2017-001: Efficient and Cost-effective Class Attendance Management with a Smartphone-based System

*Eugene Garcia, Nico Ponder, Hugo Rivera*

Many studies show a strong correlation between a student’s attendance and their academic performance. This paper presents a smartphone based attendance tracking system that can quickly and accurately track class attendance in a cost-effective way. The system consists of a mobile application for students, a web application for administrators, and a central server. The mobile application runs on Android and iOS. Students register their attendance by sending a session-specific secret code — either a short numeric password, an alphanumeric password, a pattern, or a QR code. To effectively prevent attendance fraud, the system verifies submissions using information such as time and unique device identifiers. This poster presents an evaluation plan for our attendance tracking system. We wish to qualitatively measure the usability of the application and determine if it helps reduce absenteeism by reminding students of their lecture times and their recent attendance record.

2017-009: Sustainable Building Material for a Modern World

*Kevin Garber, Alexandra Scheer, John O’Connell, Zack Olson, Sawyer Gill, Amber Duran*

Waste products can be reprocessed into materials that have the strength, stiffness, and water resistance to be viable building bricks. Utilizing waste products to create construction materials not only reduces waste that collects in landfills, but also provides a low cost alternative to traditional bricks. This concept was first presented several decades ago and is still an ongoing idea that needs researching. Present work investigates a variety of recycled waste products such as cardboard, polyethylene terephthalate (PET) and polyethylene (PE) that can be acquired for a negligible cost. These recycled material will be processed into a building brick and undergo compression testing and water absorbance testing. A Cox model will also be created to determine and establish the optimum composition of the bricks.

2017-014: Self-Regulating Nuclear Reactor

*Megan Armstrong, A.J. Fallgren*

The purpose of this research was to look at the effects of thermal expansion and Doppler broadening on the reactivity of a nuclear reactor. This was done by modeling the reactor using computer simulations. The simulations were written in Python code, but used MCNP-6 (Monte Carlo N-Particle 6) to look calculate $K_{\text{effective}}$. To represent thermal expansion on the reactor, the input decks for MCNP-6 varied in plate diameter and plate thickness. When the size was varied, the mass of the reactor was kept constant causing density to change with reactor size. The input decks written for MCNP-6 varied the neutron cross-sections in temperature. This was done to simulate the effects of Doppler broadening on the reactor. The results of this research are used as a safety basis and feasibility for live testing that will be done on the reactor.

2017-018: New Method of Mine Ventilation Surveying Data Collection and Analysis

*Joaquin Roibal*

Optimum design of an underground mine ventilation system is important for the health and safety in underground mining personnel. The method being introduced is used to record environmental data of an underground mine environment by developing a programmed data collection unit with sensors available to measure underground mining environment. This method was designed to be automated, low-cost, and to collect, save and analyze important measurements. We successfully tested the device in an underground mine environment, and displayed data visually to provide insight to the underground mine environment. The results of this test were interesting because of the high precision of the data. From these results, we learned that this method can be used to collect data in an underground mine environment. Future project directions include developing a hands-free device and to develop a working network and infrastructure in operating underground mines. Ultimately this research will merge with other Ventilation on Demand (VOD) systems to provide high-quality, fresh air to mining personnel in an efficient manner.
2017-020: Solar Hydrogen Electrolysis Utilizing Nanoparticle Catalysts  
Reid Hendricks, Kelsey Wilson, Salomon Maestas, Ayrton Jordan

Climate change has increased public awareness of the need to develop methods of producing clean energy. Hydrogen fuel cell technology is promising. However, its primary limitation is the large amount of energy that must be input to a system to produce hydrogen gas from water. Recent research has focused on the use of nanoparticle (NP) catalysts to split water using solar radiation. The photocatalytic properties of TiO₂ exposed to UV radiation has been thoroughly characterized by previous researchers, however it exhibits very low yield. A recent area of interest has been to increase photocatalytic efficiency using colloidal suspensions of noble metal-titania, core-shell, NP configurations.

In this project, we attempt to increase photocatalytic efficiency by synthesizing a novel nano-particle composition and morphology, in which titania NPs are surface doped with palladium. An apparatus was designed and optimized for exposure of a colloidal suspension of the Pd/TiO₂ NPs in water to the solar spectrum. The apparatus is transparent to the spectrum from the infrared to ultraviolet. Several variants of nano-particle sizes and compositional ratios were tested and optimized.

2017-022: Water Quality Comparison Pre- and Post-Infiltration  
Haley Hanson, Emerson Blake, Hansen Dube, Adrianna Nieto

In-situ water quality can change as rainwater percolates through the vadose zone and into the groundwater. Simulated rainwater was applied to four test sites at the New Mexico Tech Experimental Watershed. Water samples were collected, using lysimeters, and analyzed for changes in water quality, specifically arsenic concentration, conductivity, and pH. Our hypothesis is that the soil matrix causes substantial changes to water quality. The purpose of this research is to evaluate water quality changes pre- and post-infiltration with respect to the soil matrix and to compare post-infiltration with Safe Drinking Water Act (SDWA) standards. Over the four tests sites following infiltration, the average arsenic concentration observed was 30.4 parts per billion (ppb), well above the SDWA standard of 10 ppb. The average conductivity change was 238.2 microsiemens (µS), and there was no significant change in pH.

2017-026: NMT CSE Department Mobile App  
Hannah Jones, Emily Bardwell, Baxter Wood

The purpose of the research is to develop a mobile app for the Computer Science and Engineering Department on campus. The mobile app will summarize admission, course catalog, department faculty, contact information, research projects, and opportunities within the department. It is important for companies to have information available on both websites and mobile applications in order to keep customers informed and involved whether they're on the go or sitting at home on the computer. As time goes on the demand for applications rises as normal websites become a less mainstream way to browse. Mobile apps are also useful for college and university departments as a way of informing students in the department of different things.

2017-030: Theoretical Study of a High Performance Thermoelectric Material: Stanene  
Charles Griego, Pabitra Choudhury, Joshua Livingston

Improving the efficiency of power generation while reducing the amount of energy waste is crucial for sustainability. High performance thermoelectric materials with the capability of converting waste heat to electricity are a potential solution to step farther away from an energy crisis. In recent years, the research towards finding new candidates for such applications has gone to great lengths. More specifically, the reduction of low-dimensional materials to the nanoscale has produced fascinating results regarding the improvement of thermoelectric performance. In this study, we investigate the enhancement of the thermoelectric figure of merit for stanene between nanoribbon form and the bulk using first-principles calculations. The thermopower properties were calculated using combined first-principles calculations and Boltzmann transport theory within the relaxation time approximation calculated from deformation potential theory. We find that bulk stanene exhibits a thermoelectric figure of merit that is approximately half of unity at the optimum doping level. We propose that the thermoelectric capabilities of stanene are enhanced further for a nanoribbon structure.
**2017-034: Enhancing Carbon Storage in Desert and Agricultural Soils with Native Plant Residue**

*Faith Simitz*

Soils are the largest terrestrial carbon sink, therefore increasing soil carbon stability can potentially reduce the impact of rising atmospheric CO$_2$. Adding C to soils from plant residue could increase soil C, but increasing soil C pools requires understanding the response of soil microbes that have a major role in C transformations. In an attempt to understand C pool stability in arid environments, we added extracts of native prickly pear (*Opuntia* spp.) as a carbon amendment to soils and measured CO$_2$ flux and soil aggregate size as evidence of microbial changes to soil C. We added extracts to both desert and agricultural soils to test for differences in C cycling between important Chihuahuan Desert soil types. Initial soil aggregate size has been determined, and data will be presented that show if C amendments alter particle size in these soils. As a measurement of microbial activity, CO$_2$ flux was measured weekly from these soils. After two weeks, soils with the cactus amendment have 57% and 144% greater CO$_2$ flux than controls from agricultural and desert soils, respectively. This suggests microbial processes are more C limited in desert soils. Overall CO$_2$ flux was higher from agricultural soils, possibly due to relaxed water and nutrient limitations on microbes. These results suggest limited capacity for C storage in arid land soil in short-term experiments, but highlight important differences between soil types (C limitation differences) that could be important for long-term soil C storage.

**2017-041: Understanding Neutron Star Atmospheres: Building a Self-Consistent Model of a Pulsar Magnetosphere**

*Keith McElroy*

Since their discovery in the second half of the twentieth century, pulsars have been mysterious. We know they are supernova remnants of massive stars that have tremendous magnetic fields, high rotation rates, and observed periodic emissions. The emissions are assumed to come from their magnetosphere, a dynamic atmosphere of charged particles, the structure of which is still unclear.

Our goal is to build a self-consistent model of the magnetosphere as a step toward understanding the pulsar emission process. Even with simplifying assumptions, the complexity of the mathematical models used often results in cumbersome code, so that researchers are forced to look at simple cases or only small sections of the magnetosphere. We seek a model that is both computationally efficient and without limitations on our domain.

The approach proposed is to begin with the fewest possible assumptions, treat the pulsar as a conductor, the particle trajectories as wires, and then determine a solution that minimizes surface EMFs (Electro-Motive Forces). We assume the star is a rotating magnetized spherical conductor and the source of both the charged particles and the forces acting on them. Also assumed is that the star and its magnetosphere are in equilibrium when the EMFs are minimal. Finally, we determine the EMFs and seek a solution that minimizes them.

