#1 - SEX DIFFERENCES IN EXPRESSION OF PROTEINS IMPLICATED IN CENTRAL SENSITIZATION: RELEVANCE TO OROFACIAL PAIN CONDITIONS. Jessica Allen, Orion Peterson, Hunter Sheckley, and Lauren Cornelison. Biology. Faculty Advisor: Paul Durham

Central sensitization is a condition of the central nervous system (CNS) that results in a reduced threshold for activation of pain-transmitting nerve cells in the absence of peripheral injury. Prevalent orofacial pain conditions including temporomandibular disorders (TMD) and migraine predominantly affect women above the age of 20, and are associated with a sensitized nervous system. A sensitized CNS is characterized by changes in protein expression in neurons and glia. Proteins associated with increased CNS neuronal activity include calcitonin gene-related peptide (CGRP) and protein kinase A (PKA) that bind and activate neurons and glia in the medullary dorsal horn and thus promote central sensitization. Another protein associated with central sensitization, is the protein Iba1, which is a marker of microglia activity. To characterize baseline sex differences in protein expression, spinal cord samples from the F1 generation (>45 days old) were taken and processed for immunohistochemistry. Interestingly, male and female offspring of unstressed mothers showed trends toward differences in basal levels of proteins associated with a sensitized nervous system, including PKA and Iba1. Basal sex differences in expression of these proteins may help to explain why orofacial pain conditions such as migraine and TMD are more prevalent in females than males.

#2 – SECONDARY TRAUMATIC STRESS INDUCES GREATER INCREASE IN ERK LEVELS IN FEMALE TRIGEMINAL NEURONS: POTENTIAL RISK FACTOR FOR OROFACIAL PAIN CONDITIONS. Harlee Kelley, Orion Peterson, and Lauren Cornelison. Biology. Faculty Advisor: Dr. Paul Durham

Secondary traumatic stress is sensitization in a naïve individual elicited through exposure to an individual who directly experienced trauma. Stress is associated with increased risk of orofacial pain disorders including migraine and temporomandibular disorder. My study's goal was to compare the effects of secondary traumatic stress on male and female Sprague Dawley rats. Male Sprague-Dawley rats (sender) were subjected to forced swim testing (primary traumatic stress) then co-housed with pregnant female Sprague Dawley rats (receiver), whose offspring were then investigated for cellular changes associated with trigeminal sensitization. Peripheral sensitization is characterized by a lowering of the amount of stimulus required to elicit activation and transmission of a pain signal to the spinal cord. An important protein in peripheral sensitization is the signaling protein ERK or extracellular regulated kinase, which is activated in response to peripheral tissue injury and inflammation. Results from immunohistochemical studies demonstrated that female rats had a higher nuclear level of P-ERK under naïve and stressed conditions when compared to males under similar conditions. Findings from my study provide evidence that female animals exhibit an enhanced level of trigeminal sensitization, which if true in humans, may help to explain why orofacial pain conditions are more prevalent in females.

#3 – ANALYSIS OF NANOPARTICLE-MEDIATED GENE EXPRESSION TO DETERMINE UNDERLYING MECHANISMS OF CELL STRESS. Cullen Horstmann, Husref Rizvanovic, Olivia Horton. Biology. Faculty Advisor: Dr. Kyoungtae Kim.

Nanoparticles have become common in many commercially used products such as zinc sunscreen and water resistant clothes. They may also be utilized in the targeted treatment of cancer, printable monitoring systems, and cost effective phones in the future. The effects nanoparticles have on biological organisms is crucial for the responsible use of these technologies. We investigated the effects of silver (Ag) and Cadmium (CdSe/ZnS) nanoparticles on budding yeast (Saccharomyces cerevisiae). Our growth assay showed that Ag has an inhibitory effect with its concentrations above 5µg/ml. We are still investigating Cadmiums effects on growth. Thousands of genes in Ag and CdSe/ZnS treated cells were differentially expressed according to our transcriptome investigation. A large fraction of upregulated genes with Ag treatment are identified to regulate ribosomal biogenesis and RNA processing, whereas downregulated genes are known to be responsible for mitochondrial functions based on our analysis of gene ontology terms. Cadmium-mediated upregulated genes are mainly involved in metabolic processes, whereas downregulated genes are involved in the cellular response to stimuli and vesicle-mediated transport. Furthermore, we validated the RNAseq results using an RT-qPCR assay. The resulting expression profiles leads us to suspect that Ag and CdSe/ZnS nanoparticle exposure creates a stress environment in the cell.

#4 – DETERMINING THE EXACT FOLD CHANGES OF TARGET GENES WITH PRIMER EFFICIENCY TESTS. Husref Rizvanovic, Olivia N. Horton, Cullen Horstmann, and Kyoungtae Kim. Biology. Faculty Advisor: Kyoungtae Kim

The purpose of running a primer efficiency test is to correctly evaluate the efficiency of primers to be used for RT-qPCR, which helps researchers determine accurate fold changes of tested genes. However, this efficiency test is a commonly skipped procedure when running RT-qPCR. Though ideal PCR amplification efficiency is 2 or 100%, but this is unlikely. Therefore, we should always run an efficiency test for our primers in order to obtain an accurate result of how effective they were in targeting our gene of interest, and furthermore, to conclude that the primers we designed are adequate enough for PCR. Here, we provide the comparison of fold changes of DAN1 and TIR1 genes, downregulated upon treatment of silver nanoparticles, with or without running a primer efficiency test. Our data without the exact amplification efficiency values displayed overestimated fold changes, which strengthens our notion about the significance of a primer test prior to RT-qPCR.

#5 - INVESTIGATING THE ROLE OF INFLAMMATORY CYTOKINES DURING INFLUENZA A VIRUS AND *ASPERGILLUS FUMIGATUS* COINFECTIONS *IN VITRO.* Meagan D. Rippee-Brooks. Biology. Faculty Advisor: Dr. Christopher R. Lupfer.

Bacterial coinfections with influenza A virus (IAV) are extremely serious and life-threatening. However, there exists limited data gathered about the importance of fungal infections with IAV. Clinical case reports indicate that fungal coinfections do happen and suggest the IAV pandemic of 2009 had a propensity to predispose patients to secondary fungal infections more than previous IAV strains. However, the factors involved remain to be determined. We have developed an *in vitro* model using primary mouse bone marrow derived macrophages infected with IAV and coinfected with the opportunistic fungal pathogen *Aspergillus fumigatus*. Our results indicate that IAV and fungal coinfections synergistically enhance cell signaling and cytokine production. We propose this exacerbated immune response during IAV and *A. fumigatus* influences clinical patients to develop more severe pneumonia, and we seek to identify the pathways responsible for the heightened cytokine responses and their significance *in vivo*.

#6 – COASTAL MANGROVE SURVEY ALONG BLUEFIELDS BAY, WESTMORELAND, JAMAICA. Leslie Hatch. Biology. Faculty Advisor: Robert Pavlowsky.

The Bluefields Bay Fish Sanctuary (BBFS) plays a pivotal role in the protection of Jamaica's coast. To maintain the marine life present in the BBFS such as coral reefs, sea grass, and mangroves, fishing is not permitted. This study reports on an inventory of mangrove species and their characteristics within an environmental education area along the bay during January 2018. The species and location of each tree was marked using GPS and mapped with GIS software. In addition, information on diameter breast height, stem habit, and landform/soil type was recorded for each tree. In total, 18 mangroves were sampled with the majority being Red Mangroves (38.8%) and White Mangroves (38.8%). Additional mangrove species sampled were the Button Mangrove (16.6%) and Black mangrove (5.5%). Mangrove distributions correlated with expected patterns for this field environment. Red and Black Mangroves were found on lower elevation/wetter sites and Button and White Mangroves were found on higher/drier sites. The results of this study will support educational and conservation goals for the community.

