Alex Abbott
Ouachita Baptist University
Biology (BI)
Undergraduate Student
Yes

Characterizing a Putative Mycobacteriophage Toxin-Antitoxin System

Alex Abbott, Ruth Plymale

Bacteria are under recurring threat of bacteriophage infection and possess defense systems to fight off these viruses. Surprisingly, these anti-phage defense systems may be encoded by prophage, bacteriophage DNA that has been integrated into a bacterial cell, thereby protecting the host bacterial cell from superinfection. Mycobacteriophage Xeno encodes a putative toxin-antitoxin (TA) system expected to defend against mycobacteriophage infection when Xeno is incorporated as a prophage in Mycobacterium smegmatis mc2155, forming the lysogen Mycobacterium smegmatis mc2155 (Xeno). The goal of this research is to identify which mycobacteriophage this putative TA system defends against, by screening more than 60 mycobacteriophage on M. smegmatis mc2155 and M. smegmatis mc2155(Xeno). Individual bacteriophage will be spotted on lawns of M. smegmatis mc2155 or M. smegmatis mc2155 (Xeno) and the number of plaques will be counted and used to determine infection rate. If a phage produces 10x to 1000x more plaques on M. smegmatis mc2155 than M. smegmatis mc2155 (Xeno), we will conclude that this phage is defended against by the TA system of the Xeno prophage. We will present the findings of our phage screening trials and our conclusions about the defensive range of the Xeno TA system.

Joseph Akers
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

Process Engineering: 3 Dimensional ColorSpace Correction

Joseph Akers

This project was developed to analyze information pertaining to the color of an industrially manufactured product and provide corrective measures to achieve an ideal product. L.A.B. ColorSpace operates in 3 Dimensions, represented by the shape of a cylinder. Following the circular face is a color scheme similar to the RGB color wheel, while the third, vertical dimension, indicates the light/darkness of the identified color. L.A.B ColorSpace functions well when tasked with nonlinear responses and uniform changes in perceived color

Joseph Akers
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

The Effects Of Weather On Insurance

Joseph Akers, Paul Niyonkuru

One could make the assumption that there would be a variance in the average insurance premium of private property based on the frequency at which it is exposed to exceedingly inclement weather, such as straight-line winds, tornadoes, drought, etc; However, how localized can this assumption be made, as the limiting area is already restricted to the state borders of Oklahoma, is it possible that environmental history and climatic occurrences significantly impact insurance premiums on a county or even city district scale?

Variables such as average property value and relative location will be taken into account, as insurance for a home in Oklahoma City will vary drastically from more rural locations due to the placement of the home. Other variants include the multiple divisions of insurance, such as Home and Crop overages.

John Bentley
Philander Smith College
Chemistry (CH)
Undergraduate Student
Yes

Theoretical Semi-empirical Calculations of Ethylenediaminetetraacetic acid (EDTA) bound Metal Complexes Modeled for Heavy Metal Poisoning

John Bentley, Christopher Taylor, Cynthia Burroughs, Joseph De Soto, Insu Frank Hahn

Exposure to Lead (Pb), Mercury (Hg), Chromium (Cr), Arsenic (As), Chromium (Cr), and Iron (Fe) can cause heavy metal poisoning. EDTA (ethylenediaminetetraacetic acid) based inorganic chemical chelation therapy has been used to treat the heavy metal poising by capturing toxic heavy metals in the cardiovascular and lymphatic systems. These chelated metal complexes are then excreted through the urine. In this study, 3-D molecular modeling for controlled EDTA and Cr3+ and Fe3+ chelated with EDTA were performed for their theoretical thermochemical bond stability via AM1 (Austin Model 1), PM3 (Parameterized Model number 3), and MNDO (Modified Neglect of Diatomic Overlap) in gas and water phases. It was found that PM3 was a better computational approximation method of examining thermochemical stability and reactivity of EDTA vs. AM1 and MNDO, based on the data comparison with the reported ΔHfo (heat of formation) of the control EDTA. No difference in ΔHfo for the modeled molecules tested between gas and water phase by each calculation method was observed. The newly obtained comparative thermochemical data in this study revealed that a stability order based on the obtained ΔHfo for the liganded complexes between EDTA and target heavy metals was ETDA-Cr3+ > EDTA-Fe+3. This may not only allow for a better understanding of chelation therapy related chemistry, but for the applications of new chelating agents.

Charles Bertram
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

Potential Differences in Problem Solving Approaches When Using Different Textbooks

Charles Bertram, Andrew Mason

Part of a long-term study on factors that impact biology and behavioral health science student attitudes toward introductory physics courses, this project focuses on the impact that changing textbooks has had on student problem-solving skills.

Tyler Bowman
University of Arkansas
Engineering (EN)
Graduate Student
No

Terahertz Pulsed Imaging of Freshly Excised Xenograft Breast Cancer Tumors in Mice

Tyler Bowman, Narasimhan Rajaram, Keith Bailey, Magda El-Shenawee

Terahertz (THz) imaging has recently emerged as a promising methodology for many biomedical imaging applications including the detection of cancer. Specifically, research using pulsed (time-domain) THz systems has been shown to be effective in distinguishing between cancerous and healthy tissue of excised breast cancer tumors for both fresh and formalin-fixed, paraffin-embedded specimens, and thus THz shows potential for intraoperative margin assessment during breast cancer lumpectomies. However, there is a need to further develop the methodology for imaging fresh tissue before THz devices can be incorporated into a surgical setting. This work makes use of freshly excised murine xenograft tumors as a cost-effective and highly controlled source of fresh tissue for building THz imaging methods of breast cancer. Several C57BL/6 strain mice are maintained on a high fat diet (D12492 from Research Diets, Inc.) in order to promote fat deposits similar to human breast tissue. Once the mice reach a suitable size, they are then injected with E0771 mouse-derived breast adenocarcinoma cells from the American Type Culture Collection (ATCC). Following 3-4 weeks of growth, the xenograft tumors are then excised and imaged within one hour of surgical removal. The tumors are imaged first as bulk tissue and then bisected in order to image a cross-section of the tumor. The two tumor halves are then stored in formalin and sent to the Oklahoma Animal Disease Diagnostic Lab for paraffin-embedding and histopathology processing.

Comparison between THz imaging of freshly excised tissue and subsequent pathology assessment has shown a strong differentiation between breast cancer tissue regions and healthy fat tissue, and further imaging of the paraffin-embedded tumor sections provides additional support of the use of THz for detecting breast cancer. The imaging methodology developed in this work can be applied to imaging freshly excised breast cancer tissue from human patients in the future.

Shelby Bridges
University of Central Arkansas
Chemistry (CH)
Undergraduate Student
No

Towards a Chlorin-Based Fluorophore Synthesis for Pharmacokinetic Diagnosis in Neglected Tropical Diseases

Shelby Bridges, Emily Tran, Gregory Naumiec

Neglected Tropical Diseases (NTDs), such as leishmaniasis, Chagas disease and sleeping sickness, are a class of diseases that receive a low grade of attention. These diseases usually incubate within third world countries where there are few medical resources and money is scarce, but because these diseases have been neglected for so long we are seeing their reach of pestilence spread into Northern Mexico and even reported cases in Southern United States. Many of these NTDs have similar symptoms such as skin lesions, ulcers in the organs and intestinal problems, leading to misdiagnosis of diseases and loss of crucial treatment time. The diagnostic avenues for most NTDs require routine blood work for 24 months, which can be almost impossible in nomadic communities still somewhat common in many third world nations. Due to multiple components, including the lack of drugs and common misdiagnosis of these NTDs, drug resistance is rapidly increasing.

Our aim is to develop a chlorin-based fluorophore, active in the near infrared (NIR) spectrum, capable of accurately diagnosing NTDs efficiently. A NIR diagnostic method was chosen due to the fact that it is relatively inexpensive compared to other diagnostic methods, such as MRI, PET and SPECT, as well as much faster than a full blood panel. Low cost and readily delivered diagnostics is very important due to the fact that the treatment of these diseases will be done in rural countries with few medical avenues. When using deep tissue applications of the fluorophore, light has the deepest tissue penetration from 600-900 nm in the NIR spectra. This total fluorophore synthesis consisted of over ten steps, but was broken down into two separate halves that incorporated together at the end of the synthesis. The fluorophore will then be tethered to a synthesized substrate that has high affinity towards one of the aforementioned NTDS allowing the fluorophore to act as a pharmacokinetic tracker and a diagnosing agent.

Timothy Brown 106
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

Precipitation totals and the effect on Soil Temperature

Timothy Brown, Garrett McKamie

Water possesses many characteristics, such as a high specific heat capacity, which makes water a good thermal insulator. When rain falls on bare soil, the water layer on top of the soil will insulate the ground underneath, lowering the temperature of the soil. The hypothesis of this study assumed that there would be a direct correlation between months with higher average rainfall and months with lower average are soil temperature. This will be accomplished by analyzing data from “mesonet.org”, and comparing monthly averages to see if a correlation can be determined between the amount of rainfall and the surface soil temperature. Furthermore, how these variations can affect growth and yield of different crops.

Blake Bryant
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

Correlation of Average Temperature vs. Consecutive Temperature to Drought Conditions in the Oklahoma City area

Blake Bryant, Garrett Tyndall

The Oklahoma Mesonet and Weather Underground databases contain comprehensive data for seasonal extreme heat statistics and drought conditions, which play an important role in the agricultural well-being of the Oklahoma City area. By comparing the average number of days with highs above 90 and 100 °F and the consecutive number of days with highs above 90 and 100 °F to drought conditions, correlations were identified. The information obtained from these correlations gives insight into what has the most impact on the onset and sustainment of drought conditions in the Oklahoma City area, and what impact they might have on the agricultural industry.