**2017-048: History and Ethnicity: Representation of National Identity in Ukrainian Media**

*Connor Whitman, Jonathan Hobson, Ole-Jeger Hoffstuen, Anton Verdugo*

The current conflict in Ukraine has raised questions about the national identity of the Ukrainian People. The media in the Ukraine has taken a nationalistic stance and put forth many arguments as to why the ethnic Russian populations in Ukraine are not related to the nation as a whole. These arguments are based on assumptions about the definition of ethnicity and nationality. We analyzed several articles from Ukrainian Media and compared the contained assumptions with modern academic views on nationality. We found a common trend among several publications to portray the ethnic Russian populations as completely separate and unrelated to Ukrainian history.

**2017-052: Development of a 3D Virtual-Reality Visualization of Current in Lightning**

*Jared Canright*

The New Mexico Tech (NMT) Lightning Mapping Array (LMA) is an instrument capable of mapping the evolution of a lightning flash in space and time. These data can be visualized in animated 2D plots demonstrating the evolution of a lightning flash as viewed from a set angle. This means of visualization lacks stereo depth and thus hinders the viewer’s ability to develop an intuitive grasp of the evolution of the lightning bolt from stepped leader
to return stroke. This work describes the development of a 3D visualization of lightning suitable for display using the HTC Vive and Google Daydream virtual reality (VR) platforms using the Unity3D software package. The application’s potential usage in research and broader impacts is explored. The implementation of a rapid visualization method for live/immediate visualization of data and quick, efficient playback has applications in further lightning research. Additionally, modification using more advanced computer graphics software will enable lifelike re-creation of the original lightning strikes, allowing for development of an educational application and public demonstrations.

2017-055: Proposed Low-Cost Capacitive Position Sensing for Magdalena Ridge Observatory Interferometer

Jonathan Dooley

The Magdalena Ridge Observatory Interferometer (MROI) is a ten-element optical/IR interferometer currently being developed and constructed in the mountains west of Socorro, NM. With baselines (spacing between each unit telescope) ranging from 7.8 to 340 meters, the facility will be able to image stars with a very high resolution (over 100 times that of the Hubble Space Telescope). Capacitive sensors, in conjunction with piezoelectric actuators, will be used to precisely and repeatedly position the mirrors to direct light from each unit telescope towards the delay lines and scientific instruments. The day-to-night diurnal cycle as well as the differential heating from incident sunlight causes thermal expansion/contraction, which introduces irregularities in the measured capacitance and therefore in the position of the mirror. The material used to build the sensors and the circuitry used to measure the difference in capacitance is therefore important for accurate mirror positioning. In this poster, I follow up on the conceptual design for the capacitive sensors and introduce plans to characterize the sensors over a range of temperatures.

2017-060: Gelatin Characterization for Tissue Biomimetic for Studying the Mechanisms of Blast Induced Traumatic Brain Injuries

Kelsea Welsh

Blast-induced traumatic brain injury (bTBI) has become a common problem for military personnel in recent years. It has been reported that 150,000 soldiers returning from Afghanistan and Iraq have suffered bTBI1,2. The mechanisms that cause bTBI remain poorly understood, but may be involved in the development of post-traumatic stress disorder3. With better understanding of the mechanisms, researchers could develop better protective equipment for military personnel. Three gelatin based materials have been characterized through tensile, compression, and shear tests to ensure they accurately mimic brain tissue under stress. Bovine skin gelatin properties proved to be the most consistent with those presented in literature for brain tissue, with a density of 1.098 g/mL, Young’s modulus of 4.483 psi, and fracture strength of 3.28 psi. The average shear storage and loss moduli were found to be 0.5945 psi and 0.05698 psi with standard deviations of 0.1592 and 0.06375, respectively, at 0.02 atm overpressure and 0.1 s^-1. These findings provide a promising direction for research in the mechanism of bTBI.

2017-064: Optimizing Ethanol Fermentation for Fuel Purposes

Jacob Sibert, Sam Bicks, Babatunde Adejumo

During ethanol fermentation, yeast mortality increases as the concentration of alcohol in the fermentation solution increases, with mortality rates dramatically increasing past roughly 20% alcohol by volume (ABV). As bioethanol fuel requires very high concentrations of ethanol distillation is heavily required to rectify the low concentration of ethanol from fermentation.

The leading hypothesis of the mechanism of yeast death from ethanol production is the yeast’s inability to maintain an ion gradient across the cellular membrane, making the cells unable to perform functions requiring the ions. We hypothesize that by introducing ions necessary for intercellular functions into the solution via the dissolution of ionic salts, we can increasing the survivability of the yeast by maintaining the ion gradient between the cells and the solution; this increases the yield from fermentation and reduces the required distillation for biofuel grade ethanol. We will perform fermentations with potassium, strontium, calcium, and magnesium in separate solutions to determine if the yeast’s survivability is affected. Optimization of salt concentrations will occur to maximize the yeast’s survivability will occur afterwards.
In testing funded by the Office of Naval Research overcharge and thermal heating conditions were explored to characterize the gas venting process via high-speed schlieren imaging and measure any produced pressure waves. Data recorded included chamber pressure and temperature, plus battery voltage, current, and surface temperature. A direct comparison between lithium iron phosphate (LiFePo) K2 26650 and lithium ion LG 18650 cells is made through a test series of three failure methods. Weak shock waves were able to be visualized. Combination tests demonstrated an ability to “reconnect,” leading to secondary, more energetic failures.

Current research pertains to the external dynamics of single battery cell failures under thermal abuse which lead to venting. Experimentation with venting flow fields is intended to increase safety in real world applications. Specific experiments will be conducted to measure internal pressure of cells before and after failure, visualize liquid electrolyte droplets during venting, and assess flammability of vented material within these flows.
2017-003: Thermal Enhancement of Nanofluids

Holden Hyer, Ernest Miramontes, Dhruv Tiparti, Gabriel King

It has been seen that small additives of nanopowders to a thermal fluid enhances the thermal conductivity of the fluid up to 100%. This work includes using graphene, graphene oxide, and other nano powders of different geometric shapes.

Up to 5wt% of the powders were added to different fluids: water, ethylene glycol and a 50/50 mix (similar to antifreeze). Measurements of thermal conductivity were done using a transient hot wire system in which a temperature is measured from the base of a heating tip to top of the fluid.

It was found that indeed small amounts of nanopowders increased the thermal conductivity of heat transfer fluids by up to 60%. The graphene and graphene oxide are sheet-like, but showed the best enhancement versus a more spherical particle geometry. Moreover, the best fluid base to see the best enhancement was the 50/50 mix of water and ethylene glycol.

2017-006: Engineering a 3-D Printing Outreach Partnership

Geronimo Macias, Joshua A. Capps, Douglas N. Hood, Christopher M. Dinelli, Gregory G. Strobel

Our objective is to investigate the infrastructure necessary to develop a sustainable and equitable 3-D printing outreach partnership between New Mexico Tech and Socorro Consolidated Schools. Preliminary research shows that applying STEM skills through hands-on engineering projects in K – 12 improves achievement in math and science by making these subjects relevant to students. Throughout the process of developing our research proposal, we modeled the process of Intelligent Trial & Error, as we demonstrate through the iterations of our changing research hypotheses and perception of tech-fixes vs. technological solutions. Beginning with the misconception that more technology equates to more learning, providing Socorro schools with 3-D printers seemed to be a straightforward solution. After researching case studies, we realized that the unintended consequences of introducing technology without the infrastructure required to maintain, support, and utilize it creates barriers for minority students and undermines the core curriculum necessary to build to higher-level thinking. Initial discussions with stakeholders emphasized the importance of using a scaffolding approach to introduce basic technology concepts to teachers over time. We will use surveys to collect stakeholder input about (1) safety and regulation; (2) organization and communication; (3) funding and resources; (4) training and maintenance for educational technology. This input will be used to develop a framework for 3-D printing education that allows for flexibility and modification.