#7 – USING IMAGES TO MEASURE PLANT BIOMASS AND ABUNDANCE.
Jordan Heiman, Indigo Tran, Madison Gurski. Biology. Faculty Advisor: La Toya Kissoon-Charles.
Image analysis has been used by various researchers to measure structure, biomass, size, surface area, abundance, and health. In biology, this technique has been used to determine biomass of plants, fish, and macroinvertebrates. Few studies have used image analysis to measure growth of small floating aquatic plants such as *Lemna minor* (duckweed). Duckweed has a single lobe or frond (a leaf-like structure), which grows in clumps or colonies with roots hanging below. We used Image J software to measure surface area from an image of duckweed of known abundance (frond number) and biomass to determine relationships between these variables. Results of our image analyses were used to develop regression equations that can determine frond number and biomass from surface area. These regression equations can be used to expand information obtained in research projects. Determining total biomass requires drying all plant material, which means plant material cannot be used for other analyses that require fresh plant biomass, for example, chlorophyll extraction and DNA analysis. Determining frond number involves counting which can take a long time. The use of image analysis will allow researchers to obtain data for plant abundance and biomass while saving time and plant material for other analyses.

#8 – ACCUMULATION OF LEAD IN SYCAMORE TREES ON A MINING-CONTAMINATED GRAVEL BAR IN BIG RIVER, MISSOURI. Trang Tran, Jordan Heiman, Bob Pavlowsky. Biology. Faculty advisor: Dr. La Toya Kissoon-Charles.
Big River, located in the Old Lead Belt of southeast Missouri, contains sand and gravel bars with high levels of residual lead resulting from over 200 years of lead mining pollution. Vegetation on gravel bars can affect sediment deposition, soil erosion, and metal movement in river channels. Previous studies focused on sediment contamination and lead concentrations in organisms, such as birds and fish in the Big River ecosystem. However, data on metal concentrations of vegetation in this river ecosystem are lacking. Plants are at the base of the food chain, thus exploration of metal uptake by vegetation could inform us of the potential transport of metals to organisms at higher levels of the food chain. We collected samples of bark, stem, branch, and leaf from sycamore trees at different locations on gravel bars in contaminated and non-contaminated reaches of Big River. Plant samples were dried, crushed, acid-digested, and analyzed to determine lead concentrations using ICP-MS. Preliminary results indicated that sycamore trees on the contaminated gravel bar have higher concentrations of lead compared to trees on the non-contaminated gravel bar. Among the different tree parts sampled, sycamore bark had the highest lead concentrations, which could indicate compartmentalization of this toxic metal.

#9 – FIELD RESEARCH TRAINING PROGRAM FOR PRE-COLLEGE YOUTH SHOWS CONSISTENT PARTICIPANT BENEFITS OVER TEN YEARS. Adam Vorel, Susan K. Flowers. Biology. Faculty Advisor: Erica Cox
For the past ten years, the Shaw Institute for Field Training (SIFT) has engaged St. Louis area high school youth in field training experiences at Shaw Nature Reserve. Through experiential education activities, SIFT aims to provide authentic environmental research career exploration and early entry into the environmental biology career path. We sought to assess whether there was a change in perceived benefits by participant cohorts during the SIFT training week from the start of the program in summer 2008 to summer 2017. A climate survey was administered to all SIFTers on the Wednesday and Friday afternoons of the 5-day training week. We chose to analyze three specific Likert-scaled items that are grounded in experiential education practice: (1) learning by doing, (2) perceived gain of new knowledge and skills, and (3) personal challenge leading to growth. Data show that SIFTers across six participant cohorts liked the experiential education model, perceived gains in knowledge and skills, and experienced personal growth. Our results indicate the SIFT training week has been consistent as a successful experiential education model over ten years. SIFT training is an important first step into ecological research and allows for a diverse pool of youth to have early access into authentic career exploration.

#10 – BACTERIAL SOURCE TRACKING OF HUMAN, BOVINE, DOG, AND GOOSE FECAL CONTAMINATION IN THE LITTLE SAC WATERSHED. John Kincaid, Marc Owen, Robert Pavlowsky, Microbiology. Faculty Advisor: Dr. Babur Mirza.

Due to urbanization and fast agricultural developments, impairment of water quality by fecal pollution is a global public health concern. In this study, we monitored the potential fecal contamination of human, bovine, dog, and goose in the Little Sac watershed in Greene and Polk Counties. Water samples were collected from five different location of the Little Sac watershed on September 22nd and October 6th, 2017. Genomic DNA was extracted, and the abundance of *Bacteroidetes* specific markers associated with human, bovine, dog, and goose fecal material were quantified using real-time PCR. In addition, the abundance of indicator microorganisms (total coliform and E.coli) in the water samples were quantified using IDEXX Colilert test kits. Results of the Colilert testing showed the presence of both E. coli and coliforms. At most of the sites, coliform concentrations exceeded the upper limit of the procedure (>2,420/100 mL). The qPCR results indicated the presence of fecal contamination at four of the five sites for at least one marker gene. At sampling locations (PR_102) adjacent to urban areas, fecal contamination of both human and goose were found. In conclusion, the presence of fecal contamination suggests that continuous monitoring and further testing of potential pathogens is needed at these sites.

#11 - FUNCTIONALIZATION OF QUANTUM DOTS UNDER VARIOUS ELECTROPHORETIC CONDITIONS. Deborah Ehie, Chemistry. Faculty Advisor: Dr. Katye Fichter.

Here, quantum dots (QDs) were functionalized to generate a fluorescent probe for single-molecule imaging. The first set of intermediates were poly (ethylene glycol) (PEG)-conjugated QDs, using PEGs with 45, 12, and 8 repeat units. These conjugates were further modified with adipic acid dihydrazide (ADH) to form the second set of intermediates. The gel electrophoresis was performed with a 0.4% agarose gel in three different buffering conditions (0.1 M MOPs (pH 7), 0.1 M borate buffer (pH 8.5), and 0.1 M MES buffer (pH 6). The goal of this project was to optimize the electrophoretic conditions to provide the best separation between the intermediates, allowing for identification of successful synthesized intermediates.

#12 - EFFECTS OF SSRIS IN 5-HT$_{1B}$ TRANSMEMBRANE RECEPTOR TRAFFICKING IN N2A CELLS. Emily B Nowak, Gregory K. Illy, Katye M. Fichter. Chemistry. Faculty Advisor: Katye M. Fichter

The behavior of 5-HT$_{1B}$ serotonin receptor was observed in N2a (murine neuroblastoma) cells to monitor intracellular trafficking. We examined the change in membrane of expression of 5-HT$_{1B}$ in N2a cells during differentiation. Previous studies have implicated an effect of selective serotonin reuptake inhibitors (SSRIs) on the membrane expression of 5-HT$_{1B}$; therefore, understanding the trafficking of 5-HT$_{1B}$ could aid the generation of more effective SSRIs. N2a cells were transfected with pDNA expressing HA-5-HT$_{1B}$ and cells were serum-starved to promote differentiation, causing the transfected cells to develop axons and dendrites. Immunocytochemistry (ICC) was performed to locate 5-HT$_{1B}$ receptors in relation to these processes. Preliminary data shows that the longer the cells were starved, the more differentiated the cells became, up to 12 days. The membrane expression of 5-HT$_{1B}$ was also observed in differentiated cells, and examined over the course of differentiation. We hope that studying the membrane expression of 5-HT$_{1B}$ will help elucidate the effect of SSRIs on the molecular mechanisms of psychological disorders.

