY DILLARD, ERIC TENNANT, ERIC TIDMORE, LUKE SADECKY, Department of Natural Science and Mathematics, West Liberty

University, West Liberty, WV 26074; STEWART WELSH, West Virginia University, Morgantown, WV 26506; ZACHARY LOUGHMAN, Department of Natural Science and Mathematics, West Liberty University, West Liberty, WV 26074. **Determination of Crayfish occupancy rates across the North, Middle, and South Forks of the Kentucky River.**

In the coal fields of eastern Kentucky, coal extraction occurs via surface mining, where coal seams are exposed to the Earth's surface through the elimination of mountain tops. The current status of the epigean crayfishes in the greater Kentucky River headwaters, composed of the North, Middle, and South Forks of the Kentucky River, where this form of mining is prevalent is currently unknown. To remedy this lack of knowledge, the goals of this project were to determine the crayfish fauna of the region, identify habitat use for each crayfish species, and finally ascertain conservation concerns for the crayfish fauna as a whole. During the summer of 2014, crayfish were sampled across all three watersheds at 60 sites. Both physiochemical and habitat quality data acquisition was completed at each 150 m stream reaches. Physiochemical data were collected with a YSI datasonde; habitat data were collected through completion of the OEPA QHEI habitat form. Mining presence was identified for each stream through collection of a water sample, which was later tested in the laboratory for sulfates, with sulfate concentrations > 50 mg L^{-1} indicating mining activities. All of the aforementioned data were used to create occupancy models through use of logistic regression for each species.

Sampling results determined that six species (*Cambarus* cf. *robustus* A, *Cambarus* (cf). *robustus* B, *Cambarus distans*, *Cambarus sphenoides*, *Cambarus jezerinaci*, and *Orconectes cristavarius*) occurred in the three basins, with *C. distans*, *C. jezerinaci*, *C. sphenoides* and *C.* cf. *robustus* B limited to single watersheds. Of the 33 co-variates modeled for each species, sulfate levels proved to be the most predictive covariate, driving site occupancy for 50% of the crayfish species; elevated sulfate levels always were associated with either crayfish absence or low crayfish CPUE. In addition to sulfate, sediment scores proved to be predictive for the other three species. Overall, elevated sedimentation scores were always indicative of low crayfish CPUE, both on an individual and pooled bases. This study indicates that mining influences this region's rich crayfish diversity. Understanding stream and habitat quality will allow for proper conservation of the epigean crayfishes of the Kentucky River watershed.

ERIC M. TIDMORE, NICOLE SADECKY, and ZACHARY LOUGHMAN, Department of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **Epigean crayfishes of the North, Middle, and South Forks of the Kentucky River: life history and ecology.**

The headwaters of the Kentucky River Basin's (HKRB) epigean crayfish fauna were surveyed during the summer of 2014. Goals of this project included determining the native fauna of the basin, as well as identification of basic life history parameters. Sixty random sites were chosen for sampling through use of GIS. Site coverage accounted for all stream orders conducive to crayfishes. Physiochemical and biotic data were collected at each site, as well as crayfish vouchers for identification in the laboratory. The native epigean crayfish fauna of the HKRB consists of six species: *Cambarus* (cf.) *robustus A*, *Cambarus* (cf.) *robustus B*, *Cambarus distans*, *Cambarus jezerinaci*, *Cambarus sphenoides*, and *Orconectes cristavarius*. *Cambarus* (cf.) *robustus B* was only found in the Middle Fork of the Kentucky River, while its ecological equivalent, *Cambarus* (cf.) *robustus A*, possessed a broader distribution and was found in the

north and south fork of the Kentucky River. Sites with high density of *O. cristavarius* on average had lower density of *C. robustus A* and *C. robustus B.* *Cambarus distans* was limited to the headwaters of the Middle Fork of the Kentucky River, where it occurred primarily in smaller streams. Both *C. jezerinaci* and *C. sphenoides* were limited to the headwaters of the South Fork basin. *Orconectes cristavarius* was the only species that occurred in all three watersheds, and was the most common species encountered in the study. Crayfish populations reached their highest densities in the South Fork, where environmental degradation was limited. Results of this study indicate that the forks of the Kentucky River harbor a rich crayfish assemblage, with several species relegated to small sub-basins within the greater watershed.