2017-007: Computation Investigation of High Entropy Alloys (HEAs)

Alexandra Scheer, Joshua Strother

High Entropy Alloys, HEAs, are composed of equal or nearly equal quantities of five or more metals in a single solid solution phase. Some of the promising qualities of HEAs are improved strength-to-weight ratios, higher degree of fracture resistance, increased tensile strength, and higher resistance to corrosion and oxidation over conventional alloy systems. The first publication of HEAs in literature was twelve years ago; so, it is currently a fast developing field in Materials Science. Predicting HEA formability and understanding interactions between elements in the alloys are costly and time consuming experimentally. This problem results in a huge need for computational methods to understand and predict new HEAs for commercial use. Computational research of HEAs is challenging because HEAs are disordered solid solutions. The present work computationally investigates the effect of atomic configuration of the elements by using special quasirandom structures, SQS. SQSs are used to simulate random solid solutions with a finite number of atoms to reduce computational expense, by mimicking the pair correlation function of a random solution. More specifically, the present work is investigating 20-atom SQS positions to determine if the atom positions affect energy convergence. For example, this work investigates the interaction between two more similar atoms clustered together in the random solution. Once this is completed, future work will include similar investigations on a 125-atom SQS and eventual application to stacking fault energies and diffusion coefficients. Relevant computational details will be discussed in the poster.
2017-011: Use of Fluorescence to Quantify Bacterial Membrane Permeability

Kimberly McNair

Antibiotic research must persist as bacteria continue to develop resistance to common treatments. As scientists dedicate more resources to creating new compounds to combat microbial evolution, efficient drug testing procedures must be developed. This study outlines a process to quantify the effectiveness of compounds that permeabilize bacterial membranes. Gram-negative bacteria have an additional protective coating beyond the cell membrane to prevent foreign particles and antibiotics from entering. Compounds called membrane permeabilizers penetrate this outer cell wall so drugs may kill the bacteria. After treating cells with a membrane permeabilizer and a dye that fluoresces only when inside plasma membranes, it is possible to use a spectrometer to measure a sample’s fluorescence and determine the relative magnitude of induced permeability. As expected, higher concentrations of permeabilizer generally result in higher fluorescence readings, indicating that adding more of a permeabilizer makes the membrane more permeable. Different permeabilizing compounds also produce varying results at similar concentrations, illustrating that some substances are more potent than others. This process involves no additional incubation because the change in fluorescence is instantaneous, making it a time-saving procedure can be applied in the search for new Gram-negative antibiotics.

2017-019: Designing a Multipurpose Diagnostic Device Using Microbubbles and Microfluidics

Eligio Madrid, Daniela Salinas

Lipid coated, micron-sized bubbles, or microbubbles, combined with microfluidics shows promise in the biomedical field as tools for both therapeutic and diagnostic ultrasound applications. The ability to modify the microbubbles composition to selectively bind to specific targets allows the flexibility of diagnosing a multitude of conditions. Targeted binding is achieved by incorporating certain bioactive groups into the lipids that make up the lipid monolayer shell, then forcing contact with the receptors of these groups. As a proof-of-concept, a mixture of nano- and micro-sized targets and microbubbles were run through a microfluidic device after an incubation period. Microbubble-bound targets are separated from their unbound counterparts using acoustic focusing. Targets are separable because unique characteristics exhibited by the microbubbles when exposed to an acoustic environment, which stem from their density and compressibility. Previously, the binding mechanics between microbubbles composed of biotinylated lipids and streptavidin coated microspheres were explored with flow cytometry data, and when a sample was run through a microfluidic device and exposed to an acoustic environment there were also signs of the microbubble bound microspheres being manipulated along with lone microbubbles. In this study, the objective is to optimize this procedure. Improving the separation of this system will eventually be characterized by providing flow cytometry data from samples obtained before and after being run through the microfluidic device. A novel device such as this could provide an inexpensive point of care approach to early diagnostics of cancers involving circulating tumor cells (CTCs) which is currently difficult due to low concentrations.

2017-021: Synthesis and Testing of New Compounds against Drug-Resistant Cancer Cell Lines

Ria Kidner

Not long ago, chemical compounds, called crinine-type alkaloids, isolated from iris plants were shown to be effective at inhibiting the growth of drug-resistant cancer cells. Recently, a collection of compounds based off of these natural alkaloids was synthesized and tested for biological activity. Found among them was a promising derivative which proved particularly interesting because it represented a heterocyclic mimetic of the natural compound not found in nature. Studies about how this compound behaves in cells showed that this molecule works by blocking RNA translation into proteins by a mechanism involving deactivation of eIF2α, an enzyme critical in synthesizing proteins. The molecule, therefore, prevents the creation of needed proteins in cancerous cells. Prevention of growth by blocking protein synthesis is also what the natural compounds Bulbispermine and Haemanthamine do; this is good because it shows our modifications are not so drastic that the compound deviates from the natural chemical structure upon which the new molecule is based.

While this new compound has biological activity at the same level as the best natural alkaloids, the goal of this project was to make a new collection of compounds, based on the derivative, but with the aim of increasing the cancer-killing efficiency of the molecule to be comparable to the commonly prescribed chemotherapeutic agents.
Modifications of the parent compound were developed in order to improve how effectively the compound reaches its intracellular target and how selective it is against cancer cells vs. normal cells.

2017-023: Mitigating Erosion in a Desert Watershed

Bon Durica, John Durica, Mercedes Lucero, Cheyenne Gant

High rates of run off cause soil erosion, leading to undercutting of surrounding features, failure of structures, and contamination of water sources. Indigenous and historical methods of erosion control may provide low cost, easily constructed solutions to these issues. We investigate the effectiveness of Zuni bowls and loose-rock check dams as erosion control methods in US Southwest desert scrublands by simulating rainfall on an eroding hillslope with small ~ 1-meter wide channels or rills. We selected three channels for testing of similar size, slope angle, and soil composition. In two of these channels, we constructed erosion control structures; the third remained unmodified as a control. In preliminary tests, using simulated flow rates of 4 gallons per minute for 10 minutes, simulating a high intensity short duration event, similar to the monsoon season of NM, we observed a significant reduction in channel erosion and water speed, measured as the time it took for water to reach the end of the channel, and an increase in water infiltration and soil retention within these structures. The addition of these structures show increased infiltration area and reduced water speeds in the channels where they are placed. These structures collected enough sediment in early tests that they had to be heightened to allow for continued sediment collection. We will continue to run water down these channels to model the longer term behavior of the erosion in the control vs the control structures. The tested methods are effective in reducing the soil erosion of the channels.

2017-031: DHL: Development of a Novel Anticancer Scaffold

Maximo Santarosa, Channelle Salazar, Kailee Zingler

The purpose of this research was to develop a novel anticancer scaffold, DHL. A new method for synthesizing this compound was first created and optimized. Once DHL-1 was successfully synthesized and properly characterized through NMR spectroscopy and X-Ray Crystallography, small changes in the reagents were made to synthesize different derivatives. A total of sixteen derivatives now exist within the DHL family. Each derivative was tested on different cancer cell lines and activity was determined via MTT Assays. Some derivatives showed micro molar cytotoxic activity.


Liam P. Hallada, Doleshwar Niroula, Susantha Ganegamage

Cancer is one of the leading causes of death worldwide; designing therapies for the treatment of cancer requires striking a balance between potency and side effects. Using the combined approach of synthetic modification of drugs and mechanistic evaluation is an invaluable tool for the discovery of effective, cancer-specific therapies. In order to support the elevated rate of metabolism, cancer cells increase the rate of protein breakdown for reuse. Inhibiting the proteasome, the primary protein degradation machinery of the cell, serves as a cancer-specific treatment strategy. This study evaluates the anticancer activity of compounds obtained from the synthetic modification of the natural proteasome inhibitors, Cystargolides A and B, obtained from the bacteria Kitasatospora cystarginea. Testing several variations of the general drug scaffold, the cancer killing potential of the compounds improved by over 100 times, achieving nanomolar levels of toxicity in breast cancer cells while leaving normal breast tissue cells unharmed. Investigating additional therapeutic potential for these drugs, this study aims to prove the antimetastatic potential of the compounds at subtoxic concentrations. Altering the protein expression of cancer cells and microvesicles, proteasome inhibition causes a decreased potential for metastasis. Shown to infiltrate both cells and microvesicles, these compounds have exhibited the potential to prevent the creation of cancer friendly environments that are susceptible to cancer cell invasion. Overall, the synthetic Cystargolide analogs exhibit promising therapeutic potential for the selective treatment of breast cancer by the inhibition of the proteasome.
2017-044: Total Synthesis of (-)-Hortonone C
Doleshwar Niroula, Liam P. Hallada

Hortonone C, together with hortonone A and B are a group of terpenoid natural products that were isolated from a collection of plants belonging to the Hortonia genus in Sri Lanka. In order to uncover their potential as anticancer drugs, this project accomplished the total synthesis of the terpenoid hortonone (-)-C thus allowing the confirmation of the absolute stereochemistry of the natural product. A key Intermediate was synthesized using either an asymmetric conjugate addition strategy, or by elaboration of the Hajos-Parrish ketone. Reduction of common intermediate under dissolving-metal conditions and trapping of the enolate intermediate served to control the cis-stereochemistry at the ring fusion and provide a silyl enol ether necessary for ring expansion. Comparison of optical rotation data confirmed that the absolute configuration of natural hortonone C is (6S,7S,10S). Evaluation of cytotoxicity using MTT assay demonstrated that synthetic (-)-hortonone C was not active (IC50 >100 µM) against MCF-7 breast cancer cells, indicating that the absolute stereochemistry of the natural product is essential for anti cancer activity.

2017-049: Why History Matters: The Eastern Ukraine Conflict in Western Media
Troy Vigil, Elias Flores, Tyler Stockberger, Keith Wright

This project analyzes how the conflict between Russia and Ukraine is represented in western media. We do so by comparing claims made by journalist, with those of academic historians. We pay particular attention to representations of ethnicity, history, and state territory. We argue that most media are impartial towards both sides, but some show bias favoring Ukrainian ethnic nationalists.