#13 - THE EFFECTS OF pH ON THE STABILITY OF TOPICAL CREAMS CONTAINING A NOVEL SOLVENT COMPONENT. Victoria L. Bax and Melinda J. Sutton. Chemistry. Faculty Advisors: Dr. G. Alan Schick and Dr. David W. Osborne. Diethylene glycol monoethyl ether (DEGEE) is being used increasingly as a solvent in FDA approved topical pharmaceutical products due to its effectiveness in solubilizing otherwise insoluble active ingredients. The goal of this study is to characterize the effects of pH on the chemical and physical stabilities of topical emulsions (creams) containing high concentrations of DEGEE. Typical formulations of DEGEE-based creams use phosphate emulsifiers that cause the pH to be $\lesssim 2$, too low for use on human skin. However, upon the addition of sodium hydroxide to the aqueous phase of the formulation, the pH of the cream can be raised to suitable levels, which are observed to endure long-term storage. A pH profile of the cream over the full topical range, 3.5 to 9.0, is found to exibit a pK_a inflection point near pH 7.0, suggesting that chemically-stable formulations can be achieved for a range of target pH values, 3.5 to 5.5 and 8.0 to 9.0. The physical stabilities of the formulations are evaluated by ultra-centrifugation in terms of how easily the emulsions break into their individual oil, water, and solid phases.

#14 - INVESTIGATION OF THE THERMORESPONSIVE PROPERTIES OF TRI-BLOCK COPOLYMER SOLUPLUS®. Carajill Campbell, Chemistry. Faculty Advisor: Dr. Alan Schick.
The purpose of this research was to investigate the thermoresponsive properties of Soluplus®, a tri-block copolymer made of polyvinyl caprolactam, polyvinyl acetate, and polyethylene glycol. The Soluplus® compound aids in increasing the solubility of non-soluble drugs in water, making it suitable for applications in healthcare. This research further investigated the cloud point (lower critical solution temperature) and gel point (point of phase change from liquid to solid). It was found that the cloud point of Soluplus® varied from 29.0°C to 31.0°C in solutions with a wt% range of 5% to 28%, with the general trend being that the higher the wt% of Soluplus® in solution, the higher the temperature of the cloud point. It was also found that the point at which the gel point occurred decreased as the solution's wt% increased. It was observed that the solutions were generally unaffected by multiple heating and cooling cycles during the multiple experiments. This means that Soluplus® is suitable for multiple uses, increasing its potential as a pharmaceutical aid.

#15 - INEXPENSIVE ASSAY METHOD FOR DETECTION OF METAL IONS BY USING METAL ION REACTIVE DYES AND PRINCIPAL COMPONENT ANALYSIS.
Tucker Ruark. Chemistry. Faculty Advisor: Dr. Keiichi Yoshimatsu
The presence of metal ions in solution can be determined by using metal ion reactive dyes. Common examples of some of such dyes include dimethylglyoxime, xylenol orange, and diphenylcarbazide. In this work, the metal ion reactive dyes were applied in a metal detection assay. The procedure involves the spotting of the dye solution onto wax pattern filter paper and metal ion solutions were applied to the same spots. The paper was scanned and the color change observed was used as a basis for the detection of metal ions in "unknown" solutions. However, a problem with these dyes is related to their board cross-reactivity. In order to address this problem, we utilize the color intensity from multiple dyes rather than the data from a single dye. This allowed for the identification of different metal ions. This could be performed by using an eye test or using a pattern recognition approach, principal component analysis (PCA). The intensity of the developed colors are quantified by using ImageJ. The obtained data was analyzed by PCA on PC. We are currently investigating the feasibility to identify metal ions by using a cellphone app with built-in capability to capture images and perform PCA.

#16 - SYNTHESIS OF LAYERED ZINC OXIDE NANOPARTICLES. <u>Allison Freese.</u>
Chemistry. Faculty Advisor: Dr. Adam Wanekaya.

Nanomaterials are beginning to make a huge impact in our world. The goal of this project is to create a vessel to transport nucleic acids into mammalian cells. The particles were assembled by a technique recently used with gold nanoparticles called Layer-by-Layer Assembly completed by Eva-Christina Wurster and colleagues. Zinc oxide was synthesized with mercaptoundecanoic acid (MUA) in the solution to produce the vessel and first layer of the system. MUA is a stabilizing agent and will begin the charged layering for the system since it is negative. Those nanoparticles were then coated with lysozyme which is a positively charged enzyme. Layers of polyelectrolytes—poly(ethylenimine) and poly(styrenesulfonate)—will then be added to finish the coating process finishing with a negative outer layer with cell penetrating properties. As each layer was added to the system, the following instruments were used to assure that the characteristics of the particles are what is expected: Dynamic Light Scattering, Electrophoretic Mobility for Zeta Potential, and UV-Vis Spectrophotometer.

#17 – QUANTUM YIELD DETERMINATION OF NITROGEN-DOPED CARBON DOTS AND FLUORESCENCE DEPENDENCE ON PH. <u>Megan Prado</u>, Chemistry. Faculty Advisor: Dr. Adam Wanekaya.

Carbon quantum dots (CDs) are fluorescent nanoparticles whose surfaces can be modified by dopant additions to alter their pH-dependence and fluorescence intensity. CDs are inexpensive to prepare with low toxicity and high water solubility making them favorable in biocompatible applications. In this research, nitrogen-doped carbon dots (N-CDs) were synthesized from urea and sugar in three methods: green oil-bath, reactor, and microwave; the oil-bath method having the most favorable results. The ultraviolet absorbance and fluorescence were taken for each method at varying pHs revealing the highest fluorescence at pH 3 with decreasing trends for more alkaline solutions. In the process to determine the Quantum Yield, the measurable magnitude of fluorescence, the absorbance readings revealed an inverse trend of increased absorbance for each decreasing dilution. This demonstrated an unexpected reaction between the NCDs and pH 3 buffer. From these results, the quantum yield of other doping methods can be compared to determine the ideal dopant and conditions for optimum fluorescence. Carbon dots can then be utilized in pH-sensing within the environment or body where their biocompatible and pH-sensitive fluorescence are beneficial.

#18 – EFFECT OF NANO CERIA ON TOTAL PHOSPHOROUS AND PHYTATES.
<u>Madison Jones</u>, Oluwasegun Abolade and Kameron Coates. Chemistry. Faculty Advisor: Dr. Cyren Rico.

Two generations of wheat were treated with cerium oxide nanoparticles and the effect of the nano-ceria in wheat grains was evaluated. The focus of this study is the metabolites total phosphorous and phytates. The wheat grains that were treated with nano-ceria in only the second generation demonstrated an increase in total phosphorous compared to the control group. Wheat grains treated with nano-ceria in only the first generation did not display an increase in total phosphorous compared to the control group. The concentration of phytates increased in the same pattern as the total phosphorous. It is problematic for wheat to have an increase in phytates because phytates include phytic acid, which is an indigestible component for humans and other non-ruminant animals. Phytic acid also prevents the absorption of many necessary minerals. The findings suggest that the generational exposure to nano-ceria may affect the nutritional quality of wheat grains.