AMBER WOOTEN and MARK FLOOD, Department of Biology, Chemistry and Geoscience, Fairmont State University, Fairmont, WV 26554. **Determining the short- and long-term effects of 4-methylcyclohexanol exposure on aquatic species.**

West Virginia is one of the biggest providers of coal in the United States, and although it has great economic value it has some environmental problems. Used in the mining industry, 4-methylcyclohexanol (MCHM) is involved in the washing of coal before it is burned. In January 2014, 7,500 gallons of MCHM contaminated the Elk River. The effects of MCHM on aquatic life are not well known. The objective of this study is to look at the short-term and long-term effects of MCHM on the aquatic species *Daphnia magna*. Several concentrations of MCHM solutions were made: 0 ppm, 0.5 ppm, 1.0 ppm, 1.5 ppm, and 2.0 ppm. Short-term effects were observed by introducing *Daphnia* to each concentration of MCHM for 1 hour, and then heart rates were observed to determine stress level. The long-term effects of MCHM on *Daphnia* were observed by exposing the species to the varying concentrations of MCHM for two weeks, to determine if the chemical was having an effect on their reproductive rate. It was hypothesized that higher concentrations of MCHM would yield faster heart rates as well as smaller population sizes when compared to the smaller concentrations. The observations for long-term exposure were unexpected and are being investigated further. The observations for the short-term exposure were expected but are being further investigated as well.

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Zoology

SPENCER BELL, ZACHARY DILLARD, LUKE SADECKY, NICOLE SADECKY, ERIC TENNANT, ERIC TIDMORE, and ZACHARY LOUGHMAN, Department of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **A pilot study into the habitation requirements of burrowing crayfish.**

Crayfish have historically been classified as primary, secondary, or tertiary burrowers based on burrowing behavior. Secondary and tertiary burrowers are primarily stream-dwelling species which enlarge natural depressions into simple burrows. Primary burrowing species typically create more complex burrows with tunnel systems connecting multiple chambers. Although primary burrowing species inhabit a wide range of habitat types, they are typically thought to have similar morphology and ecological requirements for habitation. To test this theory, multiple primary burrowing crayfish species were collected in the area surrounding

Lewisburg, WV. During collection efforts, morphological measures were taken, soil cores were collected, and site data was noted. Morphological ratios were calculated using chelae, carapace, and palm measures. Soil type was determined by calculating the percent sand, silt, and clay from each soil core. Preliminary cluster analyses of both morphology and ecological site data show variance existing between primary burrowing species. In the future, this theory will be further tested by including primary burrowing species from the Ohio River floodplains in analyses.

This project was carried out using funding from the West Virginia University Summer Undergraduate Research Experience.

ZACHARY DILLARD, KATIE SCOTT, MATTHEW McKINNEY, and ZACHARY LOUGHMAN, Department of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **Geospatial analysis of *Cambarus monongalensis* across a habitat gradient.**

Cambarus monongalensis (Blue crayfish) are burrowing crayfish that are found throughout the mountains and hills of West Virginia and Pennsylvania. This study was conducted in order to determine *C. monongalensis* habitat preferences. Transects were set up around a crayfish colony and data concerning burrow entrances and burrow numbers was collected. Collected data was interpreted using geostatistical analysis techniques which created maps that reveal *C. monongalensis* preferred habitat. In addition to discerning habitat preference, the geostatistical analysis also reveals that *C. monongalensis* behave differently depending on their microhabitat. This can be inferred by differences which were identified in burrow entrances across multiple microhabitats. It was determined that *C. monongalensis* prefer to inhabit "seep" microhabitats. These areas are typically found adjacent to waterways and have high water tables and moisture levels, yet experience no water flow. Specimens inhabiting burrows outside of seep microhabitats employ specific burrow architecture in responses to deeper water tables. Identified behavioral differences across microhabitats included creating open burrow entrances where water levels were highest and utilizing burrow plugs and chimneys where water tables are lowest. This is believed to be a behavior adapted in order to inhibit and decrease evaporation rates where water is relatively scarce. These revelations are important aspects of *C. monongalensis* ecology that were previously unknown.