2017-054: Exploring the Physics of Exoplanet Atmosphere Spectroscopy with NESSI
Megan Hein

Exoplanet atmospheres are highly intriguing entities due to the difficulty in observing them. One way to detect them is to analyze the spectra of the stars they orbit. When an exoplanet transits in front of its host star, it blocks a portion of the light, causing a dip in the star's observed flux. By observing the specific changes to the star's spectral characteristics, including the wavelength-dependent changes in flux, we can infer the composition of the transiting planet's atmosphere. This project focuses on the techniques used to observe and interpret transit spectra to study planetary atmospheres, specifically with the New Mexico Exoplanet Spectroscopic Survey Instrument (NESSI). With NESSI, we will be able to observe the atmospheres of exoplanets by capturing their spectra as they transit. Using these spectra, we will be able to better characterize exoplanet atmospheres, including learning about composition, atmospheric dynamics, and variety of types of atmospheres. In this poster, I give an overview of the planet transit detection method, why we will use NESSI and near-infrared spectroscopy, and future plans to observe exoplanet spectra.

2017-056: Atmospheric Processing of Mineral Dust Aerosol; a Bioavailable Source of Iron
Eshani Hettiarachchi

Iron is one of the most important element for the life. Though it is, the fourth most abundant element in the terrestrial crust dissolution of iron minerals in the ocean will give a concentration low as 0.1nM due to the high pH (~8.5) of ocean. Nevertheless, the iron in ocean is high as 2 nM despite this limitation. Therefore, it is hypothesized most iron comes to the ocean via atmosphere, and dissolution occurs in acidic atmospheric environments. This work focuses on chemical and photochemical processing of iron containing mineral dust particles in the presence of HNO₃, and organic pollutants such as dimethyl sulfide (DMS) under atmospherically relevant conditions. Here, spectroscopic methods are combined with batch reactor studies to investigate atmospheric processing of iron in mineral dust aerosol, with a specific focus on source material i.e. particle size, and mineralogy, and environmental conditions, i.e. pH, temperature and solar flux. Ilmenite used as the proxy because it has both titanium and iron internally mixed. The studies also conducted with authenticated dust samples collected across the nation. Results of these studies clearly indicate that above factors play a significant role in the rate and extent of iron dissolution. The data suggest that presence of titanium in the lattice structure of ilmenite and in authenticated dusts enhances iron dissolution, at least by 2-fold in a comparison with hematite
(alpha-Fe₂O₃). The current study thus highlights these important, yet unconsidered, factors in the atmospheric processing of iron-containing mineral dust aerosol.

**2017-057: Fluid Inclusion Composition and Evolution of Mineral from the Lewis Wollastonite Skarn**

*Ke Li*

A new method called crush-fast scan (CFS) mass spectrometry fluid inclusion gas analysis, which provides high diversity of gas species and accuracy of measurement, was applied to discriminate fluid inclusion sources (meteoric, magmatic, or crustal fluids), constrain redox environments, and identify evolution of minerals in the Lewis Wollastonite Skarn, Adirondack Mountains, New York. The aim of this research is to develop a more comprehensive understanding of fluids through Grenville metamorphic processes as recorded at the Lewis Wollastonite Skarn. Calcite, quartz, wollastonite, garnet, and pyroxene fragments were passed through CFS to quantitatively release inclusion volatile gasses, including H₂, He, CH₄, H₂O, N₂, Ar, and CO₂. Five analyzed minerals record evidence for three different generations of fluid from the meteoritic and crustal gas. This is in contrast to previously proposed production of fluid from the meteoritic and magmatic fluids. First group minerals, quartz and calcite, contain relatively oxidized (higher CO₂/CH₄), CO₂-rich inclusions with low N₂/Ar and high Ar/He ratio, consistent with a fluid source that is in the range of very shallow to deeply circulated meteoric water. Second group minerals pyroxene and garnet contain relatively reduced (lower CO₂/CH₄), H₂O rich inclusions with high N₂/Ar and low Ar/He, consistent with a fluid source belonging to crustal gas. Third group mineral, wollastonite, shows the similar result with second group except for the high Ar/He fluid source, which is consistent with very shallow meteoritic water. Based on the regional geologic history, garnet and pyroxene formed before quartz and calcite, but there are two possibilities for relative formation time between wollastonite and the other four minerals. Wollastonite may have formed either later during the contact metamorphism P-T path after garnet and pyroxene or on the pro-grade P-T path during the granulite-metamorphic event before quartz and calcite.

**2017-061: Corrosion Evaluation with Non-Destructive Ultrasonic Technology**

*Matthew Davenport, Seth Gordon, Kristian Martindale, Houston Maxwell, Ryan Ziegler*

SAVY containers are prone to interior corrosion and are sometimes damaged during normal use and shipping. Non-destructive testing (NDT) for mechanical damage, plastic deformation, and corrosion within SAVY containers will augment current container monitoring procedures. Our user-friendly, automated system offers novel quantitative analysis capabilities to assure the structural integrity of SAVY containers. This system will reduce the average cost and time per inspection.

Following a feasibility study, ultrasonic wall-thickness testing and eddy current flaw detection were chosen to comprise the system’s NDT component. Deviations from the wall thickness of a control are strong indications of corrosion. Eddy current technology can detect surface and subsurface flaws, including pitting and cracks. Data will be recorded from multiple ultrasonic and eddy current probes simultaneously while a proprietary mechanical system repositions them over the container’s surface. Ultrasonic measurements will be used to create a color-coded thickness plot for rapid visual inspection, while eddy current analysis generates a quantitative surface map of abnormalities to identify flaws.

Currently, container surveillance must be performed in a glovebox by an experienced technician. An automated NDT system will improve worker safety and surveillance cycle efficiency, allowing for unprecedented capabilities in container management. More frequent surveillance of at-risk containers, creation of a detailed record of each container, and long-term data collection for lifetime certifications will now be possible.

**2017-065: Effect on Mechanoluminescence due to Varying Preparation Techniques**

*Cora Carman, Nicholas Apodaca, Sara DiGregorio, John Lee*

Mechanoluminescence is light emission resulting from any mechanical stress on a solid. It is one of the least understood luminescence phenomena. Our objective is to characterize the intensity and glow time of two different mechanoluminescent particles, strontium aluminate doped with europium and zinc sulfide. We will be using two different methods to optimize the luminosity of the mechanoluminescent particles. One method is to embed the particles into our sample and the other method is to use a spin coater to create a layer of mechanoluminescent particles on top of the sample. To characterize europium doped strontium aluminate, a dynamic light scatter will
be used to determine the size of the particles and a UV-VIS spectrophotometer will be used to determine the excitation of the particles at the emission wavelength. For our substrate, we are using polydimethylsiloxane (PDMS) because it is durable under stress, transparent, and affordable. To get rid of bubbles in our PDMS, we place our samples into a vacuum oven at negative eighteen pounds per square inch (psi). For the spin coating method, we are planning to layer our PDMS sample with a solvent of the particles mixed into PDMS. To analyze the intensity of our particles, we are using a spectrometer provided by the Ocean Optics Company.

2017-071: Preliminary re-cataloging of the NMT Paleontological Research & Teaching Collection (PRTC)

Jason Silviria

The fossil collection at the NMT Department of Earth & Environmental Sciences (EES) had been in disarray since it moved into its current home in the Mineral Science and Engineering Complex (MSEC). The collection had been hastily arranged by geological epoch. Beginning in January 2014, I undertook a massive re-cataloging and reorganization of the collection, which has been renamed the Paleontological Research & Teaching Collection (PRTC). It currently has 3510 taxonomic records in 3293 specimen sets and counting. Eukaryota is the most represented biological domain, and Animalia the most represented kingdom. The animal fossil collection is dominated by mollusks, brachiopods, arthropods, and cnidarians, highlighting NMT’s historical importance in the field of invertebrate zoology. Most of the specimens were uncovered in Paleozoic strata. 355 taxonomic records are from Socorro County, particularly the Pennsylvanian-Permian Madera, Sandia, Bursum, and Abo formations, the Cretaceous Mancos Shale, and the Pli-Pleistocene Santa Fe Group alluvial sediments. Future prospects for the PRTC include expanding its catalog to including the fossil collection at the New Mexico Bureau of Geology & Mineral Resources (NMBGMR) Mineral Museum.

2017-075: Determination of Friction Factor using Digital Method in Mine Ventilation Network

Jason Roibal, Eric Richardson

(Pending conference publication)
2017-004: Computational Screening and Characterization of Heterogeneous Catalysts for Natural Gas to Liquid Feedstock Conversion Process

*Thalia Quinn, Joseph Kerwin, Sierra Headrick, Sean Mussel, Dr. Pabitra Choudhury*

Catalysts are needed in applications regarding the world’s fuel and chemical production. To assist these processes, catalysts are used to simplify the chemical reaction by lowering the energy required for reactions to complete. The goal of our project is to identify and characterize specific catalysts through computational research and more specifically the conversion from methane to methanol. Previous work shows that the hydrogen affinity of a structure, the energy needed to move electrons in a reaction, can be directly linked to the reactivity of a catalyst for conversions involving hydrocarbons. By recognizing the correlation between hydrogen affinity, C-H bond activation and transition state activation energy, new optimal catalyst based on porphyrins/phthalocyanines can be identified for the target conversion. Also this work will support the idea of not only decreasing the computational costs for future simulation but also reducing the future experimental efforts by providing the necessary inputs to the experiments. This work includes the analysis of porphyrins and phthalocyanines, centered with various transition metals such as Nickel, Iron, Copper, Cobalt, Lead, Chromium, Molybdenum, and Ruthenium.