#19 - MECHANISTIC OPTIONS IN *TRANS*-CINNAMIC ACID BIOSYNTHESIS. Bryttani N. West, Chemistry. Faculty Advisor: Dr. Matthew R. Siebert

Trans-cinnamic acid is used in the manufacture of flavors, dyes, pharmaceuticals, and in the production of its methyl, ethyl, and benzyl esters for perfumes. It is also a precursor to the sweetener aspartame. Scientific literature debates how *trans*-cinnamic acid is formed from L-phenylalanine. The mechanism of elimination may proceed by E1, E2, or E1cb. We have conducted quantum chemical calculations aimed at elucidating the different possible mechanisms that could form *trans*-cinnamic acid on smaller analog chemicals. Preliminary results indicate that antiperiplanar orientation of the incoming base with the leaving group is energetically favored. This orientation results in a much more exothermic reaction when *tert*-butyl chloride reacts with hydroxide ion (-37.7 kcal/mol, antiperiplanar; -8.62 kcal/mol, synperiplanar).

#20 - EVOLVING NEURAL NETWORK SHAPE WITH THE ANT COLONY OPTIMIZATION ALGORITHM FOR PREDICTING EYE STATE WITH EEG DATA. Ryan Bagby, Michael Knapp, and Leonard Museau. Computer Science. Faculty Advisor: Dr. Jamil Saquer.

Neural networks have gained prominent attention for their extraordinary skill for problems of classification as well as regression. Though useful, these networks still require careful tuning of parameters and preprocessing of data in order to attain the high levels of performance. For this reason there is a wide-ranging literature dedicated to developing techniques to algorithmically fine tune and optimize the network. The Ant Colony Optimization algorithm (ACO) from the related field of Evolutionary Computation is one such technique which draws insight from the foraging and resource management strategies of real ants. For evolving the shape of a neural network, the algorithm balances the trade-off of exploring new shapes and exploiting variations of known shapes with the current best performance by probabilistically constructing a candidate solution through artificial pheromone signals which are updated and decayed according to local and global best solutions. The resulting neural network constructed using the shape found by ACO consistently displays a high degree of accuracy on a classification task consisting of predicting the state of an individual's eye (open or closed) from EEG data of fourteen regions of the brain.

#21 – DETECTING INCOMPLETE BOOK REVIEWS WITH THE NATURAL LANGUAGE TOOLKIT AND NAÏVE BAYESIAN CLASSIFIER. Aubrey Hormel. Computer Science. Faculty Advisor: Dr. Jamil Saquer.

As time passes we rely more on the Internet for interpersonal communication, news, and reviews of products and services. As such, natural-language processing (NLP) is an increasingly important area of study. NLP refers to processing natural language in such a way that a computer can deduce the meaning of the language. Our research focuses on the analysis of textual language in the form of customer book reviews. We created a model which uses the Natural Language Toolkit to calculate the probabilities: a) that a word is present in a book review whose author read the entire book, and b) that a word is present in a review whose author did not read the whole book. These are then used in the Naïve Bayes model to classify samples as "complete" or "incomplete". Our model is applicable for websites that allow consumers to write book reviews, but there exists some ambiguity as to the purpose of detecting these incomplete book reviews. For instance, one may wish to eliminate reviews which are incomplete and not helpful in determining the book's quality. However, an incomplete book review could also be used as an important quality indicator, as many consumers state that they did not finish a book due to uncomfortable material or low-quality writing. Thus, our model may be improved by distinguishing between these types of incomplete book reviews.

#22 - VISUALIZING THE CRITICAL DYNAMIC EVENTS OF CARBON NANOCOMPOSITES USING VIRTUAL REALITY TOOLS. Chad Brewer and Taylor Kuttenkuler, Computer Science. Faculty Advisor: Dr. Razib Iqbal.

Purpose of the study is to construct Virtual Reality tools that can be used for material science education to educate topics related to the dynamics in nanomaterials. Researchers used the Unity Game Engine to visualize the reactions between Carbon Nanocomposites and Oxygen molecules. The original application was developed for Google Cardboard with Unity. Researchers have since updated the application to be compatible with Google Daydream to allow for enhanced user interaction within the program as well as the HTC Vive to utilize larger data sets that mobile devices cannot handle. After the development of the atomistic models and the initial development in Unity, now the application can be installed on mobile devices that meet the API level for Google Daydream. Lastly, researchers implemented a system of networking where by multiple users can access a shared view of a given simulation by connecting to a dedicated server hosted by the MuSyC Lab in the Computer Science Department.

#23 - USE OF VIRTUAL AND MIXED REALITY FOR GEOGRAPHICAL INFORMATION SYSTEM DATA VISUALIZATION. Ryan Jenkins, Computer Science. Faculty Advisor: Dr. Razib Iqbal.

GIS is a framework for the gathering, managing, and analyzing of spatial location and many other data types, and to display data using 3D imagery to grant further understanding of the patterns and relationships present within. Through the use of Virtual Reality and Mixed Reality, GIS data can be experienced in an impactful way by allowing for immersion into a virtual 3D environment in which to interact with data, or by bring that data into the real world through holographic simulation. We have developed an application that allows a user to import a file containing GIS data, and to view and filter that data through changeable parameters using multiple layers to help establish patterns. This project has potential as a collaborative tool for use in the study of GIS data and as a demonstrative tool for sharing GIS data in both education and research. In future, we plan to increase the types of relationships and patterns that can be found by expanding the ways in which GIS data can be visualized and filtered using visual layers, additional filter parameters, and allowing users to work with multiple files concurrently.

#24 - TOWARDS AN EASY-TO-USE MICROPLATE IMAGE READING SOLUTION FOR CHEMISTRY EDUCATION. Jamie Johnson. Computer Science. Faculty Advisor: Dr. Razib Iqbal.

In our attempt for enabling cross-disciplinary STEM research, in this project we worked on a solution for the Chemistry Department to act as a replacement of the highly expensive tool called a Spectrophotometer. Our developed tool helps to visually compare the relationship among protein values obtained from the optical density readings of a 96-well microplate by using Principal Component Analysis (PCA). PCA is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. These readings are imported by raw data from a text or jpeg image file(s). PCA is performed on these values and is visually displayed using 2D and 3D graphs. We used MATLAB to implement our proposed solution. The application provides advanced features such as populating the x-y-z axes labels, displaying pop-up windows with zoom in and zoom out capabilities, the option for importing single or multiple datasets, customizing the color and symbols of the markers, and exporting text files containing the eigenvectors, eigenvalues, and PCA values for research purposes. At present, we are working on an android application for wide-scale adoption of our proposed solution.

#25 – IMPROVING USER EXPERIENCE FOR INTERNET OF THINGS PROVISIONING AND CONTROL SYSTEMS. <u>Trenton Nale</u>, Computer Science. Faculty Advisor: Dr. Razib Iqbal

Recent advances in technology have allowed microprocessors to be embedded in many day-to-day objects and devices, like lights, fans, appliances, etc. These objects are then connected to the internet so that users can interact remotely, hence the origin of the name Internet of Things (IoT). Extensive research and development is ongoing to automate the IoT networks. In this project, we investigated a Graphical User Interface (GUI) for provisioning and maintaining a massively distributed IoT control system. We present an effective but user-friendly GUI for a complex IoT network ensuring the scalability of the control system. We adopted the Electron platform which offers deployment flexibility for most of the desktop operating systems and curated two-way data bindings precluding the need for user action to save data and prevent accidental data loss. Features common to productivity software such as document and spreadsheet editors are adapted to streamline the creation and interaction with the IoT control system. Presently, we are working on a dynamic data model to accommodate the changing IoT device requirements. In the future, we plan to add network analytics to assist the users as well as to assess the performance of the IoT network.

#26 - META-LEARNING RELATED TASKS WITH RECURRENT NETWORKS: OPTIMIZATION AND GENERALIZATION. <u>Thy Nguyen</u>, Computer Science. Faculty Advisors: Dr. Tayo Obafemi-Ajayi, Dr. Emmett R. Redd, Dr. A. Steven Younger.