Mallory Bryant
Harding University
Chemistry (CH)
Undergraduate Student
Yes

Identifying the Structure of Fat-Mobilizing Substance (FMS-1) Associated with Congenital Lipodystrophy

Mallory Bryant

A fat mobilizing substance is present in the urine of fasting individuals. It is believed that the same fat mobilizing substance is found in the urine of people who suffer from congenital lipodystrophy. A sample of urine from an individual with congenital lipodystrophy was obtained and purified. It was separated into fractions on an HPLC using size exclusion chromatography. All fractions were analyzed for fat-mobilizing activity using an adipocyte-cell kit that tested for glycerol production. Based on these results, select fractions were submitted for MALDI and LC-MS analysis. Future research involves analyzing standards of known fat-mobilizing substances along with collecting well-fed and fasting samples from different demographics.

Kaitlynn Butler
University of Central Arkansas
Biology (BI)
Undergraduate Student
Yes

Glucose Mediates Early-Life Stress Resistance in *C. elegans*

Kaitlynn Butler

Caenorhabditis elegans, a commonly used model organism, is a small free living soil nematode that is easy to cultivate in a lab and possess a short (~30 day) lifespan as well as remarkable disease conservation pathways between itself and higher order organisms. Lifespan and stress resistance assays are often employed under varying nutritional availabilities to examine the impact of the nutrient or lack thereof on the organism's lifespan and stress resistance. Glucose, which has been shown to decrease lifespan in *C. elegans*, was added the dietary media of four strains (N2, eat-2, hsd-3, and eat-2;hsd-3). These were mildly stressed at 35ºC for 7 hours at the L4 stage of life and then kept at 20ºC for the remainder of the experiment, moved away from larvae, and scored for number alive until all worms had died. Interestingly, an significant increase in stress resistance was observed for both the eat-2 and eat-2;hsd-3 strains instead of the hypothesized decrease. We propose that glucose provides energy to enhance the activation and continuation of an early life stress response in *C. elegans*.

Jacob Cameron
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

Determining Black Hole Mass of Active Galactic Nuclei using FWHM of the H-β Emission Line and Luminosity Relations

Jacob Cameron, Debra Burris

At the center of some active galaxies are super-massive black holes and for some time the accepted method of measuring the mass of such galaxies has been the method used by Vestergaard and Peterson, among others. By using the luminosity function which is related to H-

Howden Carly
Hendrix College
Biology (BI)
Undergraduate Student
Yes

Impact of Bakken/Three Forks unconventional oil and gas development on important wildlife landscapes in North Dakota

Carly Howden, Taylor Stone, Varenya Nallur, Maureen R. McClung, Matthew D. Moran

Unconventional oil and gas production (i.e. horizontal drilling and hydrofracturing) has expanded rapidly since the year 2000 with tens of thousands of well drilled across the United States. One important region is the Bakken/Three Forks Formation, a tight oil play that has made North Dakota one of the top U.S. oil producing states. The expansion of unconventional oil and gas has caused great concern among conservationists, in particular the extensive land-use development and fragmentation that accompanies this industry. We measured the development patterns caused by oil and gas activities on two important wildlife habitats in North Dakota: public lands and prairie potholes. Our measurements showed that about 3,000 hectares of public lands have been developed from unconventional oil and gas while edge habitat has increased by 30 km and average fragment size has declined by 0.70%. Surprisingly, public land development was actually occurring at higher proportions compared to private lands. Very few prairie potholes were directly impacted by this activity, but distance to development declined for almost 1/3 these wetlands. These land-use changes, while modest, are likely having a negative impacts on native wildlife, and considering future well drilling rate projections, could increase substantially. We urge the public and governments to consider the value of these lands and develop regulatory mechanisms to minimize future long-term negative consequences to North Dakota wildlife

Nathan Carmichael
Harding University
Biology (BI)
Undergraduate Student
Yes

Caenorhabditis elegans hermaphrodites have reduced stress tolerance when grown in the presence of residual male pheromones

Amber Adams, Kinsey Baker, Garrett Bryant, Nathan Carmichael, Jessica Johnson, Joe Tolar, Jo Goy

Reproduction is a fundamental characteristic of all organisms. The reproductive strategy an organism utilizes is in large part determined by environmental factors. For example, stable environments in which food is abundant and ephemeral changes are rare may find that asexual reproduction allows for large populations of individuals genetically suited for the ambient conditions. In the wild populations of the soil nematode, *Caenorhabditis elegans*, are primarily composed of asexually reproducing hermaphrodites. However, in the lab populations exposed to stressful conditions such as starvation, elevated temperature and over crowding result in an increase in the number of males in the population. This observation is congruent with the theoretical prediction that sexual reproduction and genetic recombination is beneficial in stressful environments. However, sexual reproduction may carry costs. Hermaphrodites grown in the presence of males, or on plates pre-conditioned by males, have a shortened lifespan suggesting physiological changes occur when hermaphrodites are exposed to pheromones deposited on the plates by males. To better understand the physiological changes occurring to the hermaphrodites we assessed the ability of adult wild type *C. elegans* to tolerate heat stress following exposure to male pheromones. We cultured hermaphrodites of increasing age on plates pre-conditioned by male worms. Here we show that hermaphrodites grown in the presence of male pheromones are significantly less heat tolerant compared to unexposed controls even at post reproductive senescent age.

Megan Cassingham
Hendrix College
Chemistry (CH)
Undergraduate Student
Yes

Water adsorption on montmorillonite: Comparison of washed and unwashed clays

Megan Cassingham, Ryan Tumminello, Courtney Hatch

Montmorillonite clay readily adsorbs water and acts as a cloud condensation nucleus (CCN) while suspended in the atmosphere. Previous studies have shown that the existence of pre-adsorbed water significantly affects the CCN activity. It was suggested that the difference in CCN activity measured from wet and dry-generated mineral aerosols was due to rearrangement of soluble material within the particles upon nebulization from an aqueous suspension. The work reported here attempts to explore this hypothesis further by measuring water adsorption on montmorillonite clay before and after rinsing with 18 MÎ© water and methanol. Chloride and nitrate ions were monitored using Ion Chromatography (IC) in successive rinses. Horizontal attenuated total reflectance Fourier transform infrared (HATR-FTIR) spectroscopy equipped with a flow cell was used to monitor water adsorption on the rinsed and unrinsed montmorillonite samples. Adsorbed water content was measured as a function of relative humidity (RH) and analyzed using type II adsorption isotherms, including Brunauer Emmet and Teller (BET), Frenkel Halsey and Hill (FHH), and Freundlich adsorption isotherms.

Kassandra Cendejas
Arkansas Tech University
Chemistry (CH)
Undergraduate Student
Yes

In Silico Predictions of Conformations and Orientations of Small Molecules within a Macrocycle

Kassandra Cendejas, Rajib Choudhury

We have examined conformations and orientations of small molecules (guest) within a water-soluble macrocycle (host) known by the trivial name Octa Acid (OA). Docking program Vina, which was originally developed for screening drug-like molecules, has been used to identify binding modes and affinities of select guest molecules with OA. Hydrophobic guests were encapsulated into the nonpolar cavity of OA capsule owing to solvophobic interactions. Amphiphilic guests were bound by keeping the nonpolar part within the cavity of OA, while pointing the polar anionic group out of the cavity. All these results obtained from the docking study were in accord with experimental findings. The post-complexation attributes of the guests were regulated by available free space and the specific interactions between guest-OA pair, which led to unusual conformations and orientations. This study showed that scoring function available with Vina, which was derived from protein-ligand data set, could successfully predict post-complexed structural features of guests within OA, thus opening opportunities to modulate physical and chemical behavior of guest molecules.

Berk Cetinsaya 72
University of Arkansas - Little Rock
Computer Science (CS)
Graduate Student
Yes

Design of Virtual Endoluminal Surgery Simulator (VESS)

Berk Cetinsaya, Mark A. Gromski, Melih Turkseven, Doga Demirel, Tansel Halic, Coskun Bayrak, Cullen D. Jackson, Suvranu De, Mandeep Sawhney, Daniel Jones

Endoscopic Submucosal Dissection (ESD) is an endoscopy technique for en bloc resection of large lesions (>20mm). ESD is a widely-used technique in Japan, but not as prevalent in Europe or the United States currently. The procedure is technically challenging and entails high risk due to complications such as perforations and aggressive bleeding. Inadequate training platforms and lack of established training curriculums specific to the ESD procedure restricts its wide acceptance in the US. Therefore, we aim to develop a Virtual Endoluminal Surgery Simulator (VESS) for ESD procedures. VESS platform will enable training of the complete procedure preliminary focusing on colorectal tumors starting at the injection step and followed by dissection of the lesion. The ultimate goal of VESS is to provide a realistic training and assessment platform with providing highly realistic visualization of rectum and high fidelity. In the context of this work, we performed a thorough task analysis to determine the critical procedural steps for the design of VESS. We have identified major ESD steps and detailed each including any possible variations in the technique. As a part of our task analysis efforts, we constructed hierarchical task tree that elaborates the order of tasks in these steps with cognitive actions. The metrics will be incorporated and used in our validation studies of VESS simulator for performance score computation. As the peculiarities of lesions such as size/shape/location have significant impact of the completion time, which is often used as a performance measure in metrics, we generate three dimensional virtual models for various tumors respecting the commonly used tumor classifications. We achieve realistic ESD instruments-lesion interaction with our custom designed haptic device. The electromechanical interface with 2-degrees of freedom manipulates a dummy endoscope to provide the users with haptic feedback during the simulation.