GEORGE H. LAMBERT, SUSAN MARTINEZ, and SHER HENDRICKSON, Department of Biology, Shepherd University, Shepherdstown, WV 25443. **Species occurrence and genomic sampling of salamanders in the Eastern Panhandle of West Virginia.**

The objective of this research was to determine species occurrence and genomic sampling of salamanders in Jefferson and Berkeley counties in the West Virginia panhandle. Salamanders in Jefferson County were sampled in Morgan's Grove Park in Shepherdstown, West Virginia. Berkeley County samples were taken at Sleepy Creek Wildlife Management Area. Most sampling in Morgan's Grove Park consisted of sampling for aquatic larvae within the stream in 10 meter transects. Sleepy Creek samples consisted of terrestrial sampling. Specimens were taken from the field sites to a laboratory setting in order to gather morphometric data and collect tissues for a genomic repository. Morphometric data collected consisted of weight, total length, and snout-vent length to determine age class of specimens sampled.

Genomic sampling consisted of clipping tails and toes for DNA extraction and for future identification of recaptured specimens. Liver and heart samples were collected from freshly euthanized voucher specimens. DNA extraction quality and quantities from the toe, tail, liver, and heart samples were compared to establish minimum amounts of each type of tissue necessary for less invasive sampling.

The predominate species that occurred in the Jefferson County survey were *Eurycea bislineata bislineata*. The second most numerous species was *Pseudotriton ruber ruber*. The most numerous caught in Berkeley County was *Plethodon cylindraceus*.

CAROL Z. PLAUTZ, Department of Biology, Shepherd University, Shepherdstown, WV 25443; ALLISON BROOKS, Department of Chemistry, Shepherd University, Shepherdstown, WV 25443; COLLEEN J. NOLAN, Department of Biology, Shepherd University, Shepherdstown, WV 25443. **Effects of Roundup on reproduction, steroid hormone levels, and the steroidogenic pathway in *Lymnaea palustris*.**

The aquatic pond snail *Lymnaea palustris* is a good system in which to study exposure to environmental contaminants, in particular the developmental and reproductive effects of the herbicide Roundup. Following exposure to Roundup, alteration in reproductive levels as well as decreased production of steroidogenic acute regulatory protein (StAR) are demonstrated. We used enzyme immunoassay to monitor steroid sex hormone levels and monitored fecundity by reproductive output in the hermaphroditic *L. palustris* following chronic (6 week) Roundup treatment. Snails exhibited a significant decrease in fecundity and altered levels of progesterone and testosterone. Protein analysis by Western blot of StAR and aromatase reveal altered levels of these steroidogenic pathway enzymes. These results suggest that Roundup can cause significant changes in fecundity and steroid hormone production levels resulting in reduced reproductive capability in non-target aquatic organisms.

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LUKE SADECKY, NICOLE SADECKY, and ZACHARY LOUGHMAN, Department of Natural Sciences and Mathematics, West Liberty University, West Liberty, WV 26074. **Ecology of *Cambarus carinirostris* in Northern West Virginia: A baseline study.**

The primary goal of this study is to better understand the ecology of a common Appalachian secondary burrowing crayfish, *Cambarus carinirostris*, the Rock crayfish, by achieving the first complete life history study of this species. Understanding *C. carinirostris* ecology will help aid in conservation and protection of closely-related imperiled taxa by discovering unknown biological behaviors of secondary burrowing crayfish. By collecting physiochemical and climatic data at a single site and recording one population's responses to changes in the environment, we can determine multiple behavioral strategies that correlate with those environmental changes. In addition, we can determine important life history variables such as growth rates, fecundity, and required age and size to reach sexual maturity. So far, this study has consisted of catching, measuring, sexing, and determining how old each crayfish is, and noting their preferred habitat within a reach (a 20 meter stretch of stream). This process was repeated in various locations along the stream. During the summer months, 384 crayfish were captured and Total Carapace Lengths (TCL) were measured. We now know that

the dominant carapace length during the summer months is roughly 11 millimeters. There were 149 crayfish with this carapace length, 87 of which were female. During the month of June, the habitat preference was equally distributed between the run and riffle. However during July, 69% of the crayfish were found in the runs.