There have been recent interest in meta-learning systems: i.e. networks that are trained to learn multiple tasks. This project focuses on optimization and generalization of a meta-learning system based on recurrent networks. The optimization investigates the influence of diverse structures and parameters on its performance. We demonstrate the generalization (robustness) of our meta-learning system to learn across multiple tasks including tasks unseen during the meta-training phase. We propose a meta-cost function (Mean Squared Fair Error) that enhances the performance of the system by not penalizing it during transitions to learning a new task. Evaluations are presented for Boolean and quadratic functions datasets. The best performance is obtained using a Long Short-Term Memory (LSTM) topology without a forget gate and with a clipped memory cell.

#27 - MULTI-OBJECTIVE OPTIMIZATION TO FIND BICLUSTERS IN GENE EXPRESSION DATA. <u>Jeff Dale</u>, Computer Science. Faculty Advisor: Dr. Tayo Obafemi-Ajayi.

Biclustering, the process of finding highly correlated submatrices within a (large) data matrix, has been valuable in bioinformatics in the analysis of gene expression matrices. The biclustering problem can be reformulated into a combinatorial optimization problem, where the goal is to find an optimal subset of rows and subset of columns such that entries indexed by the cartesian product of these sets follow a specified model. Unfortunately, finding optimal biclusters in expression matrices has been proven to be NP-Hard, required an exhaustive search of the 2^{m+n} possible biclusters in an m by n matrix. Evolutionary algorithms are excellent tools for attacking combinatorial optimization problems, and hence, finding meaningful biclusters. We propose a novel approach based on the well-known NSGA-II multi-objective evolutionary algorithm and internal bicluster validation metrics to find high quality biclusters in large expression matrices, with results comparable to the current state of the art in biclustering.

#28- ELECTRICKS: PRE-COLLEGE ACTIVITIES IN ELECTROMECHANICS. Anna Buckthorpe, Electrical Engineering. Faculty Advisor: Dr. Theresa Odun-Ayo

The need for engineering graduates in many fields is outpacing the supply. Outreach programs have been developed to encourage more pre-college students to enroll in engineering programs and STEM courses. This program was designed to introduce pre-college students to electrical engineering in a fun, hands-on manner that demonstrates the basic principles of power generation and electromagnetism. It involves a set of 3 experiments which build on each other to teach the participants about how electrical currents and magnets create an electromotive force that we can use to generate power. These activities were presented alongside information about regional college level engineering programs that are accessible to them. The program is an easily scalable addition to camp-based programs that can be taken to schools to introduce students who are unable to participate in STEM related extracurricular programs. The students were given surveys to gauge their level of interest. The survey responses indicated the students enjoyed the experience, found it educational and were more interested in electrical engineering after performing the experiments.

#29 – MODEM MADNESS-ABSTRACT. Keegan Allen, Dersham Schmidt, Konstantin Dashkevich. Electrical Engineering. Faculty Advisor: Dr. Rohit Dua.

Transmitting information through the air using high frequency modulation has been around since the 1900's. This project is designed as a teaching tool for future students to understand how modulation and demodulation works. The transmitter and receiver contain tap points that can be hooked up to an oscilloscope and observed at every crucial step. The three modulation techniques used are frequency modulation, amplitude modulation, and amplitude shift keying. Each technique has a modulator mounted on the transmitter board and a demodulator mounted on the receiver board. The transmitter has an AUX cable for a phone plug-in and the receiver has a power amplifier and a speaker. Music is transmitted via one of the three processes, received and demodulated, then amplified and played on a speaker.

#30 - AUTO-MODULATED DUAL SINGING TESLA COIL. Evan Talbot, Chanya Thipwiboonchai, and Trevor Gaffery. Electrical Engineering. Faculty Advisor: Dr. Rohit Dua.

Existing Singing Tesla Coil design generally follows one of two designs. The first is the single coil design using a modulator for the input. The issue with this is that combined high and low frequencies are not well represented through modulation and the output. The second is a dual coil design using a computer-generated input. While the dual design allows for better sound representation when dealing with simultaneous high and low frequencies, the input generation is a tedious process. Our design combines the ease of modulator circuits in the input, and the accurate representation of using dual coils in the output. Another issue with Singing Tesla Coils is potential safety issues. The biggest concerns are high voltages from the coil circuit leaking into the input, and arcing risks to observers. The first concern is mitigated by sending the output of the modulation to a photodiode which triggers a relay to the power circuit. This electrically isolates the input. The second concern is mitigated by a calculated physical distance from the discharge portion of the coil as well as an emergency power-off.

#31 - BUILDING A LOW-COST DIGITAL AC WATTMETER. <u>Ryan Ladd and Ryan Sweet</u>, Electrical Engineering. Faculty Advisor: Dr. Rohit Dua.
It is essential for electrical engineering students to have access to a high-quality digital wattmeter for a variety of different labs and experiments. However, these devices can be incredibly expensive and are often out of the price range of most college students. The goal of this project is to design a digital AC wattmeter of this same high quality that can be constructed at a fraction of the cost. This project consists of both a hardware and a software portion designed around the capabilities of our Arduino MEGA2560 microcontroller. The physical circuit steps down the incoming voltage and currents to a value that can be utilized by the Arduino board, and the programming of the Arduino board gathers this incoming data an outputs it onto the attached, easily-read LCD screen. This screen will display the measured values for current, voltage, power, and phase.

#32 - PLC DISCOVERY STATTION USING PROGRAMABLE LOGIC CONTROLLER SYSTEM TO HELP PEOPLE LEARN AND UNDERSTAND DIGITAL LOGIC. <u>Joe Minner and Ryan Kiesling</u>, Electrical Engineering. Faculty Advisor: Dr. Rohit Dua.
The goal of this project is to build and design an interactive module that will allow children and young adults to develop an understanding of Digital Logic and how programmable logic controllers can be used in automation. The machine will sort LEGO blocks using 2 parameters allowing the use of Logic operators to choose which of the parameters are desired. This is accomplished with an HMI that allows selection of 2 size parameters, 4 color parameters and 6 logic operators. The system uses a Control Logix PLC to determine when a LEGO should be accepted or rejected.

#33 - 3D SCANNER. <u>Conner Sweet</u>, <u>David Forgy</u>, Electrical Engineering. Faculty Advisor: Dr. Rohit Dua.
This 3D scanner will be a useful tool for teaching students about engineering. It's a simple design that can be easily used even with little knowledge of engineering. Students will be able to learn more from this device than they would from a normal 3D scanner because they will be able to see the individual parts and see more of how it actually functions. It will show students how to plot data points using an infrared sensor and then turn those points into a 3D image. It will also provide a demonstration of codes in Arduino and Matlab and how to transfer between the two. This will allow students to have access to a device that they would not be able to normally interact with, as well as further their knowledge and interest of engineering.

#34 - U-PB ZIRCON GEOCHRONOLOGY OF RHYOLITE TUFFS FROM THE BELL TOP FORMATION, SOUTHWEST NEW MEXICO. Brooke Benz, James Quick, Tyler Sundell and Gary Michelfelder. Geology, Geography, and Planning. Faculty Advisor: Gary Michelfelder

The Mogollon-Datil Volcanic Field (MDVF) in Southern New Mexico has many exposed ignimbrites of Eocene-Oligocene age. During this time, subduction of the Farallon Plate beneath the North American plate transitioned to extension of the Rio Grande Rift, leading to an ignimbrite flare-up in southern New Mexico. The caldera forming eruptions produced numerous ash flow tuffs including the Bell Top Formation tuffs, which are divided into four members. The Bell Top Tuffs have been dated by $^{40}Ar/^{39}Ar$ with ages ranging from 31.4 Ma to 42.1 Ma. Here we present new thin section petrography and major and trace element geochemistry from 16 samples representing Tuff 2-4 and compare these data with samples from the Kneeling Nun Tuff (Bell Top 5) and similar age ignimbrites from southern New Mexico. We also are presenting new radiometric age dating by using U-Pb dating in zircons that were extracted from each of the Bell Top tuffs.