Reese Childers
University of Central Arkansas
Computer Science (CS)
Graduate Student
Yes

Low-Delay Rate Control for H.265/HEVC Video Compression

Reese Childers, James Palmer, Joseph Hilton, Yu Sun

Ever since the invention of 4k and HD TV's, there has been a great need to improve the performance of international video compression standards. High Efficiency Video Coding (HEVC)/H.265 is the most recent video compression standard. Unfortunately while its methods for compressing data have improved, the current methods for rate control of H.265/HEVC are nearly the same as they were in its predecessor H.264. In this research, we investigate a new rate control algorithm for H.265/HEVC and conduct performance evaluation. Our research objective is to efficiently control encoding bitrates so as to meet the channel bandwidth, while maintaining optimum encoding quality. Different from traditional approaches which use buffer control in target bit estimation, our proposed rate control algorithm predicts target bits directly without using buffer control. This is accomplished by calculating the target bitrate through an improved initial target bit estimation, then using a Proportional-Integral-Derivative (PID) bit controller to adjust encoding bitrates. Our extensive experimental results have demonstrated that our proposed algorithm outperforms the rate control algorithm of H.265/HEVC by achieving more accurate rate regulation and obtain higher encoding quality.

Stephen Chordas III
Ohio State University
Biology (BI)
Faculty / Researcher
No

Literature record checklist of true bugs (Hemiptera) for Arkansas with the first report of *Pseudopachybrachius vinctus* (Rhyparochromidae) (also Oklahoma) and an analysis of Miridae sex ratio from light traps.

Stephen Chordas III, Renn Tumlison, Chris McAllister

A current literature record checklist of the true bugs (Hemiptera) of Arkansas is provided. It has been almost 30 years since the 1988 True Bug catalogue was published and over 100 new bug records for Arkansas have been published since then. A problem is that the 1988 catalogue is missing many early published records for Arkansas. We address the missing records problem and provide a single current source for referencing Arkansas bug records. Further, we add a new Arkansas (and Oklahoma) record for the dirt-colored seed bug *Pseudopachybrachius vinctus* (Rhyparochromidae). Additionally we provide an analysis of the sex ratio of Miridae (plant bugs) captured in light traps.

Ethan Clement
University of Central Arkansas
Biology (BI)
Graduate Student
No

EXPRESSION OF OCT4 AND NANOG IN HUMAN FIBROBLASTS WITH SHORT TELOMERES

Ethan Clement, Calin Marian

The biological aging of somatic cells causes shortening of telomeres due to the end replication problem. Critically short telomeres can signal cells to enter into senescence, a cell state defined by the cessation of cellular division. We seek to understand the changes that occur in cells that undergo replicative senescence; specifically, the impact of critically short telomeres on the expression of self-renewal factors. Using RT-PCR and immunofluorescence we observed regulative changes and localization of transcription factors OCT4 and NANOG, in human fibroblast with critically short telomeres. RT-PCR data shows NANOG, but not OCT4, is upregulated in human fibroblast with critically short telomeres; while preliminary immunofluorescent imaging indicates increased nuclear localization of NANOG. Our results suggest NANOG may play a key signaling role as cells become senescence due to telomeric loss. Elucidating NANOG's signaling role in senescence may be key to understanding cellular aging and potentially lead to the development of new anti-cancer treatments.

Stetson R. Collard
Arkansas Tech University
Biology (BI)
Undergraduate Student
Yes

Evaluating the Effects of Bird Feeders on Songbird Plumage Coloration

Stetson R. Collard, Douglas G. Barron

Approximately 43% of United States households regularly feed birds. This practice is becoming increasingly popular, largely because people view bird feeders as a way to connect with the natural world around them. The bright colors exhibited by birds catch the attention of birdwatchers and serve a critical role in attracting mates, yet very little is known about the effect of bird food on plumage coloration. This is surprising considering that plumage coloration is known to be influenced by the quantity and quality of food consumed. Specifically, the production of colorful plumage is expected to be energetically expensive, meaning that only birds with abundant food consumption are able to afford the costs of producing colorful plumage; this idea of condition-dependent plumage coloration has garnered considerable theoretical and empirical support. Similarly, most red, orange, and yellow colors come from carotenoid pigments that can only be derived from the diet, meaning birds that consume more of these pigments are better able to deposit them into their feathers. This project aims to test the hypothesis that the individual birds which utilize bird feeders most frequently during the winter months will be in better condition at the time of molting and thus will molt more colorful breeding plumage. Across the Arkansas Tech University campus, we have established bird feeders and placed automated radio-frequency identification (RFID) readers on the feeders that will monitor the feeding activity of tagged birds. We have begun catching birds and using photographs to quantify their plumage coloration, and will present our findings to compare this coloration to feeding activity. If bird food does influence plumage coloration it would carry scientific and societal implications, and as such could enhance our understanding and conservation of songbirds.

Matthew Connior
Northwest Arkansas Community College
Biology (BI)
Faculty / Researcher
No

Survey of Rodents within Arkansas Game and Fish Commission Wildlife Management Areas

Matthew Connior, Renn Tumlison, Douglas Holland, John Hunt, Lance Durden, Blake Sasse

We collected rodents from 15 Arkansas Game and Fish Commission (AGFC) Wildlife Management Areas (WMA). A total of 329 rodents was collected representing 10 species. Currently, field identifications of 97 individuals have been verified to species. We report 2 new county records, reproductive data, and ectoparasites from the survey.

Matthew Connior
Northwest Arkansas Community College
Biology (BI)
Faculty / Researcher
No

New Records of Parasites (Apicomplexa, Acari, Anoplura, Nematoda) from Rodents in Arkansas

Matthew Connior, Lance Durden, Chris McAllister, Robert Seville, Charles Bursey, Henry Robinson

We surveyed select species of rodents from across the state for both endoparasites and ectoparasites. We document a coccidian, 5 species of chiggers and mites, one species of sucking louse, and a nematode from various rodents in Arkansas. Two new host and 6 new geographic records are reported.

Matthew Connior
Northwest Arkansas Community College
Biology (BI)
Faculty / Researcher
No

The Fleas (Arthropoda: Insecta: Siphonaptera) of Arkansas

Chris McAllister, Lance Durden, Henry Robison, Matthew Connior

Fleas (Insecta: Siphonaptera) are important ectoparasites of dogs, cats, other mammals (including humans), and birds, and are an important component of the biota of North America. In addition, they can be nuisance biters and serve as vectors of several flea-borne disease agents and parasites that negatively affect higher vertebrates. In Arkansas, there have been no recent comprehensive summaries of fleas in the last 35+ years. Here, we provide a summary of the 29 species of fleas that have been recorded from the state, update their taxonomy, and note their medical and veterinary importance.

Dakotah Cooper
Southern Arkansas University
Chemistry (CH)
Undergraduate Student
Yes

Analyzing the Properties of Biodiesel.

Dakotah Cooper, Gija Geme

High cost of diesel fuel in the early 2010s triggered a new search for alternative fuels, thus expanded the need for biodiesel research. It is apparent that every known form of biodiesel lacks in providing the same level of performance as petroleum based diesel. The main goal of this research is to analyze properties of biodiesel such as density, energy released upon ignition, viscosity, and stability as a way to understand where biodiesel lacks compared to petroleum based biodiesel.

A biodiesel sample was synthesized at Southern Arkansas University using canola oil, methanol, and sodium hydroxide, as a catalyst, and about a 500 mL sample was obtained. This sample was washed to remove any impurities and molecular sieves were used to absorb any excess water. At that point, the sample was tested using a bomb calorimeter and hydrometer.

Biodiesel research at Southern Arkansas University first began in the Spring of 2015. Over this time period the method of synthesizing biodiesel has been improved, a calorimeter constant was obtained for the Bomb Calorimeter, and the calorie count and density were obtained. Plans are being made to continue with the viscosity and stability studies.

Seth Cooper-Baer
University of Central Arkansas
Computer Science (CS)
Undergraduate Student
Yes

Arthroscopic Rotator Cuff Surgery Performance Comparison Study of Novices and Experts

Doga Demirel, Seth Cooper-Baer, Mustafa Tunc, Tansel Halic, Sinan Kockara, Nizamettin Kockara, Mark Edward Rogers, Shahryar Ahmadi

Shoulder arthroscopy is a minimally invasive surgery aimed at repair of the shoulder muscles and joints. Repair of the rotator cuff is one of the most common arthroscopic procedures. The rotator cuff is one of the groups of muscles that provide mobility and stability to the arm. A damaged rotator cuff can cause pain, constraint of movement, and weakness of the arm. We have been developing a virtual simulator for rotator cuff procedures. Our long-term goal is to perform validation studies with human subjects to determine effectiveness of our virtual simulator. The validation studies require authentic performance measurement metrics of surgery. In an effort to develop dependable metrics, we have constructed a quantitative grading metric and conducted video analysis of the surgeries performed by expert and novice surgeons. Ten shoulder arthroscopic rotator cuff surgeries performed by novice and fourteen arthroscopic rotator cuff surgeries performed by expert surgeons were analyzed and evaluated by three blinded raters. After comparing expert and novice surgeons', the results revealed that novice surgeons used surgical tools approximately 10% less effectively, identify and stop bleeding less swiftly. Novice surgeons were found to complete 40% of the tasks in grading metrics and skipping several tasks such as identifying the anchor location. We also noted that novice failed to achieve clear vision at all times. Our results showed that there is significant difference in performance score between the experts and novice.