*Matthew Hinton, Lara Draelos, Mariana Flores, Jesse Adamczyk, Benjamin Bone*

Modern solar arrays, or photovoltaic (PV) arrays, are electrical systems that output high amounts of current at relatively low voltage. The high current in solar arrays arises as a result of hundreds of solar panels being chained together, often through a single connector which leads into the power grid. As a result of a variety of environmental factors, corrosion in the chained connectors can occur. Corrosion in these connectors may lead to resistive heating which can cause arc faults, electrocution, and ignition of surrounding substances. Safely mitigating electrical fires is challenging because as long as the sun is shining on a PV array, there is not a method of shutting down the solar panels. Mitigation of these hazards has recently been implemented as a requirement for solar arrays by the National Electric Code. The purpose of this project was to develop a device which can react to the resistive heating to prevent fire and electrical hazards. A self-disconnecting device designed to utilize the volumetric expansion of wax to cause disconnection upon heating was produced. Using 3-D printers and rapid prototyping equipment, functional connector models were developed and tested. With each prototype iteration, improvements which moved the design towards a production-ready model were created. The tests were successful enough to serve as the reduction to practice for a patent application. DSC and volumetric expansion tests were performed to characterize the wax. The thermal characteristics of the waxes that were obtained allowed for the selection of an optimal wax for the application.

2017-012: Climate Relevant Aerosol Impacts from Combustion Sources

*Samantha Bixler, Caroline Allen, Christian Carrico, Manvendra Dubey, Allison Aiken, Thomas Rahn*

Ambient air quality is impacted by diverse sources, both natural and anthropogenic. Recent evolution in aerosol and gas measurement techniques has allowed for more specific, accurate, and robust measurements. Aerosol particles are regulated parameters important to human health, atmospheric photochemistry, and atmospheric light attenuation. The atmospheric role of biomass burning emissions has substantially increased with continued warming and drying in the Southwestern US. To better understand air quality impacts related to combustion emissions, measurements were obtained using several techniques including a custom controlled relative humidity (RH) nephelometry system to measure light scattering as a function of RH. To detect aerosol hygroscopic response, controlled RH nephelometry relies upon the direct measurement of light scattering using two nephelometers—one at dry conditions and one at a controlled high RH. Lab experiments with selected Southwestern US fuels examined the influence of fuel type and combustion conditions on emissions. Aerosol hygroscopicity was observed to be strongly linked to the fuel type and its chemical composition. Several ambient events during summer in Los Alamos yielded interesting observations regarding local air quality and instrument response to combustion sources. Episodes examined include smoke from the Dog Head Fire and Independence
Day fireworks. Results of this study enable the development of a framework for predicting water uptake and optical properties of emission from the fuels. Through the further understanding of aerosol behaviors, we can understand impacts from different combustion sources on the environment and human health particularly related to impacts from smoke emissions.

2017-016: Nitrogen Oxide Measurements using Direct Optical and Chemiluminescence Techniques

Caroline Allen, Christian M. Carrico

Ambient nitrogen oxides (NO\textsubscript{x}) are important to atmospheric photochemistry, human health, and atmospheric light attenuation. Recently NO\textsubscript{2} has been subject to more stringent regulation leading to interest in new NO\textsubscript{x} measurement techniques in the low-ppb range. Here we used two techniques to measure NO\textsubscript{x}: light absorption of NO\textsubscript{2} at 405 nm (2B Technologies Model 405) and a traditional chemiluminescence monitor (Thermo Electron Corporation Model 42C). The method of chemiluminescence uses the reaction of NO and O\textsubscript{3} to produce excited NO\textsubscript{2}, which then emits measurable radiation. A principal drawback to this method is that NO\textsubscript{2} is measured indirectly. Light absorption by NO\textsubscript{2} at 405 nm is advantageous because there is little overlap of other airborne species absorbing light at this wavelength. The absorption method relies on a comparison of visible light intensities with and without NO\textsubscript{2} present. In this analysis, we characterize detection limits, and examine ambient and laboratory measurements. Results explored here include the sensitivity and noise of the absorption instrument as well as an examination of the possible interfering N-species of atmospheric relevance. Testing to date shows an LDL of approximately 4ppb (t = 5 min) for both NO and NO\textsubscript{2}. The data showed that average NO\textsubscript{2} levels in sparsely populated Socorro, NM and Los Alamos, NM are well below both the annual standard of 53 ppb as well as the hourly standard. The absorption instrument was also recently deployed at an air quality monitoring station in Albuquerque NM and shows favorable comparison with three other methods.

2017-024: Investigation of Sediment Sources In A Flash Flood Dominated Ephemeral Wash

Joseph Phillips

Ephemeral streams express a system that becomes sporadically active during times of the year with increased precipitation. Ephemeral streams are present throughout the world in arid environments where precipitation leaves streams dry for the majority of the year. With flashes of precipitation in a stream, the sediment load will quickly rise and fall in conjunction with the precipitation. A detailed grain analysis of the Arroyo de Los Pinos located northeast of Socorro, New Mexico will present information on how the lithology and size distribution of these grains change along the Arroyo. Grain data are collected with wolman counts technique for the intermediate diameter and the lithology of the grain. With a Digital Elevation Model (DEM) and photogrammetry programs, a detailed size and slope analysis of the basin will provide information to how slope affects the size of the grain. By using the slopes along the Arroyo, the lithology and diameter of the grains may be explained with steeper slopes coinciding with larger grains. Resistant lithologies that persist through the basin in the largest grain sizes have predominantly marked as limestone. The Arroyo de Los Pinos may be analyzed for understanding sediment transport and deposition within a basin, as well as how factors differ from adjacent arroyos. By identifying sediment load features of ephemeral streams, the dynamics may be translated to systems in other arid environments under the same conditions.

2017-028: SPIDR-WEB: An Efficient NGS Platform for Diagnostic and Transciptomic Applications

James Horne, Andrew Hatch, Chien-Chi Lo, Momchilo Vuyisich, Lindsay Benage, Emily Ennis

We are transforming the field of infectious disease diagnostics with the development of SPIDR-WEB (Sample Prep for Infectious Disease Recognition With EDGE Bioinformatics), a biotechnology platform for pathogen detection and transcriptomic applications. SPIDR-WEB is a sample-to-result process that relies on efficient laboratory and in silico steps. Clinical samples mostly comprise non-informative RNAs. SPIDR-WEB incorporates removal of non-informative RNAs (RNR), thereby enriching all other RNAs, including those from pathogens. This step enables either higher sensitivity and specificity, or less expensive and faster sequencing. Our custom EDGE bioinformatics data analysis platform provides rapid read classification at all taxonomic levels, and reliably detects all organisms present in a sample. EDGE is an efficient process, as it uses databases with pre-computed signatures, instead of aligning sequencing reads to the entire Genbank. In addition to RNR and EDGE, SPIDR-WEB includes robust, inexpensive and rapid sample lysis, RNA extraction, and library preparation steps.
2017-032: Synthesis and Protein Docking Modeling of Marine Alkaloid Derived Anti-Cancer Compounds

Brandon Gehris

A class of recently discovered marine alkaloids and their derivatives, known as rigidins, have demonstrated remarkable anticancer activity. They work by preventing the division of cancer cells by binding to the protein Beta-Tubulin which is required for proper cell division. The synthesis of these compounds can be modified such that a nitrogen contained within the molecular structure is replaced with a sulfur. These new sulfur containing derivatives fall under a class of compounds called thiophene pyrimidines which are also known to have a wide range of biological activities. By synthesizing the thiophene pyrimidine mimetics of these rigidins, the anticancer activity can be increased while also increasing both the solubility and selectivity relative to the previously synthesized rigidin derivatives.

In addition to the synthesis, the interaction between the target protein, Beta tubulin, and these compounds can be modeled using a program called autodock Vina. The interactions of these thiophene pyrimidine mimetics with Beta Tubulin can be compared to the interactions of the most active rigidin derivatives. This data can be used to explore the structure activity relationship between B-tubulin and these compounds. An understanding of the structure activity relationship can be used to guide future modifications to rigidin mimetics in order to optimize their biological activities.