#35 - PETROGRAPHY AND GEOCHEMISTRY OF THE VICKS PEAK, LA JENCIA AND CABALLO BLANCO TUFFS, MOGOLLON DATIL VOLCANIC FIELD, NEW MEXICO. Mary Humphreys; Brooke Benz and Gary Michelfelder. Geology, Geography, and Planning. Faculty Advisor: Gary Michelfelder

The Mogollon Datil Volcanic Field of southern New Mexico erupted over 30 tuff units related to at least 15 caldera volcanic centers. Most of these tuffs are difficult to distinguish in the field. This study incudes samples from three large rhyolite tuffs spanning 3 million years including the Caballo Blanco, La Jencia and Vicks Peak tuffs. Petrographic thin sections and whole rocks geochemistry will be performed on samples from each unit to determine the crystallinity, chemical composition and variation within the tuffs. This summer additional samples will be collected from each unit. This will be combined with stratigraphic sections to determine the volume and extent of each tuff. The Caballo Blanco Tuff has been dated at 31.7 Ma. It is a crystal-rich rhyolite tuff with quartz, sanidine and K-feldspar. The type section thickness is 325 ft with welding and lithic inclusions at the sample location. The La Jencia Tuff (28.8 Ma) consists of multiple ash flows. All flows are crystal-poor with K-feldspar as the primary phenocryst. The tuff may be as thick as 3000 ft. The Vicks Peak Tuff stratigraphically overlies the La Jencia Tuff (25.5 Ma) and is compositionally similar. The tuff is crystal-poor with only rare quartz.

#36 - THE PETROLOGY AND GEOCHEMISTRY OF A MIOCENE UNDIFFERENTIATED DACITE IN THE MOGOLLON-DATIL VOLCANIC FIELD, NEW MEXICO. Mackenzie Wegmann, Conor O'Dowd; Gary S. Michelfelder. Geology, Geography, and Planning. Faculty Advisor: Gary Michelfelder

The Mogollon-Datil volcanic field in southwestern New Mexico contains rocks that represent a transition time period between arc magmatism and extensional magmatism. As of now they have been identified as undifferentiated dacite flows. These rocks have been dated at 25.2 Ma, and at type location are 280 meters thick. Previous investigations have described these rocks as fine-grained porphyritic pyroxene bearing dacite with equal amounts of orthopyroxene and plagioclase. The source of the dacite remains unkown. This study combines thin section petrography to identify mineral textures and whole rock geochemistry to characterize the rocks as a whole. Results from two different samples from the undifferentiated lava flows have shown differences in mineral size and assemblage. For example, Sample SMO3 contains smaller phenocrysts and less biotite than sample PP4. Previous descriptions do not characterize these rocks as containing biotite. After collecting mineral point counts for five more samples from this area the study will analyze a subset of these samples by whole rock geochemistry to provide a more complete analysis. Future work on this project will include additional sample collection and petrographic analysis this summer as well as geologic mapping and volume estimations of individual lava flows.

#37 – THE PETROLOGY AND GEOCHEMISTRY OF THE KNEELING NUN TUFF, MOGOLLON-DATIL VOLCANIC FIELD, NEW MEXICO. James D. Quick, Tyler Sundell, Conor O'Dowd, Brooke Benz and Gary S. Michelfelder. Geology, Geography, and Planning. Faculty Advisor: Gary Michelfelder

The Kneeling Nun Tuff is an ash flow in the Mogollon-Datil Volcanic field (MDVF) of southern New Mexico dated by $^{40}Ar/^{39}Ar$ at 34.89 ± 0.05 Ma. Ignimbrites of the 40,000 km^2 MDVF were erupted episodically from 36.2 Ma to 24 Ma with the Kneeling Nun erupting in the first of four identified volcanic episodes. The Kneeling Nun consists of more than 900 km^3 of volcanic material, and may represent one of the largest volcanic eruptions of the MDVF. Previous work on the tuff has focused on field descriptions and stratigraphy around the source caldera. Here we present new thin section petrographic analysis, trace element geochemistry carried out on 20 samples, and electron microprobe analysis carried out on a few selected samples. Our goals are to: 1) Determine if the Kneeling Nun was emplaced as a single eruptive cooling unit or multiple eruptive units. 2) Determine whether Bell Top 5, which has previously been considered part of the Kneeling Nun, should actually be considered part of the Kneeling Nun. 3) Contribute to a "bigger picture" understanding of the MDVF through an understanding of some of the pre-eruptive conditions of the Kneeling Nun.

#38 – RELATIVE DATING OF SUSPECTED ASH FALL(S) WITHIN THE MOGOLLON-DATIL VOLCANIC FIELD, SOUTHWEST NEW MEXICO. Paul Wilkerson, Conor O'Dowd; Gary S. Michelfelder. Geology, Geography, and Planning. Faculty Advisor: Gary Michelfelder

The Mogollon-Datil Volcanic Field consists of ash flows that are dominantly rhyolite in composition. Very few documents volcanic rocks associated with the volcanic field are intermediate composition until the waning stages of volcanism, and these are dominantly pyroclastic. An outcrop of suspected intermediate composition ash fall(s) can be found exposed near the town of Winston, NM. These rocks are fine grained ash deposits that are thin bedded with occasional inclusions of lithics derived from the local area. Samples were collected on a field trip in early April 2018. Initial field observations indicated a sequence of ash fall tuffs and a general homogeneous composition throughout. Samples were collected from various locations stratigraphically within the sequence and from xenoliths within sequence. These xenoliths may correlate with the Sierra Cuchillo laccolith (38 Ma), Dacite Rhyolite (36.6 Ma), Latite Andesite (36.2 Ma), or the Rhyolite Porphyry (28 Ma) and therefore be used to refine the age of the ash fall(s). These samples will be analyzed and compared to known strata and formations geochemically and by thin section. Resulting data will also be utilized in describing this sequence as a single event or separate events.

#39 – THE PETROLOGY, GEOCHEMISTRY AND U-PB ZIRCON GEOCHRONOLOGY OF PRECAMBRIAN GRANITES IN THE ST. FRANCOIS MOUNTAINS, MISSOURI Matthew Zerilli; Gary S. Michelfelder. Geology, Geography, and Planning. Faculty Advisor: Gary Michelfelder

The St. Francois Mountains are comprised of various igneous rock types, ranging from 1.3-1.5 Ga. Some of the exposed plutonic rocks are compositionally Quartz Monzonites to Syeno-Granites. The granites present are: Butler Hill, Breadtray, Knoblick, Slabtown, Silver Mines, Stono, Buford, Carver Creek, Munger, Jonca, and Cold Water Creek. Nearly all of the granites have some form of alterations occurring in the alkali-feldspars, biotites, and hornblendes. To understand the age and origin of the St. Francois granitoids, we are using petrographic analysis, geochemical analysis, and U-Pb zircon geochronology to determine the origin and age of the granitic source(s). Thin sections were made and analyzed for petrologic characterization. Whole rock geochemistry will analyze for trace element concentrations and laser ablation ICP-MS will determine U-Pb age of zircon grains to understand the magmatic source and timing. Previous studies have dated the economically important granites between 1.32-1.33 Ga and between 1.47-1.49 Ga and the associated volcanic rocks at 1.46-1.5 Ga. This study will focus on the lesser known plutonic bodies of Knoblick, Slabtown, Stono and Buford granites and will add zircon trace element geochemistry data to the economically well-known granites of Butler Hill, Breadtray, Silver Mines and Munger.