Lauren Corby
University of Arkansas - Pine Bluff
Physics (PH)
Undergraduate Student
Yes

Renewable Energy in Research and Education

Lauren Corby, Eleni James-Becton, Seyed Amir Ghetmiri, Seyed Taghavi, Wei Du, Fisher Yu, Mansour Mortazavi

As people go through their everyday routines, they never really realize how much energy is used or even stop to think about where that energy comes from. “Over 85 percent of energy used in the United States comes from fossil fuels”, according to the U.S. Department of Energy. When put into perspective, one can see that these fuels are used to power everything from the cars they drive to the electricity in their homes. However, what many fail to understand is how much harm can come from these fossil fuels. As these fuels are converted into energy they produce emissions that pollute our environment. However, there are alternatives that provide energy without its harmful output, which is called renewable energy. A few of these options being solar panels, wind power, hydroelectric energy, biomass, hydrogen cells, and geothermal power. Renewable energy is slowly taking hold in the United States and could possibly replace fossil fuels completely in the future.

Kendall Davis
Hendrix College
Biology (BI)
Undergraduate Student
Yes

A comparison of the impacts of wind energy and unconventional gas development on land-use and ecosystem services: An example from the Anadarko Basin of Oklahoma, USA

Kendall Davis, Michael Nguyen, Maureen McClung, Matthew D. Moran

The United States energy industry is transforming with the rapid development of alternative energy sources and technological advancements in fossil fuels. Two major changes include the growth of wind turbines and unconventional oil and gas. We measured land-use impacts and ecosystem services costs of unconventional gas and wind energy development within the Anadarko Basin of the Oklahoma Woodford Shale, an area that has experienced large increases in both energy sectors. Unconventional gas wells developed three times as much land compared to wind turbines (on a per unit basis), resulting in higher ecosystem services costs for gas. Gas wells had higher impacts on intensive agricultural lands (i.e. row crops) compared to wind turbines which had higher impacts on natural grasslands/pastures. Because wind turbines produced on average less energy compared to gas wells, the average ecosystem cost per gigajoule of energy produced was almost the same. Our results demonstrate that both unconventional gas and wind energy have substantial impacts on land-use, which likely affect wildlife populations and ecosystem services. Although wind energy does not have the associated greenhouse gas emissions, we suggest that the direct impacts on ecosystems and land conservation efforts are similar to unconventional fossil fuels. Considering the expected rapid global expansion of these two forms of energy production, many ecosystems are likely to be at risk.

Kyle Davis
University of Central Arkansas
Biology (BI)
Undergraduate Student
Yes

Rwandan Societal Improvements via the Use of Rocket Stoves

Kyle Davis, Lindsay Jefferson, Jake Linna

This research is investigating the levels of CO2 emissions from rocket stoves and three-stone fires used in Kanembwe, Rwanda.. Most cooking in Kanembwe is done using a three-stone fire, which is very simple to set up; however, due to it being an open fire, more wood is consumed and more smoke is produced than when using a rocket stove. Previous studies conducted in Kanembwe show that the rocket stoves reduce wood consumption by approximately 30% (unpublished data). While study participants report reduced smoke exposure from the rocket stoves, we do not yet have quantitative data concerning the CO2 emissions. We propose the utilization of a rocket stove as an alternative method of food preparation and hypothesize that CO2 emissions will decrease. CO2 emissions from both methods will be measured by using a CO2 sensor. One primary objective is to develop a cost-effective and easily transportable method for measuring emissions in the field. This preliminary testing will be performed at UCA with the goal of eventually conducting the experiments in Kanembwe.

Nicholas Dial
University of Central Arkansas
Biology (BI)
Graduate Student
No

Physiological effects of lead nitrate on four Arkansas native plant species and the role of Arbuscular Mycorrhizal Fungi on plant stress mitigation

Nicholas Dial, Richard Noyes, Katherine Larson

The nature of human activity such as resource mining, fossil fuel combustion, and synthetic chemical use are adding excess heavy metals and nutrients to urban soils. Different plant species have shown varying degrees of physiological responses to growing in contaminated environments. Arbuscular Mycorrhizal Fungi have demonstrated the ability to ameliorate stress responses in plants by enhancing nutrient uptake capability, secreting metal chelating agents, and increasing the surface area available for roots to mine nutrients and water. Phytoextraction is the process in which plants take up soil contaminants through their roots and store them in their tissues. This study aims to evaluate phytoextraction potential of four Arkansas native plant species, *Cleome hassleriana*, *Juncus effusus*, *Helianthus annuus*, and *Typha latifolia*. Plants will be grown in pots in a greenhouse and the soil will be spiked with three concentrations of lead nitrate – a common urban contaminant. Half of the pots will be treated with AM Fungi culture. Phytoextraction capability will be measured by digesting plant tissues in solution and measuring contaminant concentration via atomic absorption spectroscopy. The physiological responses to contamination will be measured by leaf anthocyanin and chlorophyll concentration, chlorophyll fluorescence efficiency, and growth rate. We hypothesize that the pots cultured with AM Fungi will have a higher chlorophyll/anthocyanin ratio, higher chlorophyll fluorescence efficiency, and higher growth rate. We also hypothesize that each of these responses will decrease with increasing concentrations of lead nitrate. This study will further our understanding of how native plants respond to soil contamination, the role that AM Fungi plays in stress amelioration, and whether or not these species should be further investigated for phytoremediation potential.

Kandria Driskill
Arkansas State University
Biology (BI)
Undergraduate Student
Yes

Body shape variation within and among lineages of the Rainbow Darter, *Etheostoma caeruleum*

Kandria Driskill, Kyle Dineen, Brook Fluker

The Rainbow Darter (*Etheostoma caeruleum*) is distributed widely throughout the eastern United States, with several disjunct populations in the lower Mississippi River drainage. An unpublished morphological study of *E. caeruleum* suggested several potentially distinct species in the White River drainage and in tributaries of the lower Mississippi River drainage. However, published phylogeographic studies are not concordant with morphological data. This study used geometric morphometrics to evaluate body shape differences of *E. caeruleum* across its range. Specifically, we asked whether differences in body shape corresponded to previously identified lineages or putative species based on meristic data. Preliminary results based on populations from loess habitats of Crowley's Ridge in Arkansas (St. Francis River drainage) and upland habitats of the Ozark Highlands (White River drainage) revealed some overlap in body shape between distinct lineages. However, disjunct populations from Crowley's Ridge were somewhat differentiated from other populations based on the distinction of the nuchal hump. Results from this study will provide valuable information about the distinctiveness of potentially unrecognized diversity within *E. caeruleum*.

Recep Erol 74
University of Central Arkansas
Computer Science (CS)
Graduate Student
Yes

A Gentleness Simulator for Surgical Dexterity Evaluation of Surgeons with Haptic Interfaces

Recep Erol, Doga Demirel, Tansel Halic, Sinan Kockara, Kevin Sexton

Background: For many types of surgical procedures force-feedback is critical. Force-feedback is an aptitude that permits the surgeon to apply appropriate tension during delicate surgical procedures and avoid excessive or unnecessary damage to surrounding anatomical structures. Each surgeon develops unique adaptation mechanisms with special perceptual and motor skills. This skill development becomes even more intricate for minimally invasive surgeries such as laparoscopic/arthroscopic surgeries. Gentleness is one of the key adaptation mechanisms, which can be used to measure skill level of a surgeon. Gentleness indicates how much a surgeon learned to adequately interpret visual information in 3D-space, how learning is reflected on his/her movements based on force-feedback, and how appropriately he/she modifies the amount of force applied. There are currently several gentleness simulators that have limited maneuver capabilities such as palpation/pulling. Results: In this study, we develop two 3D-virtual scenarios with bimanual haptic interfaces to measure gentleness of a surgeon. We utilize a pair of haptic devices to help continuously quantify dexterity of a surgeon on any movement with any interactions in 3D-virtual-scene. These movements help us identify skill level of a surgeon. Conclusion: Based on the feedback/suggestions given from experienced surgeons in the Department of Surgery at UAMS, we have built two unique virtual scenarios; tennis-racquet/double-grasper simulators with integrated haptic force-feedback. While the user performs the given task, user hand movements along with the applied force are continuously recorded until completion of the task. The degree of realism of soft body kinetics and physical interactions have been created by using the SoFMIS framework and Nvidia's PhysX SDK. After extensive data collection/analysis of surgeons/residents, we successfully measure skill level of a surgeon and gentleness.

Deion Everhart 28
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Biology (BI)
Undergraduate Student
Yes

Western Spruce Budworm Herbivory Influences Stream Macroinvertebrate Structure And Biomass

Deion Everhart, Claudy Sarpong, Clay Arango, Sally Entrekin

Stream-riparian interactions are often mediated by leaf litter inputs. In the Pacific Northwest, herbivorous Western Spruce Budworm (WSB) outbreaks have increased in intensity and extent along riparian areas of managed Douglas-Fir forests. We predicted high rates of WSB herbivory in riparian areas would increase microbial production and food resources of macroinvertebrates through increased amounts and lability of leaf litter inputs as frass and intensified solar radiation from canopy damage. We used stable isotopic signatures of possible macroinvertebrate food sources (Frass, FBOM, CBOM, algae, and moss) to identify contribution towards growth. We also identified macroinvertebrates from quantitative samples for community structure and biomass. Preliminary data shows total frass-derived macroinvertebrate biomass was greater in low WSB stream (600 mg/m2) from more collectors compared to the high WSB stream (100 mg/m2). However, the percent of frass-derived biomass was greater in the high WSB stream (28%) than low WSB stream (9%). The results suggest WSB activity upstream may have contributed to the unexpected contribution of frass in the low WSB stream and frass appears to be an important food resource for consumers.