2017-039: Synthesis of N-arylc Sulfonamide-acetophen ones - Very Important Starting Material for Novel Biologically Active Heterocycles

Nicholas Goodwin

N-aryl-and-alkylsulfonamido-acetophenones are the basic starting material for different types of biologically active nitrogen containing heterocycles. These heterocycles include pyrrolines, pyrroles, pyrroldiones, pyrrole pirimidines and other heterocycles. Under Dr. Frolova, novel alkylsulfonamido-acetophenones are synthesized and used in the development of correspondent pyrroldiones and pyrro-pyrimidines. On the basis of three-component synthesis N-(methyl sulfonamido)-acetophenone, N-(Butyl sulfonamido)-acetophenone, and N-(Octyl sulfonamide)-acetophenone were synthesized using 2-aminoacetophenone hydrochloride and corresponding sulfonyl chloride in the presence of trimethylamine until good yields were achieved. One of the compounds, N-(octyl sulfonamide)-acetophenone, was synthesized for the first time. These compounds are used next for the synthesis of biologically active heterocycles. Which will be tested for anti-cancer, anti-bacterial, anti-fungal, and anti-parasitic applications.

2017-043: Novel Bacterial Infections of Terrestrial Tardigrades

Haley Campos, Danielle Turner, James Horner

Tardigrades are aquatic invertebrates form the phylum Tardigrada, and are a part of the super phylum Ecdysozoa. These microorganisms consume the microflora and smaller invertebrates found in their ecosystem and inhabit marine and terrestrial aquatic environments. Terrestrial tardigrades experience frequent fluctuations in water availability and temperature but have evolved a mechanism to deal with these recurrent instabilities by entering a state known as cryptobiosis. Cryptobiosis is a stress-induced condition where the organism has no growth, reproduction, and essentially no metabolism. In the cryptobiotic state, organisms are resistant to dehydration, osmotic stress, and extreme temperatures. While many invertebrates undergo cryptobiosis, the tardigrade is unrivaled in the efficiency and efficacy of this mechanism. Nonetheless, the tardigrade cryptobiotic state appears to be an inefficient defense against certain bacterial infections. Terrestrial Tardigrades collected from Water Canyon near Magdalena, NM presented a novel bacterial infection that is detrimental to tardigrades but present no pathogenicity to other fresh water invertebrates in co-culture. The most likely culprits were identified using the novel Bioinformatics program SPIDR-WEB, which was developed by Los Alamos National Labs (LANL). Tops reads called Variovorax paradoxus (V.paradoxus) and Stenotrophomonas maltophilia (S.maltophilia) as the likely cause of infection. V.paradoxus and S.maltophilia are currently being isolated from environmental samples using standard microbiological techniques. Mixed cultures show a minimum inhibitory concentration of 3 ug/mL of Polymixin B, but this treatment proved detrimental to Tardigrades. Further treatments included a 2% dilution of Kitomer (a chitosan solution) which is currently showing promise in eradication of bacterial infection while leaving the Tardigrades in ideal health.
The tendency people have to like things more greatly as they become familiar is called the Mere Exposure Effect. The purpose of this experiment was to investigate whether this effect can be observed in social media, specifically Facebook. It was predicted that the student’s Facebook ‘friends’ would prefer her actual image over her mirror image, as they are exposed to her actual image in daily life.

The experiment was set up so that the Facebook friends were randomly assigned to two groups. Next, the student took four headshots. These images were altered so there was a mirror and actual version of each. Both of the groups were exposed to each of the photos, except if one group was shown the mirror image, the other was shown the actual one. The experiment was controlled in that the members of one group were not able to see those versions presented to the other group and vice versa. The photos were shown within a time span of one week, after which the amount of ‘likes’ for each was tallied.

The data was analyzed using a Chi-Square Test, and the results showed significance with a p-value of 0.001. Because the p-value was below 0.05, the null hypothesis was rejected, concluding that some factor other than chance had to be present for the deviation to be so great. The experimenter was able to conclude that this factor was the Mere Exposure Effect, which contributed to the deviation between the expected and observed results.

There are many assumptions present in the Russian media when discussing Ukraine. One of the main assumptions present in Russian propaganda is that modern nations are directly connected to early medieval entities, with Russia being the sole heir to Kievan Rus, while Ukraine is simply an “artificial” nation constructed out of borderlands. However, this is not true since more than one country can trace its roots back to the same historical entity. Therefore, both Russia and Ukraine are legitimate successors to Kievan Rus and its religious and cultural heritage. The other main assumption revolves around national identity and religion, namely that places of historical or religious significance to a certain country should belong to that country. This assumption is used in the case of Russia claiming Crimea since it is where Prince Vladimir, Grand Prince of Kievan Rus, was baptized in 988. Again, however, if Ukraine is a legitimate successor of Kievan Rus, then it too has the same claim on Crimea.

Nearly 20 million people worldwide are infected with Trypanosoma cruzi, the etiologic agent of Chagas’ disease. The suboptimal effectiveness and significant toxicities of existing antiparasitic drugs drives the search for new therapeutic strategies in the treatment of this disease. T. cruzi are most commonly transmitted through a vector and have four well-defined developmental stages that include distinct morphological and functional characteristics, each of which affect the parasites’ ability to infect human hosts. The search for antiparasitic compounds began by establishing an infection in mammalian cells. The different stages of T. cruzi were confirmed by confocal microscopy and the appropriate parasitic stage was used for infection. Human retinal pigment epithelial cells (ARPE) were cultured and infected with T. cruzi for 2 hours before being treated with the novel compound DR-P27. Post-treatment with sub-toxic concentrations of DR-P27 revealed a dramatic reduction in the presence of both extracellular and intracellular parasites. After an incubation of 7 days, confocal microscopy revealed that treatment with DR-P27 had prevented further infection in ARPE cells and had inhibited replication of extracellular parasites. Furthermore, a natural tea extract from leaves of Arctostaphylos uva ursi (Uva ursi) in combination with curcumin, an active compound found in tumeric, offered surprising and promising results in vitro. Additionally, Uva ursi prevented an infection from being established in Vero cells at 0.25% v/v, a dose that was ten times lower than the IC50 of 2.5% v/v in Vero cells. This data provides a promising new lead on the search for a better understanding of the different T. cruzi developmental stages as well as for the search for a less toxic, more effective treatment of T. cruzi infection.
2017-062: Development of a Shock Absorbent Composite Horseshoe

Joshua Livingston, Jaia Lockett, Joseph Apodaca, Chase Kicker, Matthew Stalcup

The purpose of this research is to modify and improve on the existing horseshoe design that is cost effective, durable and simple to reproduce. Our team seeks to design a horseshoe that is durable, can absorb shock, allow for hoof expansion, and is cheap—that is, at or around the price of a steel shoe (about $5 a pair). In order to truly fit this description, the shoes must be attached to a live horse’s hooves, and tested.

2017-066: Oxygen Diffusion and Fluorescence Quenching with Biomedical Application

Gary Lopez, Hannah Romberger, Bridget Daughton, Kyle Foster

The goal of this project is to quantify the diffusion of oxygen through various oil/lipid layers. This can be determined by measuring the quenching of fluorescent light given off by a fluorescent dye. The dye that will be used is octaethylporphyrin, and its fluorescent light is quenched by oxygen. Therefore, the rate of oxygen diffusion can be determined by observing the quenching of the fluorescent dye using a fluorescent microscope.

Encompassed in this project is the design of a test vessel, sample preparation, statistical analysis of experimental data, and the compounding dynamics of engineering in a team construct. When completed, the product of diverse minds of team L.I.P.I.D.S will be used in the interdisciplinary research at New Mexico Institute of Mining and Technology.

2017-072: Mechanoluminescent Impact Sensing Team (MIST)

James Allison, Zachary Alvarez, Francisco Hernandez, Brandon Holguin, Hugh Shortt

The objective of this project is to produce a composite that is capable of monitoring its own structural health to reduce the need for regular inspections. The composite we plan to build will take advantage of mechanoluminescent materials to detect impacts loads. Similar to the way pain receptors are dispersed throughout our skin, the composite will have multiple sensing cells spaced out just under its surface. Each sensing cell will contain a small amount of EuD₄TEA, a fractoluminescent material meaning it emits light when it is fractured. When the composite undergoes impact, the EuD₄TEA crystals will crack, releasing light that will be monitored with a light-sensing apparatus within the composite. By correlating the amount of light produced by the EuD₄TEA with impact energy and the distance from where the impact occurs, a code will be able to estimate both the magnitude and location of an impact along the composite.

2017-078: The effects of entropy on diffusivity determined by first-principles calculations

Harrison Lee, John M. O’Connell

The diffusion characteristics of an alloy system are critical to understanding phase formation, mechanical properties, and failure mechanisms such as a creep. One of the key driving forces of diffusion is temperature. An increase in temperature results in an increase in diffusivity caused by the increase in the vibrational entropy of the system. Experimental determination of diffusion coefficients can be a long and costly process. Computer calculations of diffusion coefficients using first-principles based on density functional theory are a reliable alternative to costly experimental techniques. While faster than performing experiments, first-principles calculations of diffusion coefficients have one major drawback. All calculations done using this method are done at 0 K, which is not as useful to engineers as experimental data obtained at service temperatures. The object of this research is to determine how significant of an effect entropy plays in the diffusion coefficient calculations. Self-diffusion calculations using first-principles are performed in VASP using a 32 atom supercell of Ni, which are compared to experimentally determined self-diffusion coefficients and previous first-principles work. Other relevant computational details are discussed in the poster.
2017-005: The Flow of Water Policy Information in Socorro County, New Mexico

Eddie Humetewa, Donovan Jenkins, Adrian Mink, Marcos Aragon, Zane Arias

Our proposed research project is to identify how information about current water policy is distributed and if misconceptions about policy affect the use of water conservation methods. One prevalent misconception is the belief by irrigators that they will lose a portion of their water allotment if they do not use it each year. This “Use it or Lose it” view stems from a 1978 Act stating that water rights can be revoked if they are not used within a four-year period. Although this Act was amended in 2003 to encourage water conservation practices, irrigators retain the “Use it or Lose it” mindset. To collect information from irrigators and community-level regulators, we have developed survey questions that address (1) knowledge of current water policy; (2) water conservation methods currently in use; (3) methods of obtaining information; (4) methods of information distribution. Feedback from this survey, combined with data available from the USDA Census of Agriculture, will identify how present misconceptions about water policy are affecting the use of water conservation measures in Socorro County, New Mexico. Results of our data analysis will be interpreted to develop best practices for communicating information between irrigators and regulators.