#40 - METEORITE IMPACT STRUCTURES AS OUTCROP-SCALE ANALOGUES FOR MOUNTAIN BUILDING EVENTS: DECATURVILLE, MO. <u>Simin Wu</u>. Geology, Geography, and Planning. Faculty Advisor: Dr. Matthew McKay.

In west-central Missouri, a Paleozoic meteorite impact is exposed that contains a range of outcrop-scale orogenic structures. High-detail mapping and structural analyses of road cut exposures near Decaturville, MO reveals thrust fault sequences contain 1-2 m thick mixed carbonate and clastic sheets that include rollover anticlines, structural orphans, and lateral ramp features. While the strain rate in a meteorite impact is orders of magnitude greater than that in orogeny-scale structures, the morphology and spatial relationships in these impact structures may provide insight into larger tectonic features. U-Pb and (U-Th)/He radiometric dating of zircon grains from sandstones collected on the crater rim was conducted to investigate the age of the impact structure. Results, however, reveal that the sample sites did not reach temperatures in excess of ~200°C, and the impact was not recorded in our samples. This indicates that deformation occurred at lower temperatures than estimated. The geochronology data, however, provide evidence of 300 million year old sediment transport from the south. Zircon grains in ~315 million years old sediment are ~800-550 million years old, which requires sediment pathways from areas of Texas and Louisiana that have been buried since the opening of the Gulf of Mexico in Jurassic time (~180 million years ago). This study yielded evidence for low temperature, high strain deformation during bolide impacts and also provided insight into 300 million year old sedimentary drainages

#41 - MELBOURNE, AUSTRALIA: A WORLD CITY. <u>Adam Olinger</u>, Geology, Geography, and Planning. Faculty Advisor: Dr. Krista Evans.

Melbourne is a city of over two million people in the state of Victoria, Australia, and was founded in 1835 by John Batman. Melbourne grew exponentially after gold was discovered in the area northwest of the city, ballooning to a population of over 300,000 less than 50 years after being settled. When first established, Sydney native Robert Hoddle was sent to outline the original plan for the city, and created the Hoddle grid in what is now Melbourne's CBD. Today, Melbourne is working to combat overcrowding in its highest density districts by establishing a height limit on buildings based on its base size. Melbourne is not without its flaws, as it is facing two major issues in climate change and the continuing mistreatment of its aboriginal population. However, even with these problems, it has been ranked as the world's most livable city every year from 2010-2017, cementing the fact that Melbourne is an all-around world city.

#42 - THE GEOGRAPHY OF ASTANA, KAZAKHSTAN. <u>Ryan Wissmann</u>, Geography, Geology and Planning. Faculty Advisor: Dr. Krista Evans.

This poster explores the geography, history, and urban design of Astana. Astana is the capital of the Republic of Kazakhstan, a former Soviet Republic in Central Asia, the largest besides Russia. Astana, although a very new city, has a history that dates back even before the foundation of the Russian Empire. Since ancient times, the city has served as a crossroads between Europe and Asia and as a bridge between cultures. Since the fall of the Soviet Union in 1991, Kazakhstan's economy has boomed, due to the discovery of oil and the exploitation of other vast natural resource deposits. The country's administration, under the leadership of President Nursultan Nazarbayev, has re-invested much of this money back into the construction of modern-day Astana, which became Kazakhstan's capital in 1997. Today, Astana is rapidly growing and developing, with new infrastructure, industry, and economic development products being added seemingly every day. Astana is also famous for its ultra-modern, space age architecture, and innovative urban planning and design. Astana continues to remain as a crossroads between Europe and Asia, and is quickly advancing its position in the global system and economy.

#43 - ASSESSMENT OF OBLIQUE PHOTOGRAPHY IN ENHANCING UAV-BASED PHOTOGRAMMETRY-DERIVED DEMs AND ORTHOPHOTOS. Bennett Conway, Geology, Geography, and Planning. Faculty Advisor: Dr. Toby Dogwiler.
As Unmanned Aerial Vehicle-based (UAV) data collection becomes increasingly prevalent, it is imperative to consider methods of enhancing such collection by improving accuracy and/or efficiency. It has been hypothesized that acquiring a combination of oblique and orthogonal photographs of the earth's surface may yield higher quality digital elevation maps (DEM) and orthophotos. Using DJI Phantom 4 Professional UAV, sub-decimeter accuracy aerial photographs of Spring Creek in south-central Missouri were captured at 50°, 70°, and 90°, which is defined as the camera orientation being orthogonal to the land surface. Both north-south and east-west-oriented flight missions were used for each camera angle, producing six unique sets of photos varying in angle and orientation. These photo sets were then processed in various combinations to create DEMs and orthophotos using AgiSoft PhotoScan software. To aid in photograph alignment and test elevation accuracy, 11 ground control points (GCP) were placed within the research area which were located with a GPS to an accuracy <10 cm. The effect of the oblique photographs on the DEM and orthophoto accuracy are being compared based on their ability to predict the coordinates of a subset of GCPs.

#44 - SUSTAINABLE LANGUAGE IN UNITED STATES HIGH SCHOOL BIOLOGY CURRICULA AND GREENHOUSE GAS EMISSIONS. Julia Kovacs. Geology, Geography, and Planning. Faculty advisor: Dr. Judith Meyer.
Climate change is challenging the limits of the Earth. Extensive research indicates that future generations will not inherit a planet. Biology is a required subject for United States high school students. In this study, the high school biology curricula for 100 public high schools were examined. The schools were selected from states that have high, middle and low levels of greenhouse gas emissions per capita. Then, a range of curricula were selected from high, middle and low income school districts. The curricula were examined for use of the terms "climate change," "global warming," and other "sustainable language." The relationship between the use of sustainable language and the greenhouse gas emission levels was explored.

#45 SPATIAL RELATIONSHIP BETWEEN THE INCLUSION OF CLIMATE CHANGE IN MISSOURI HIGH SCHOOL BIOLOGY CURRICULA AND ENVIRONMETAL FACTORS. Julia Kovacs. Geology, Geography, and Planning. Faculty Advisor: Dr. Xiaomin Qiu.
Climate change is a phenomenon that is persistently threatening the Earth and humanity. With the variety of opinions present in the U.S., the validity of climate change is still under debate. As the evidence supporting climate change grows, there is a social significance to teaching climate change related content in high schools. This study explored the relationship between the inclusion of climate change in the high school biology curricula and socioeconomic contextual factors in 30 Missouri's school districts. The districts were selected based on location in relation to Missouri's most populous metropolitan areas. The curricula, spanning across metropolitan and rural areas, were examined for the inclusion of the terms "climate change" or "global warming". Then, traditional statistical analysis and spatial analysis were performed. Maps were created to represent the spatial relationship between the use of this language and several variables, including percentage of students who qualify for free and reduced lunch, average years of teaching experience of teachers, the amount of teachers with a master's degree, the student to teacher ratio, and average daily expenditure per pupil.

#46 - SPATIAL VARIABILITY OF SEDIMENT SIZE AND LEAD CONCENTRATIONS ON A MINING-CONTAMINATED RIVER BAR IN BIG RIVER, SOUTHEASTERN MISSOURI. Madeline Behlke-Entwisle, Geography, Geology, and Planning. Faculty Advisor: Dr. Robert Pavlowsky.