Candice Foscue
University of Central Arkansas
Chemistry (CH)
Undergraduate Student
No

Synthesis of Amino Acid Radical Precursors

Candice Foscue, Cade Gurley, Jarett Duvall, Nolan Carter

Biomolecules such as proteins are subject to damage by reactive oxygen species such as hydroxyl radical. This process has been implicated in aging and disease. The reaction of hydroxyl radical with proteins is complex since hydroxyl radical is non-specific and can attack many sites within the polypeptide chain and at different sites within a given amino acid. Due to this non-specificity, studying the role played by specific radical intermediates in protein damage is difficult. The goal of this project is to synthesize radical precursor compounds that facilitate the study of this process. We are currently synthesizing compounds to photochemically produce specific amino acid radicals. The compounds in the present study are designed to generate the valine radicals of interest via photochemical cleavage of a labile C-Se bond. One of the radical precursors has been previously synthesized and the synthesis is currently being repeated and optimized. The synthesis of another radical precursor compound is currently in progress and the key step involves reduction of an intermediate oxime derived from a selenium-containing α-oxoester. The monomeric amino acid radicals produced from these precursor compounds will serve as models for the corresponding radicals formed within a protein and facilitate study of radical-mediated protein damage.

Abigail Gatmaitan
Hendrix College
Geosciences (GS)
Undergraduate Student
Yes

Quantification of levoglucosan in PM2.5 atmospheric aerosols using GC/MS: Seasonality of a biomass burning tracer in Central Arkansas

Abigail Gatmaitan, John Gann, Jake Higgins, Dagen Hughes, Courtney D. Hatch

Biomass burning is known to have detrimental effects on air quality and climate. The radiative balance of the Earth is significantly impacted by biomass burning aerosols that can directly and indirectly affect climate through scattering and absorbing radiation and acting as cloud condensation nuclei, respectively. The total concentration of biomass burning aerosols on a global scale is unknown and highly variable, but thought to be a significant contributor to cardiopulmonary illnesses. Levoglucosan is a stable biomass burning tracer that can be accurately measured in aerosol particles and serves as an indicator that the collected air mass has been influenced by biomass burning. Here, we report on the quantitative analysis of levoglucosan in PM2.5 atmospheric aerosols collected in a high-volume aerosol sampler on the Hendrix College campus in Central Arkansas. Samples were collected on quartz-fiber filters over seven-day periods followed by extraction, derivitization and analysis by GC-FID. Filters were extracted into methanol, dried using a N2 evaporator, and reconstituted/derivatized with pyridine and BSTFA with 1% TMCS. Results suggest that seasonal biomass burning affects air quality in Arkansas, particularly during the fall when residents burn yard waste.

Landon Gatrell
University of Central Arkansas
Biology (BI)
Graduate Student
No

Glucose-Mediated Neuroprotection Against Proteotoxicity is Energy-Dependent in *Caenorhabditis elegans*

Landon Gatrell, Mindy Farris

Alterations in protein folding may lead to aggregation of misfolded proteins, ultimately leading to toxicity and cell death. Protein aggregation has been shown as a normal consequence of aging, but it is largely associated with age-related disease, particularly neurodegenerative diseases like Alzheimer Disease (AD) and Huntington Disease (HD). The model organism *Caenorhabditis elegans* has been extensively used to study aging and progression of these neurodegenerative diseases. Under normal circumstances, glucose enrichment shortens *C. elegans* lifespan; however, recent research suggests that glucose actually provides some protection against cell stress, including proteotoxicity related to aggregation. Using *C. elegans,* we will investigate glucose-mediated neuroprotection against protein misfolding phenotypes including accumulation of ubiquitin-tagged protein aggregates and cell death.

Garrott Granholm 101
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

The Lagrangian and Hamiltonian formulation of the Linear Oscillator Chain

Garrott Granholm

The physical system consisting of a linear chain of N oscillators with fixed boundary conditions was analyzed using the Lagrangian formulation of classical mechanics. The Euler-Lagrange equations were solved as an eigenvalue problem to determine the eigenfrequencies and the normal modes of the linear chain and the equations of motion. The Lagrangian was then expressed in terms of the normal coordinates to derive the dispersion relation. The linear chain, expressed in terms of the normal coordinates, was also analyzed using the Hamiltonian formulation. Finally, a program was written in Maple to determine the eigenfrequencies and normal modes of the linear chain for arbitrary N and to animate the equations of motion.

Garrott Granholm
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

Air Temperature/ Dew Point vs. Frequencies of Tornadoes

Garrott Granholm, Thomas Cameron

Although not fully understood, tornadoes generally form within thunderstorms when atmospheric conditions become unstable. The likeliness and potential that each tornado could have is dependent upon the storm cell. Using data from Mesonet, our purpose in this analysis is to determine if there is a relationship between air temperature and dew point versus the frequency of tornadoes.

Adam Hargis 71
University of Central Arkansas
Chemistry (CH)
Undergraduate Student
No

The Synthesis of Natural Product-based Drugs to Treat a Neglected Tropical Disease: Leishmaniasis

Adam Hargis, Sean Stokes, Gregory Naumiec

There has been little research done in the area of creation of new and improved treatments for neglected tropical diseases. Neglected tropical diseases are communicable diseases that occur in tropical and subtropical areas. These diseases affect more than a billion people around the world. Research into new drugs to combat neglected tropical diseases is important because treatments are limited. Our focus is specifically on the disease Leishmaniasis. The symptoms of leishmaniasis include weakness, cough, long lasting fever, decreased production of red blood cells, bleeding and large open sores. This research will focus on the development of natural product based drugs to treat leishmaniasis. An improved, and safer process for the synthesis of Espintanol has been developed. A medicinal chemistry approach is currently being applied to the production of Espintanol type of drugs. Altering the Espintanol can be done to yield new anti-parasitics with properties to kill the Leishmaniasis parasites. Our goal is to develop a drug that is not toxic and is very potent to fight Leishmaniasis.

Crystal Haynes
University of Arkansas - Monticello
Biology (BI)
Undergraduate Student
Yes

Soil Crust Algal Communities of Warren Prairie Natural Area

Crystal Haynes, Rachel Knight, Caleb Lamb, Brent Baker, Marvin Fawley, Karen Fawley

Some species of the alga Nannochloropsis and its sister genus, Microchloropsis, are the only the Eustigmatophyceae known to inhabit marine environments. The Eustigmatophyceae clearly had freshwater origins, so these two genera likely evolved from an ancestral form that transitioned from freshwater to marine. However, one lineage within Nannochloropsis has apparently transitioned back to freshwater from the marine environment. Previous studies using sequences of the plastid rbcL gene have shown that the freshwater forms are somewhat more taxon rich than the marine members of the genus. In this study, we examined the diversity of freshwater Nannochloropsis using additional strains and additional loci. For all strains, we sequenced the plastid loci rbcL and ccsA. We also sequenced the additional plastid locus ccs1 for exemplar strains. Our results show that both ccsA and ccs1 have approximately twice as many substitutions as rbcL. Analyses of these data indicate that Nannochloropsis has rapidly diversified upon transition to freshwater, whereas marine taxa show a pattern consistent with slow phyletic diversification. To our knowledge, this is the first algal example of either extraordinary divergence or adaptive radiation upon transition from marine to freshwater.

Hayley Heacox
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

Mechanical and Chemical Alterations in Rat Leg Bones upon Exposure to Simulated Microgravity and Cosmic Radiation

Hayley Heacox, Jordan Barajas, Sidney Freyaldenhoven, Rahul Mehta, Brent Hill, M. Dobretsov, P. Chowdhury

It is known that space conditions such as microgravity and cosmic radiation have detrimental effects on the skeletal system of humans. This research studied the alterations in mechanical properties, elasticity, and chemical properties, calcium and phosphorus content, of rat femur and tibia bones when exposed to hind-limb suspension (simulated microgravity) and x-ray irradiation (simulated cosmic radiation). Three-point bending was employed to estimate the elastic modulus of the leg bones. A Scanning Electron Microscope (SEM) was utilized to take cross-sectional images and to perform energy dispersive x-ray spectroscopy (EDS). Trending lower elasticity was observed for most treatment groups compared to controls throughout three data sets suggesting these conditions lead to bones more susceptible to fracture. Variant concentrations of calcium and phosphorus were tracked throughout the leg bones; typically, decreases in these minerals compared to controls were observed throughout the femoral bone while increases in these minerals compared to controls were observed throughout the tibia. Further studies of combined effects of microgravity and cosmic radiation on bone characteristics are required for the development of countermeasures, pharmaceutical or physical, to mitigate the negative effects of spaceflight.

Mallory Heft
Arkansas Tech University
Biology (BI)
Undergraduate Student
No

The Effect of Habitat Fragmentation on *Sceloporus consobrinus*-Praire Lizards Located in Central Arkansas

Sarah Tomke, Mallory Heft

Habitat fragmentation constitutes a threat towards the genetic diversity of wildlife organisms. Population fragmentation arises from human infrastructures such as roads, houses, and other developments, but can also occur due to natural landforms such as rivers and mountains. Anthropogenically caused fragmentation results in the isolation of populations of organisms making it more difficult for individuals to migrate between them, which in turn restricts gene flow. Frequent gene flow increases genetic diversity by introducing new alleles or genes into a population. Low genetic diversity has been found to be correlated with increased extinction rates. We sought to discover the effects of population fragmentation as a result of both human and natural causes on the genetic diversity of populations of *Sceloporus consobrinus*-commonly called prairie lizards-in central Arkansas. To compare genetic variation, over 350 blood samples were collected from 18 populations of *Sceloporus consobrinus*. DNA will be extracted from each blood sample and amplified at thirteen microsatellite regions through polymerase chain reactions (PCR). Individuals will be genotyped at each microsatellite. Genetic diversity of lizard populations will be compared to determine if gene flow exists between populations. Our research will shed light on whether habitat fragmentation is actively effecting *Sceloporus consobrinus* in central Arkansas. This research can give insight into how habitat fragmentation is affecting reptile species, which is an important endeavor as reptile extinction rates continue to rise.