2017-010: Assessment of Genetic Diversity Among Populations of the North American Giant Vinegaroon

Joel Tecca

The North American giant vinegaroon, *Mastigoproctus giganteus*, has long been considered a single species with only four subspecies ranging from Central America to the southern United States. *M. giganteus* of the southwestern United States is a fossorial specialist, primarily populating cryptozoic microhabitats restricted to high elevation forests and riparian environments. These habitats are often isolated due to large stretches of dry desert scrubland presenting a physical barrier to dispersal. Uropygi (Thelyphonida) show tremendous morphological consistency. This work sought to characterize any genetic and morphological divergence in populations occupying the southwestern United States that would provide a better understanding of the order’s life history in their North American distributions. We would expect substantial cryptic divergence given the broad geological history of the southern montane regions of Arizona and New Mexico. However, molecular assessment of genetic variation in these populations have never been attempted to support or refute this hypothesis.

This pilot study assessed the morphological and molecular variability of the Internally Transcribed Spacer region among *M. giganteus* by comparing two populations located in the isolated mountain ranges of southeastern Arizona and southwestern New Mexico separated by low elevation desert environments. By way of morphological diagnostics and molecular techniques this project examined the possible divergence of the two geographically disjunctive populations. Comparison of ITS regions of ribosomal DNA (ITS1, ITS2 and 5.8s) in 11 specimens collected from each site (22 total) suggest there is little-to-no genetic variation in this region among the two populations of *M. giganteus* sampled in this study. Given the highly-conserved nature of some areas of the ITS region of *M. giganteus*, this may signify that there is no evolutionary pressure exacted on this gene. Conversely, morphology indicates consistent variations between females of the disjunctive populations possibly signifying phenotypic plasticity or even divergence.

Assessment of additional genes will be required to provide evidence to better characterize the nature and extent of any genetic variability. If speciation has occurred in these isolated populations, the taxonomy of the North American Uropygi representatives previously characterized by their geographic distributions and obscure external characters will need to be reassessed. Conversely, if there is minimal genetic variation among these populations, *M. giganteus* may be far better dispersers than previously considered or the populations have not been separated for long periods.
2017-013: Carbon Aerogel in Multifunctional Structural Super Capacitor Applications

Ben Katko, Jared Marks, Calvin Prokash, Keith Sillivent, Anna Wermer

Batteries and power delivery systems are important to traditional technologies. Current standalone technology has been outpacing current energy storage technology. The Multifunctional Energy Storage Design Team proposes the development of a carbon aerogel super capacitor system to bridge this gap. This system functions not only to store electrical energy but to act as a primary structural member. The goal of the design project is to develop a carbon based super capacitor that achieves a large specific capacitance along with structural support. Our design goals is to maximize the surface area and pore distribution within the carbon aerogel. Maximizing the surface area of the aerogel increases the number electrical charge stored upon its surface. The pore distribution and number of pores, i.e. porosity within the aerogel, creates a network of carbon that bestows beneficial structural properties. The large surface area and porosity are the key to the optimization of the electromechanical properties of the carbon aerogel super capacitor. A prototype and a proof of concept have been fabricated. The proof of concept has produced promising results that rival current super capacitor storage capabilities. However, further optimization iterations are required to maximize the electromechanical potential of the device the design team is fabricating.

2017-015: Studying the Immune System: Consumption of Microspheres by White Blood Cells

Sebastian Hendrickx-Rodriguez

When a pathogen, i.e. any infectious agent such as a virus, bacterium, prion, fungus, or other micro-organism, enters the body, the immune system releases small proteins called opsonins that cover the pathogen. This serves as a signal to white blood cells to engulf the pathogen, a process known as phagocytosis. Depending on the type of opsonin covering the pathogen, phagocytosis can occur in different ways. My research aimed to examine how different opsonin types and densities affect phagocytosis both qualitatively and quantitatively. Microspheres were used to replicate pathogens, and IgG antibody alongside iC3b complement were the two opsonins studied. First, a Dose-Response curve was made to show it was possible to change the density of antibody or complement on the microsphere surface. Then, the distinctly opsonized microspheres were fed to cells and the effectiveness of phagocytosis was analyzed using two different techniques: time-lapse movies and 3D image reconstruction. Through the former method, it was quantitatively found that more densely opsonized microspheres were more effectively phagocytosed, and that cells transitioned through phagocytosis quicker with IgG covered microspheres. Progress was made through the 3D image reconstruction to better observe the phagocytic cup structure formed by the cell and to more efficiently note a difference between iC3b and IgG consumption in a qualitative sense. Phagocytic studies can supply useful information for drug treatments involving passage of the drug through the cell membrane to reach its activation site. My research showed that opsonin density and type affect phagocytosis tremendously.

2017-017: How Do Levels of Intracellular Signaling Protein PKC-beta Differ Between Mouse Lung and Intestinal Arteries?

Erica Rae Herrera

Blood pressure regulation is tightly linked to the contractile state of arterial smooth muscle cells. Complex signaling pathways within the vascular smooth muscle determine how contracted these cells are. Previous studies have shown that PKCβ mediates a unique vasoconstrictor signaling pathway in pulmonary but not mesenteric arteries. Therefore, we hypothesize that the expression of PKCβ in pulmonary arteries will be greater than in mesenteric arteries. In order to test our hypothesis, our objectives are to isolate pulmonary and mesentery arteries from control mice and then to perform a Western Blot for PKCβ. By understanding the mechanisms of pulmonary vascular constriction, pulmonary hypertension can better understood and more effectively treated.

2017-029: Synthesis of Novel Anticancer Compounds via Modifying Natural Products of Marine Tunicates

Carlos Viera

Natural products, known as Rigidins, were isolated near New Guinea and Okinawa from a marine tunicate species known as eudistoma c.f. rigida, hence the name, Rigidins. Our NMT Drug Discovery Group had designed and created a library of synthetic derivatives of Rigidins. These compounds were evaluated for activity against a
panel of cancer cells and showed high potency. We demonstrated the means at which these compounds killed cancer cells; they inhibited an important biological pathway that allows for a cell to divide, known as tubulin polymerization, and they disorganized microtubules, which are hollow rods, functioning primarily to help support and shape the cell. In continuation of this research, we have synthesized a new library of Rigidin analogues. The developed analogues were tested against a similar panel of cancer cell lines, including multidrug-resistant and cancers with dismal prognosis. Preliminary results from these compounds indicate that while these analogues no longer inhibit tubulin polymerization in vitro, they still show potent anticancer activity. Valuably, the new compounds also show higher selectivity towards cancer as compared to normal cells. The mode of action of these newly synthesized compounds will be the subject of our further investigations.

2017-033: Development of a Uranium Selective Water Filter for Mining Reclamation and Domestic Water Uses

Chase Kicker

Our research goal is to optimize a recently produced filtrate material (CM1) for its selectivity towards uranium, its ability to be durable in many different conditions, and its reusability and long life span resulting in a lower cost for the consumer. Successful characterization and development of these filters will have a large impact on small water systems and individual homes. In order to evaluate out filtrate material for uranium capture we performed chromatographic studies using an Agilent 7900 Inductively Coupled Mass Spectrometer to analyze samples separated using columns made from our filtrate material. Laboratory samples of 30 ppb uranium were injected onto columns of filtrate material in Pasteur pipettes. The percent adsorption was then calculated to analyze which conditions are best for maximum adsorption. CM1 has showed high chemical stability against strong acids and bases. That allows us potentially to make a full metal recovery without losing selectivity towards uranium or capacity for uranium adsorption. Our previous study demonstrated that this filtrate material has a high specificity towards the adsorption of uranium in natural water samples. We stated to study a depending of adsorption ability from pH. Most recently we have discovered that increasing the pH of the material until 9-10 provides, so far, the best total Uranium adsorption. Currently a variety of inorganic acids are being tested to see which is most effective for stripping uranium from the material. This study will be useful for further optimization of the filtrate material to be developed as a low cost commercial uranium filter.