Assessment of sediment contamination and associated environmental risk requires an understanding of the spatial variability of toxicity within sedimentary environments. The purpose of this study is to examine the spatial distribution of lead contamination across the surface of a vegetated bar in the Big River channel at St. Francois State Park, Missouri. Underground mining for lead began in the area in 1864, and globally important deep-shaft mining occurred in the Old Lead Belt district until 1972. Large volumes of mine tailings were released into the Big River resulting in ecologically toxic lead concentrations in channel sediment for 171 kilometers. Seventy-five surface (0-5 cm) samples of bar sediment were collected along 15 cross-channel transects, GPS-located, and analyzed for metals using X-ray fluorescence (XRF) and sieved grain-size. Metal levels in the <2 mm sediment fraction were high, with lead concentrations averaging 1113 ppm and ranging from 362 to 2719 ppm, far above the probable effects concentration (PEC) of 128 ppm. Higher concentrations of contaminants tend to occur at the bar head and longitudinally down the bar center. Geographic patterns of sediment size, vegetation, and lead concentrations will be further analyzed to better understand the relationships among bar morphology, vegetation, and lead contamination.

#47 – SPATIAL DISTRIBUTION OF RIPARIAN FOREST FLOOD DAMAGE ON TRIBUTARIES OF THE NORTH FORK OF THE WHITE RIVER IN SOUTHERN MISSOURI. Josh Hess, Geography, Geology, and Planning. Faculty Advisor: Dr. Robert Pavlowsky

Climate change has increased the frequency of large floods in rivers draining the Ozarks Highlands. The effects of larger floods on the channel system include recent trends in higher rates of channel sedimentation, bank erosion, and damage to infrastructure. This study examines the effects of a large flood (>500 year recurrence interval) during April-May 2017 on riparian forests along five tributary streams in the North Fork of the White River watershed in southern Missouri. The riparian zone is the interface between land and river often including floodplain and wetland areas which flood a few times a year. This study aims to assess the spatial patterns of riparian forest damage in relation to channel position, landform, and tree characteristics. Riparian forest characteristics are delineated and quantified using GIS analysis of high resolution drone imagery and GPS-surveys of bottomland landforms. Preliminary results indicate extensive uprooting of trees along channel bends, some channel bars and low floodplain areas. Further, damage appears to be more extensive in medium-sized streams in contrast to smaller and larger streams. This information will be used to help predict ecological disturbance by floods and to improve land management practices used in Mark Twain National Forest.

#48 - AN ANALYSIS OF HOTEL ONLINE REVIEWS. Alex Baguio, Matésja Daniel, Alex Birge, Guangyi Wang, Idalia Aguilar. Hospitality Leadership. Faculty Advisor: Dr. Nancy Kageyama

More people use online reviews for travel planning including booking hotel rooms. Reviews of other tourists who have prior experiences with hotel room products are both the most preferred and the most influential sources for tourists' booking decision making. Electronic word of mouth has become a powerful source for tourists and hotels cannot ignore what their customers are discussing about on the Internet. There are about 30 million people visiting TripAdvisor to utilize reviews of other travelers every month. Therefore, it is critical to understand the trends of those user-generated comments and utilize them to enhance the product offerings. The purpose of this research is to analyze customer online reviews of the Marriott International brand. With the data from TripAdvisor, this study finds the themes mentioned frequently both in positive and negative hotel online reviews. The results suggest the areas the hotels are excelling in and the areas the hotels need to make some improvements on. The study helps hotel companies to understand what customers are caring about when they post positive or negative online reviews so hotel companies can pay attention to those areas to enhance hotel service quality and increase the number of positive online reviews.

#49 – THE IMPACT OF HOTELS' GREEN PRACTICES ON GUEST SATISFACTION.
Dallas Schneider, Madison Goodman, Chris Mills, Kennedy Powell, Jordan Moyer, Lindsey Gross. Hospitality Leadership. Faculty Advisor: Dr. Nancy Kageyama
Being more environmentally friendly is a growing trend in today's society. Hotels especially are implementing green practices in their day-to-day operations, but how are those practices impacting the guests? Are they excited and choosing places that are more environmentally friendly, or is it affecting their stay in a negative way? The main focus of this research project is to analyze reviews from guests staying at a specific environmentally-conscious hotel and explore what they think of the green features. The features included in the reviews were low-flow water pressure, motion-sensored HVAC units, LED lamps as the only electronic light source in the rooms, a salt-water pool instead of a chlorine one, and the overall LEED certification/green status that the hotel markets to the guests. The results of this research have shown that certain green features had a more negative impact on guest satisfaction, such as the water pressure and the LED lighting, but the smaller and less noticeable green features seemed to add a unique charm to the hotel and gave it a competitive advantage. These results can help not only hotels but other hospitality businesses decide what environmentally friendly changes they can make to optimize guest satisfaction.

#50 – DERIVING EQUATIONS FOR THE AREA OF STARS AND HEART SHAPES.
Josh Gooch, Mathematics. Faculty Advisors: Les Reid, Yungchen Cheng
Computing the area of various geometric figures is one of the most ubiquitous applications of mathematics in daily life. It is widely known that the area of a circle is πR^2, or that the area of a triangle is ½ *bh*, yet foolproof equations for the area of star and heart shapes had remain undetermined. When presented with the latter problems, approximations and computational methods were required. However, this paper seeks to assert that there are simple equations for the exact area of stars and hearts: equations derived via methods from both trigonometry and calculus. By discovering these equations, the process of computing the area of both stars and hearts has been reduced from a tedious undertaking to a simple calculator exercise. The following presentation will consist of each logical and mathematical step used to arrive at the final area equation for both shapes, and potential industrial applications for both as well.

#51 – THE AVERAGE NUMBER OF INTERSECTION POINTS OF A RANDOM POLYGON. Gabriel Wallace, Mathematics. Faculty Advisor: Dr. Les Reid.
Given a regular polygon with *n* vertices $v_1, v_2, \ldots, v_n$ and a permutation *p* of $\{1,2,\ldots,n\}$, we form the polygon whose edges are $v_{p(1)}v_{p(2)}, v_{p(2)}v_{p(3)}, \ldots, v_{p(n-1)}v_{p(n)}$, and $v_{p(n)}v_{p(1)}$. Two edges are said to intersect if they meet at an interior point (i.e. not at one of the vertices). We investigate the average number of intersection points averaged over all *n*! permutations. For example, if $n = 4$, the 4! = 24 permutations give 8 polygons that are squares and 16 polygons that are "bow ties". The former have 0 intersection points and the latter have 1, giving an average of $(8\cdot0+16\cdot1)/24 = 2/3$ intersection points. We generate data using the computer program *Mathematica* and use this to formulate and (hopefully) prove conjectures about the average number of intersection points.

#52 – SEISMIC ANALYSIS OF THE PULSATING SUBDWARF B STAR EPIC 212508753 USING DATA FROM NASA'S KEPLER SPACE TELESCOPE. John Crooke, Physics, Astronomy, and Materials Science. Faculty Advisor: Dr. Michael Reed

EPIC 212508753 is a subdwarf B (hot horizontal branch, sdB) star which has been observed by the Kepler Space Telescope during its extended mission, K2, in short cadence mode where a new image is obtained roughly every minute for about 80 days. Using time series analysis of the data we have found the star to be a rare hybrid pulsator with both g- and p-mode pulsations where most of the pulsations are p modes. These pulsators are extremely important as p modes sample near the surface and g modes can sample deeper, near to the core. This means that hybrid pulsators allow us to characterize the entire star. As a hotter, predominantly p-mode pulsator, EPIC 212508753 is particularly interesting for seismic study. We have discovered frequency multiplets in both the p- and g-mode regions which we use to identify pulsation modes and determine that EPIC 212508753 rotates like a solid body, in contrast to some other sdB stars.