Ashley Henderson
University of Central Arkansas
Biology (BI)
Undergraduate Student
Yes

Enzyme Production and Hormone Signaling Mediate Longevity Responses to Dietary Restriction in C. elegans

Ashley Henderson

Caenorhabditis elegans is an excellent model for longevity experimentation and has an extended lifespan under dietary restriction (DR) conditions. Additionally, their stress response as a function of age can be measured. We studied DR and heat stress applied to young (1 day old) wild type (N2) worms and mutants in an isoform of 3Î2-hydroxysteroid dehydrogenase, hsd-3. It was previously shown that worms exposed to a heat stressor exhibit increased thermotolerance under DR using bacterial deprivation (BD), compared to media with a bacterial food source (E. coli). BD conditions can be technically difficult, with worms lost to non-age-related deaths. We used a novel alternative method: minimal media (MM) lacking peptone. We compared lifespans and heat stress resistance for N2 and hsd-3 worms using regular media and MM, with and without E. coli. We found N2 had shorter mean lifespans than hsd-3 on the BD plates, although not statistically significant. Surprisingly, the fed hsd-3 worms lived longer than the hsd-3 worms under DR, suggesting that hsd-3 may be required for DR-mediated lifespan extension. In addition to showing the effects of hsd-3 signaling in DR pathways, we show that the MM condition is comparable to BD, and easier to use in the laboratory.

Steward Huang 8
University of Arkansas - Fort Smith
Biology (BI)
Faculty / Researcher
No

Central Nests are More Successful and Preferred for Reuse than Peripheral Nests in Cliff Swallow (*Petrochelidon pyrrohonota*) Colonies

Shelby Osborne, Douglas R. Leasure, Steward Huang, Ragupathy Kannan

Predator avoidance is a major factor influencing nest site selection in birds. Cliff Swallows are common colonial nesting birds in summer in North America. They construct oblong mud nests mainly under bridges and overpasses. Old nests from previous years are frequently reused. Previous studies have documented snake predation in these colonies, with nests located at the edge being more vulnerable to predation than those at the periphery of the colonies. We tested the hypothesis that Cliff Swallows prefer to nest more in the center of a colony than the periphery. We predicted that if the hypothesis is true, 1. There will be more nests in the central vs. peripheral zones, 2. There will be more tiered or stacked nests in the central vs. peripheral zones, and, 3. Central nests, due to frequent reuse, would have higher masses than peripheral nests. We conducted field work in a bridge colony at Massard Road in Fort Smith, Arkansas (Sebastian County) in the summer of 2016. All nests on both sides of the bridge were counted, removed, and weighed. The colonies were photographed before removal. The "center" of the colony was defined as the mid 50% of the length of the colony, and the "edge" was defined as 25% of that length on both sides of the colony. Our data strongly supported our research hypothesis. All three of our predictions were met. There were more nests at the center (109) than the edge (86); there was just one set of 4 stacked nests at the edge compared to eight sets of 2-6 stacked nests in the center; and finally, in terms of mean weight and weight range, central nests were heavier [572 gms±179 (259-1360, n=109)] than edge nests [511 gms±123 (246-830, n=86)] (mean, std., range, sample size). Our study shows that Cliff Swallows have a clear preference to nests in the center of colonies.

Billy Huggins
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Biology (BI)
Undergraduate Student
Yes

Influence of Common Salt Concentrations on Detritivore Respiration

Billy Huggins, Ashton Brass, Matt Gifford, Sally Entrekin

Salinization of freshwater increases the osmoregulatory stress of aquatic organisms that has resulted in species loss. Osmoregulatory stress of detritivores can also change their function by increasing respiration and changing their consumption of detritus. Together, detritivore responses to sub-lethal increases in salts can change the carbon cycle. The principle of allocation predicts that detritivores will not expend as much energy on growth and reproduction when under osmoregulatory stress, indicating lower potential for carbon cycling. We predicted that low salt concentrations would cause no change, medium concentrations would increase respiration, and high concentrations would decrease macroinvertebrate detritivore respiration. Macroinvertebrates will be placed in microcosms containing stream water with four concentrations (unimpaired, 3 mg/L; low, 6 mg/L; medium, 13 mg/L; high, 26 mg/L) of NaCl and NaHCO3. Detritivore acute and prolonged respiratory responses will be measured over a five week period. We will present our findings as detritivore average rate of respiration across salt concentrations. A significant change in the rate of respiration suggests that increasing salt concentrations are likely to alter detrital processing and may contribute to species loss.

Alan Jackson
Arkansas Tech University
Biology (BI)
Undergraduate Student
No

The Effects Of Trpc3 Channel Activation On Vascular Tone In Healthy Arteries Versus Diseased Arteries

Jonathan Billings, Alan Jackson, Jamie Dalton

Understanding how ion channel activity affects vessel tension is important for elucidating the causes of systemic hypertension, one of the leading forms of cardiovascular disease in the United States. The focus of this study is the effect of TRPC3 channel activation on peripheral arteriole tension in healthy versus diseased vasculature.

TRPC3 channels are a type of calcium channel that induce endothelial derived hyperpolarization to potentiate vasodilation, and therefore, decrease systemic blood pressure (Senadheera et al, 2012). However, if the endothelial layer is missing due to vascular disease, smooth muscle TRPC3 channels can be activated instead of the endothelial channels. Directly activated muscle cells contract instead of relax decreasing vessel diameter (Senadheera et al, 2012; Adebiyi et al, 2010; Abramowitz and Birnbaumer, 2009). In peripheral arterioles, this effect would increase blood pressure.

Our hypotheses are that TRPC3 channel activation in arterioles with intact endothelium will induce vasodilation, and TRPC3 channel activation in arterioles with denuded endothelium will potentiate vasoconstriction. We are testing our hypotheses by performing isometric tension studies using a wire myograph, and analyzing the data using LabScribe software.

The procedure for measuring isometric tension requires dissecting mesenteric arterioles from rats, removing the adipose connective tissue from the vessels, and then mounting the vessels on transducers by cannulating them with two 40 micron diameter wires and attaching the wires to the transducer jaws. To simulate diseased vasculature, the endothelium is removed by gentle rubbing with the cannulation wires.

The transducers sit in a 5 milliliter chamber that is filled with physiological saline. Vessel tension is normalized by inducing a series of contractions and relaxations until a basal level of tension is achieved. Then a TRPC3 channel agonist or antagonist is applied, and tension is measured.

Kristen Jones
University of Central Arkansas
Biology (BI)
Undergraduate Student
Yes

The effect of simulated microgravity on the biophysical properties of the tibia

Kristen Jones, Brent Hill, William Fuell, Rahul Mehta

Simulated microgravity has been linked to a decrease in bone density and strength. Our lab has previously shown that estrogen depletion leads to a decreased bone density and volume. The objective of this study is to determine the effects of microgravity on the biophysical properties of the tibial bone in female mice. Female mice (4-month old) underwent an overiectomy (OVX, n=7)) or SHAM (n=8) surgery. They were then suspended in a harness to simulate weightlessness in their hindlimbs (HLU). Food and water intake ($p>0.05$) was monitored throughout the HLU period. After 3-weeks of HLU, the mice were sacrificed. Plasma estrogen (E2), plasma corticosterone (CORT), uterine weight, and body weight was measured. The body weight was similar between groups. The OVX uteri (31±0.10 mg) was less than the SHAM group (81 ±16 mg); however, the plasma E2 and CORT levels were the same. We are currently using Three-point bending to quantify the mechanical properties (breaking point, stress, stiffness, and elasticity) of the tibia.The hindlimb unloading model allows an in detail analysis of the physiological mechanisms of the skeletal response to not experiencing weightbearing loads. This study has applications in the field of space research, simulating the effects of space flight.

Peter Joseph
Philander Smith College
Chemistry (CH)
Undergraduate Student
Yes

Theoretical Thermochemical Bond Stability of EDTA Chelation with Metal Ions for Chelation Therapy to Treat Heavy Metal Poisoning

Peter Joseph, Sean Brandon, Myoungtaek Kwon, Joseph De Soto, Insu Frank Hahn

Exposure to metals such as lead (Pb), mercury (Hg), chromium (Cr), arsenic (As), iron (Fe), etc. can cause heavy metal poisoning. EDTA (ethylenediaminetetraacetic acid) based inorganic chemical chelation therapy has been used to treat the heavy metal poising by capturing toxic heavy metals in the cardiovascular and lymphatic systems. These chelated metal complexes are then excreted through the urine. Here, theoretical semi-empirical AM1 (Austin Model 1), PM3 (Parameterized Model number 3), and MNDO (Modified Neglect of Diatomic Overlap) calculations for the newly constructed 3-D models of controlled EDTA and EDTA with Pb+2, Hg2+ and As3+ were conducted in gas and water phases to investigate the intrinsic thermochemical coordination bond properties, ie., stability and reactivity, via MOPAC (Molecular Orbital Package) simulations. It was found that PM3 was a better computational approximation method for examining thermochemical stability and reactivity of EDTA complexes vs. AM1 and MNDO methods, based on the data comparison with the reported ΔHfo (heat of formation) of the control EDTA. No difference in ΔHfo for the modeled molecules tested between gas and water phase by each calculation method was observed. The newly obtained comparative thermochemical stability order in this study based on the obtained ΔHfo for the liganded complexes between EDTA and target heavy metals was ETDA-Hg2+ > EDTA-Pb+2 > EDTA-As3+. This data would indicate that the EDTA based chelate therapy works most favorably with mercury and follows the stability order found, which will also contribute toward new chelate therapies and its applications.