2017-042: The Effects of Caloric Restriction on Bdelloid Rotifer Stress Tolerance

Haley E. Campos, Emerson Blake, Dennis Suazo, Sonora Kameron

Many animal species exhibit an increase in longevity when calorically restricted (CR). This phenomenon has proven true for a wide range of species from microorganisms to primates. While the reasons behind this are largely unknown, current hypotheses suggest increased lifespan stems from a reallocation of resources from reproduction to cell maintenance. While this trend is shown in a variety of organisms, some aquatic invertebrates are differentially impacted by CR on a species level. Due to this species variation, it would be beneficial to determine the effects of CR on a different class of aquatic invertebrate. The purpose of this study was to determine the effects of CR on stress tolerance in the bdelloid rotifer Adineta vaga (A.vaga). Currently, three stress parameters are being tested: oxidative, desiccative, and temperature stress. The hypothesis was that CR rotifers would have an increased stress tolerance in comparison to Ad libitum fed rotifers. Contrary to expectations, CR rotifers subjected to oxidative stress displayed an increased sensitivity to the stressor and expired faster compared to Ad libitum fed rotifers. Preliminary desiccation and temperature experiments show the same trend in that CR rotifers are more sensitive to these stressors than Ad libitum fed rotifers. Our observed trends therefore suggest that the bdelloid rotifer A.vaga does not increase its stress response when calorically restricted. These studies could lead to a better understanding of the basic mechanisms of CR.

2017-047: Optical Study of Post Detonation Turbulent Mixing

Raj Bhakta, James Anderson

Experiments were performed to study turbulent mixing of an iodine seeded detonation event. Three imaging techniques, schlieren, imaging spectroscopy, and particle image velocimetry, offer methods to visualize the flow environment. Schlieren provides a method to understand the flow features through refractive index changes. However, schlieren does not distinguish whether the refractive index changes are due to density changes or
chemical species changes. Imaging spectroscopy was performed simultaneously to record absorption spectra to determine changes in the chemical composition within the field of view. Test data includes shock velocity, plume size, and relative iodine concentration for a series of detonation events. With a low-cost design using multiple laser heads, a third optical approach, particle-imaging velocimetry, is in development to capture mixing directly.

2017-051: Modeling Stress-Strain Relationships for GaAs

Michael Rimada-Menasco

Quantum confinement in wide band gap semiconductors has been established for heterostructure quantum well devices. A new approach for creating lateral quantum confinement in all directions using heterostructure devices is currently being explored. The technique is called press and print quantum dot fabrication. The substrate is an InGaAs quantum well grown on GaAs using molecular beam epitaxy. It is pressed against a Si nanopillar indenter array using a custom mechanical press. It is then annealed at high temperatures during which the areas where the pillars are loaded, Indium is selectively diffused away. Upon unloading the sample quantum dots of indium are expected to form.

During indentation of the substrate, the relationship between deformation leading to strain, which then leads to stress and then ultimately solid state diffusion is being explored. Most deformation and strain relationships are obtained using a load vs. deformation model. The load vs. deformation model, in which an indenter presses down on a surface, only focuses on deformation depths at the surface of the material. However, since the quantum well of the substrate is buried beneath a capping layer more information is needed as to the deformation that occurs at various layers beneath the surface of the substrate.

2017-053: Data Collection and Internet Traffic at NNMC

Nathan Torrez

The world around us is constantly changing. As time goes on, more and more people are connecting to internet. In order to meet demands, there is more emphasis on building faster networks able to sustain the increasing internet traffic. There are many challenges that face the network here at Northern New Mexico College. There is frequent congestion in the network because of the increasing amount of traffic. Data is currently being analyzed from the border router, which could help Northern plans for the future.

2017-059: Developing Resistance Against Phytophthora capsici in Chile Pepper Using Genetic Engineering Techniques

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Chile pepper is an important cash crop in New Mexico, and is rich in plant derived chemical compounds that are known to have disease preventing and health promoting properties. Chile peppers are susceptible to different phytopathogenic fungi, bacteria and viruses. *Phytophthora capsici* is known currently to be the cause of the most catastrophic disease in chile, and the most significant threat to chile production. There are some chile cultivars that are resistant to *P. capsici*, such as CM 334. However, the resistance trait has not been successfully transferred to other susceptible cultivars which have other desirable characteristics by traditional breeding. The resistant cultivars have a resistance (R) gene that is induced following interaction with the pathogen. This interaction leads to induction of defense genes encoding for enzymes making antimicrobial metabolites collectively known as phytoalexins. A gene encoding an enzyme that plays a key role in the synthesis of the phytoalexins has been isolated and engineered for expression in chile. The engineered gene has been introduced into *Agrobacterium tumefaciens*. The engineered *A. tumefaciens* has been used in a transient assay to check for the functionality of the transgene to confer resistance to *P. capsici* in a susceptible chile cultivar. We have also transformed susceptible chile with the engineered *A. tumefaciens* using a modified, stable *A. tumefaciens* mediated transformation system developed in our Laboratory. We have obtained several independent chile plants in tissue culture. We will present the data obtained from the transient assay and chile transformation.
2017-063: Synergistic Approaches to Anti- Candida Drug Discovery
Shishir Acharya

Candida albicans is a commensal fungi which acts as an opportunistic pathogen when the host is immunocompromised. Human candidiasis destroys the mucous membrane in oral, gastrointestinal and vaginal tracts. Infection can be invasive as this fungal organism can pass through the bloodstream and infect different organs. Since both the host and Candida are eukaryotes, the development of Candida-selective drugs has been exceptionally challenging. We have evaluated a series of novel Polygodial and IM analogues for direct toxicity against Candida. Further search of synergy, these Polygodials were combined with other compounds including IMs, Anethole, Polymyxin B, Collistin and Poly-l-lysine (PLL). The results showed that Polygodial and IM compounds alone display direct toxicity to Candida at high concentration. However, a combination of certain IMs with PLL led to synergistic enhancement of Candida growth inhibition. While none of the compounds showed any toxicity to mammalian cells in culture, IM5 and IM7, both at 6 µM, proved to kill Candida in combination with PLL at 2.5 µg/ml. This demonstrates that IM5/IM7 synergize with PLL against Candida albicans and offers a novel approach towards development of anti-Candida therapies.

2017-067: Highly Efficient Fluorescence Quenching of Dye by Defect Rich Molybdenum Disulfide
Bradley Miller

Fluorescence quenching of dye molecules near molybdenum disulfide (MoS$_2$) can be used as a probe to investigate the nature of electron or energy transfer between any fluorescent molecules and MoS$_2$. The efficiency of defect rich (DR) and defect free(DF) few-layer MoS$_2$ in quenching of two different dye molecules, with different molecular structures and absorption/emission profiles, a red fluorescent dye 4-(dicyanomethylene)-2-methyl-6-(4-dimethylamino styryl)-4H-pyran (DCM) and a green fluorescent dye fluorescein sodium salt in an aqueous solution is tested. The optical absorption spectrum of DF MoS$_2$ exhibits multiple discrete absorption bands as expected from their band structure. However, for DR MoS$_2$ there were not any observable distinct strong absorbance peaks in the wavelength range of 300nm to 900nm. A simple assay that measures the quenching efficiency of these MoS$_2$ on fluorescent dyes was used when both are mixed together in solution at different concentrations. Under these conditions, steady state measurements reveal that the quenching efficiency of DF MoS$_2$ is higher for fluorescein dye emitting near the strongest absorption peak of MoS$_2$ around 400 nm. The quenching effects due to DF MoS$_2$ are dynamic in nature as the fluorescence can be recovered by separating out DF MoS$_2$ from solution. Most interestingly, the quenching efficiency of DR MoS$_2$ was significantly higher than DF MoS$_2$ for fluorescein. However, DR sample shows no discrete absorption features near the emission wavelength of Fluorescein. The fluorescence quenching properties of DR MoS$_2$ are, therefore, found to be distinct from few-layer MoS$_2$. We hypothesize that since defects, such as vacancies, are active centers for molecular adsorption, it may be forming ground state complexes with dye molecules. The second reason may be that hindered electron mobility in DR MoS$_2$ increases dielectric loss in DR MoS$_2$, hence can increase the fluorescence quenching effect. Further experiments are underway to confirm our hypothesis.

2017-070: Visual Techniques for Identification of Fungal DNA Using Computational Programming
Simone Hill

We used NetLogo 5.1.0 (Center for Connected Learning and Computer-Based Modeling), to build a program that read text files of fungal ITS DNA sequences and created visual maps of these sequences in order for the identification of the species. Preliminary testing of the model has shown it to be an easy-to-use, visual alternative that may be particularly useful for undergraduate students in understanding and visualizing differences among fungal taxa.

Iterative testing of the model was conducted by producing maps of 5.8S and ITS2 regions of 21 different fungal sequences, 3 species from each of 7 orders, and comparing those maps to one another. The original hypothesis – that the program could be used for identification of species using only their 5.8S regions – was not supported by the results that have been produced. Outlying sequences in the results were found to be not credible, so those were replaced with credible sequences. Furthermore, after only very credible sequences were used, it was apparent that the model could not be used to determine order either, when using only the 5.8S regions.
Therefore, the project will be continued for the purpose of identification at the order level using revised methods that include shifting a constant 140 base-pairs until a combination of the more conserved 5.8S region and the more variable ITS2 region allows for more accurate differentiation among fungal orders.