Kenneth Jumper
University Of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

Neutron capture elements in low metallicity stars within the inner-galactic halo.

Kenneth Jumper, Dr. Debra L Burris, Justin Seymour

The inner galactic halo is home to some of the oldest, most metal poor stars in the Galaxy. The purpose of this research is to analyze the distributions of neutron capture elements in low metallicity stars to aid in the understanding of the first stars. These stars are responsible for the chemical enrichment of the Galaxy. Heavy element formation is connected to stellar evolution. This demonstrates that these stars were not synthesized internally but a result of previous deaths of stars, generations before. This in turn provides useful information about the first star's formation, evolution and nucleosynthesis of stars, and the arrangement of the structure of the early Universe. The most r-process rich halo star's abundances are consistent with a scaled solar system r-process abundance distribution. Also, there is symmetry in the rare earth elements in the stars within the Galactic halo. However, the lighter n-capture abundances don't conform to the expected r-process pattern. This suggests the possibility of multiple synthesis mechanisms for the n-capture elements. The combinations could include the main r-process, V-P process (core collapsed super-novae), charged particle reactions with Beta delayed fission, and the weak r-process. The weak r-process is sometimes called the incomplete r-process does not have enough neutrons to supply the reaction for heavier elements. The elemental abundances of metal poor stars are calculated using MOOG's spectral synthesis program. Using the measured abundances and by observing the chronometric ages of the distributions of Thorium/Europium, one can determine the age of the oldest stars. Analyzing the distribution of Uranium and Thorium as chronometers can set a lower limit on the age of the Universe.

Stacy Justice
University of Arkansas - Monticello
Chemistry (CH)
Undergraduate Student
Yes

Determination of Fatty Acid Concentrations in Algae

Stacy Justice, Donnell White, Drake Palazzi, Jessica Lester, Haley Koenig, Andrew Williams

Algae are of scientific and commercial interest due to their ease of culture and high fatty acid content. It is reasonable to assume that different strains of algae contain different types and concentrations of fatty acids. Of interest is the fatty acid content contained within various algal strains in the class Eustigmatophyceae. The extracted fatty acids may be of potential use for phylogenetic classification of new algal species, in addition to human consumption and producing next-generation biofuels. Algal strains were collected and isolated from Lake Chicot in Arkansas, Tower Pond and Lake Itasca at Itasca State Park in Minnesota, and Thayer Lake in the upper peninsula of Michigan. The strains collected were subjected to a 5-step process for lipid preparation: lypholization, lipid extraction, filtration, esterification, and methyl ester extraction. The fatty acid extracts were analyzed using GC-MS. After qualitative determination of fatty acids by mass spectrometry, relative quantities of the fatty acids were determined by peak integration, and tricosanoic acid (C23:0) was used as a standard to determine absolute quantities. Preliminary results show differences between algal strains via relative fatty acid concentration.

Haley Kay
University of Central Arkansas
Chemistry (CH)
Undergraduate Student
Yes

Measurement of multicomponent aerosol optical properties using pulsed laser cavity ring-down spectroscopy

Haley E.D. Kay, Jessica DeYoung, Amanda N. Jarman, Justin A. Land, Kristin S. Dooley

Aerosol particles in the atmosphere impact the climate through light absorption and scattering processes. Currently, the radiative forcing by aerosols contributes significantly to uncertainty in climate models. More detailed optical measurements of particles of non-uniform size, composition, and chemical structure would aid in reducing this uncertainty. Cavity Ring-Down Spectroscopy (CRDS) is an optical absorption technique that is ideal for measuring extinction coefficients as well as scattering and absorption parameters for atmospheric aerosols. Optical experiments using various sizes of polystyrene spheres at 355 nm and 532 nm will be compared to Mie scattering calculations in order to characterize the CRDS instrumentation. Unfortunately, basic Mie scattering calculations fail when used to model non-uniform samples, and various correction techniques must be included. Multicomponent particles, varying in size and composition, can be produced using current generation techniques and will be used as a comparison to calculated results. Because most atmospheric aerosols are multi-component, a better understanding of how to theoretically treat them will lead to more accurate models of real-world aerosol interaction with light.

Ha Ram Kim
University of Central Arkansas
Biology (BI)
Undergraduate Student
Yes

Regulation of symbiotic gene expression in rice

Ha Ram Kim, Raj Singh, Arijit Mukherjee

Soil microbes especially fungi and bacteria cycle nutrients and water to plants, to our crops, the source of our food, and ultimately our health. Unfortunately, the soil microbiota is under constant threat due to overuse of fertilizers, fungicides, pesticides, and heavy tillage to boost crop productivity. Nutrient pollution in water is one of America's most widespread, costly and challenging environmental problems, which can have diverse and far-reaching impacts on public health, the environment, and the economy. Clearly we need alternatives to these harmful fertilizers for improving crop productivity. Biological Nitrogen Fixation (BNF) is increasingly being viewed as a viable alternative for supplying N to plants and improving yield and overall plant health. Several reports have shown that in rice the BNF comes from species of *Azospirillum, Herbaspirillum*, and *Azorhizobium* etc. The replacement of fertilizers with N-fixing plant growth-promoting bacteria could save billions of dollars per harvest. Unfortunately, our understanding of how plants respond to rhizospheric endophytic bacteria is very poor. We clearly need specific studies that will identify host plant genes during interactions with rhizospheric bacteria that can fix N for the plant. Our specific objective for this project is to identify differential gene expression in rice roots during colonization by N fixing bacteria, *Azorhizobium, Azospirillum* and *Herbaspirillum*. This will identify candidate plant genes involved during symbioses with these beneficial bacteria. Towards these goals, we have already set up an experimental system to study these host-microbe interactions. Recently, we performed an RNA Sequencing experiment in rice roots upon colonization with Azorhizobium. We identified 1135 differentially expressed genes and we validated the expression pattern of a few genes via RT-PCR. In the future we aim to identify the host genetic pathway controlling these interactions with beneficial bacteria.

Min Kim
University of Central Arkansas
Computer Science (CS)
Undergraduate Student
Yes

JD Humanoid Robot

Min Ji Kim, Kristen Nguyen, Caroline McNutt, Jonghyung Shin, Aaron Oh, Yu Sun

In recent years, with advanced technology plus the vast investments in researching, robotics has been developing with a rapid rate. It is obvious that robots are all around more than ever before. They interact with us in many aspects of our lives from basic industrial machines to out-of-space robots that help with the tasks that human cannot physically operate. With that being said, we were motivated to learn how a robot functions, and what it takes to develop and gets the robots to do the desired tasks. In this project, we investigate the robot called EZ JD Humanoid Robot to perform specific instructions by developing programs using its available sensors and motors. The process throughout our JD Humanoid project included researching, implementing, and testing the methods on the robot to achieve its ability to dance to a chosen song, recognize certain faces, and identify certain colors/shapes. Programming, facial and colors/shapes recognition are utilized to make these abilities feasible. We realized that some of the simple tasks such as walking or colors recognition that humans can do easily, are a lot harder for a robot (an unconscious object) to replicate. Working with JD has made us appreciate what the robotics scientists and developers have been able to do in real life with existing robots. Overall, the whole project has been valuable regarding gaining fundamental knowledge of robotics as well as enhancing experience on coding skills.

Angela Lenard
University of Central Arkansas
Biology (BI)
Graduate Student
Yes

Longitudinal patterns in an Arkansas River Valley stream: testing the River Continuum Concept

Angela Lenard, A. Burgad, S. Clark, M. Furr, M. Polett, C. Robinson, C. Sherwood,
G. Spooner, S. Stoughton, S. Adams

The River Continuum Concept (RCC) provides the framework for studying how lotic ecosystems vary from headwater streams to large rivers. The RCC was developed in Appalachian streams, but watershed natural characteristics and land use differ across ecoregions, presenting unique opportunities to study how the predictions of the RCC may differ across regions. Additionally, RCC predictions may vary due to the influence of fishes, but few studies have used fish taxa as a metric for evaluating predictions of the RCC. Our goal was to determine if RCC predictions were supported by primary producer, macroinvertebrate, and fish communities in Cadron Creek of the Arkansas River Valley. We sampled macroinvertebrates, fishes, and chlorophyll a at five stream reaches across a gradient of watershed size in the Cadron Creek watershed. As the RCC predicts, fish and macroinvertebrate diversity increased with catchment size. Contrary to RCC predictions, chlorophyll a did not increase in concentration with catchment size. Shredding and collecting macroinvertebrate taxa supported RCC predictions, respectively decreasing and increasing in composition as catchment area increased. Herbivorous and predaceous fish did not follow RCC predictions; however, surface/water column feeding fish were abundant at all sites as predicted. We hypothesize many predictions of the RCC were not supported by Cadron Creek due to regional differences in watershed natural characteristics and altered resource availability due to land use surrounding sampling sites.

Sravani Marreddy
University of Central Arkansas
Computer Science (CS)
Graduate Student
Yes

Educational Drones: Mini-Drone TRAVIS by Parrot

Sravani Marreddy, PadmaPriya Jaladi, Yu Sun

Nowadays educational drones are becoming more and more popular in sparking the curiosity and stimulating learning interest for kids in STEM. Drones with high-end technical features such as app controlling, filming and object detection will entertain, engage, and inspire kids to learn science and engineering. In this project, we investigate the educational mini-drones developed by Parrot Company with different models, and build programs using different applications available in the market. Within this project, our goal is to introduce and demonstrate the mini-drone named Travis to young students and teach them learn logic and block based programming. We have discovered mobile app control TYNKER that is available for both Android and iOS devices. We have developed programming projects and tutorials for young students to learn and play. During our out-reach activities, such as science nights and robotics camp, we found that TYNKER is an effective educational tool that let kids develop programs to control this mini-drone. Many of young students showed great interest about learning and playing with the mini-drones.

Lindsey Martin
Arkansas State University
Biology (BI)
Undergraduate Student
Yes

Effects of Black-spot Disease on the Body Condition of Bleeding Shiners, *Luxilus zonatus*

Lindsey Martin, Brook Fluker

Black-spot disease is common in freshwater fishes and results from encystment of digenetic trematodes into the fins and flesh of the fish. The fish serves as an intermediate host in the life cycle of the trematode, and deposits melanin around the cyst as an immune response, producing the black spots for which the disease is named. Several studies have documented the occurrence of black-spot disease on game fishes, but little known about how the trematode infestations affect the health or body condition of small stream fishes. The objective of this study is to evaluate the prevalence of black-spot infection in the Bleeding Shiner (*Luxilus zonatus*) throughout Myatt Creek, a tributary to the Spring River in northeastern Arkansas. Specimens collected in the 1970s were obtained from the Arkansas State University Museum of Zoology (ASUMZ) and examined for abundance and location of black-spot infection. Infection rates will be compared to body condition (weight/length ratios) and overall body shape using geometric morphometric techniques. In order to compare potential changes in infection rates in Myatt Creek over the past 40 years, ASUMZ specimens collected in the 1970s will be compared to freshly collected specimens.

Chris McAllister
Eastern Oklahoma State College
Biology (BI)
Faculty / Researcher
No

An Annotated Checklist of the Crayfishes (Decapoda: Cambaridae) of Arkansas

Henry Robison, Keith Crandall, Chris McAllister

Previous to the present study, 56 species with 3 additional subspecies for a total of 59 different taxa were recognized from Arkansas. We add a single species (*Fallicambarus schusteri*) to that list, subtract a documented synonym (*Procambarus ferrugenius* a synonym of *Procambarus liberorum*), update the classification to better reflect recent phylogenetic insights, and provide an updated annotated checklist of the 58 taxa of crayfishes presently known to occur in the state. There are 8 endemic species in Arkansas and include the Bayou Bodcau Crayfish (*Bouchardina robisoni*), Boston Mountains Crayfish (*Cambarus causeyi),* Hell Creek Cave Crayfish (*C. zophonastes*), Jefferson County Crayfish (*Creaserinus gilpini*), Ouachita Burrowing Crayfish (*Fallicambarus harpi*), Slenderwrist Burrowing Crayfish (*F. petilicarpus*), Saline Burrowing Crayfish (*F. strawni*), and Redspotted Stream Crayfish (*Faxonius acares*). There are also 2 Federally Endangered Species, the Benton County Cave Crayfish (*Cambarus aculabrum*) and the Hell Creek Cave Crayfish (*C. zophonastes*) that inhabit Arkansas karst habitat. We expect that additional species will be included in the list with further DNA analyses.

Scotty McKay 31
University of Central Arkansas
Biology (BI)
Undergraduate Student
Yes

Immunolocalization of the Cadherin 18 Protein in Fetal Kidney Cells

Scotty McKay, Calin Marian

Cadherins are typically thought of as being transmembrane proteins that participate in cell to cell adhesion. This was well documented for Type I cadherins (such as E-cadherin) but not for all cadherins. Type II cadherins lack the HAV region present in Type I cadherins which plays a critical role in the cell's adhesion functions; this leads us to believe that Type II cadherins perform roles that are different than Type I cadherins. Our hypothesis is supported by prior research that suggests that some Type II cadherins may play major roles in cancer and early morphogenesis. By learning more about the roles that Type II cadherins play in human cells, we could gain a greater understanding of bodily processes and disease development that these Type II cadherins may be involved in. The protein that we are specifically interested in is a Type II cadherin known as cadherin 18 (CDH18). For this project, we are using human embryonic kidney cells that were transformed to over-express CDH18 as well as a GFP tag. One characteristic of cadherin 18 we are researching is where it accumulates within these cells. In order to do this, we are using primary antibodies specified to CDH18 and secondary antibodies with attached fluorophores. Using a fluorescent microscope, we can visualize CDH18 which brings us one step closer to uncovering CDH18's cellular function and gives us a better understanding of the processes it is involved in.

Alexandria Melton
University of Central Arkansas
Biology (BI)
Undergraduate Student
No

Comparative genomics of the Paraburkholderia bacterial symbionts of the social amoeba *Dictyostelium discoideum*

Alexandria Melton, Mercedes Dillard, Frank Griffin, Suegene Noh, Joan Strassmann, David Queller, Tamara Haselkorn

Microbial partners can have dramatic effects on their hosts' health, ecology, and evolution. While such symbioses are common among eukaryotes, it is still not clear how these associations start and the mechanisms by which they are maintained. The soil-dwelling amoeba *Dictyostelium discoideum* is a model for studying the mechanisms of bacterial infections, and has many different interactions with bacteria in nature: bacteria are prey, pathogens, and symbionts. The ability to interrogate these host-microbe interactions makes *D. discoideum* (Dicty) an excellent model for studying the dynamics of symbiosis. One symbiont of Dicty is in the genus *Paraburkholderia* (formerly *Burkholderia*). Several different strains of *Paraburkholderia* are able to survive amoebal digestion and confer the ability for normally sterile Dicty to carry food bacteria with them inside their spores. Then, if the spores land in an environment with no edible bacteria, they can seed their own food crop, becoming "farmers". The genetic basis for the ability of these bacteria to survive digestion and confer this benefit is unknown. Our goal is to explore the genetic mechanisms of this symbiotic relationship by comparing the genomes of symbiotic Paraburkholderia with closely related non-symbiotic bacteria to look for the presence/absences of genes that may be involved in the symbiont lifestyle.

Miguel Mercado
University of Central Arkansas
Biology (BI)
Undergraduate Student
Yes

Utility of the low copy nuclear gene LEAFY for phylogenetic studies in the sunflower family (Asteraceae), tribe Astereae

Miguel Mercado, Richard D. Noyes

The plant family Asteraceae is subdivided into numerous tribes. One of the largest of these is tribe Astereae, the 'aster' tribe, which is worldwide in distribution and includes about 3000 species. Prior phylogenetic hypotheses for the group have been based on morphology and ITS and ETS sequences of nrDNA. The aim of this study was to evaluate the utility of single copy nuclear gene Leafy (LFY) for studies in the tribe. This was done by amplifying exon1 and exon 2 of Leafy for 15 different species by PCR, cloning the products using blue-white colony screening, and isolating plasmids from positive colonies using standard alkaline lysis procedure. Inserts were then sequenced using the forward M13 primer at the DNA sequencing facility at the University of Missouri, Columbia. Results show significant sequence variation (~5% among congeners). Full analysis using MEGA 6.0 will produce a phylogeny that will be compared with those resulting from other phylogenies for the group. This research will also provide a way to learn methods used to study molecular evolution and phylogeny, and to study various genes in plants.

Brandon Miller
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

A Geometric Approach to Determining Conservation Laws for Waves on a String

Brandon Miller

Noether's theorems describe the interplay between variational symmetries (symmetries of the action functional) and local conservation laws admitted by a physical system. In Lagrangian field theories defined on a differentiable manifold M endowed with a metric g, the variational symmetries are intimately tied to the isometries of the metric g. We highlight this connection by relating the variational symmetries of waves on a string to the isometries and conformal isometries of the Minkowski metric. The associated local conservation laws and conserved quantities for this physical system are determined and their physical significance discussed.

Christian Mitchell
University of Central Arkansas
Chemistry (CH)
Undergraduate Student
Yes

Expression and Purification of Calmodulin Binding Partner PEP-19

Christian Mitchell, Tori Dunlap

Calmodulin (CaM) is a calcium-sensing protein that plays a role in regulating enzyme activity. Often, CaM binds to a disordered region and causes the region to have an

John Mitchell
University of Arkansas - Monticello
Biology (BI)
Undergraduate Student
Yes

Analysis of a Drosophila melanogaster Ribosomal Protein Gene

John Mitchell, Mary Stewart

In humans, mutations genes coding for ribosomal proteins or in genes involved in ribosome biogenesis can cause conditions known as ribosomopathies. These conditions cause symptoms such as anemia, craniofacial abnormalities and abnormal blood cell production, all of which may be associated with decreased rates of protein synthesis. With some forms of ribosomopathies, patients have a higher risk of solid tumor formation or hematological cancers. Likewise, mutations in ribosomal protein genes in Drosophila melanogaster (fruit fly) cause phenotypes consistent with reduced protein synthesis such as delayed development and short, thin bristles in adult flies. Mutation of some D. melanogaster ribosomal protein genes, such as the ribosomal protein S6 gene (RpS6), cause tumors in developing animals. The RpS6 gene codes for ribosomal protein S6 (RpS6), a component of the small ribosome subunit. In addition, the first intron of this gene contains information for a small non-coding RNA thought to function as a small non-coding RNA known as a snoRNA. We are working with a strain of D. melanogaster that has a mutation in the RpS6 gene that is known to reduce RpS6 mRNA expression, but we do not know how RpS6 protein expression is affected in these flies nor do we know if the mutation affects expression of the snoRNA. Our current work is aimed at comparing RpS6 protein expression in the mutant flies and in wild-type flies. To this end, we are working to optimize protein extraction, protein quantification and Western blot procedures. Determining how RpS6 protein expression is affected in the mutant flies will be essential for future studies.

Victoria Niedzwiedz
University of Central Arkansas
Chemistry (CH)
Undergraduate Student
No

Retinoic Acid Receptor Gamma Reciprocally Regulates Cellular Adhesion and Proliferation in K562 Cells

Victoria Niedzwiedz, Rachel Mayo, Melissa Kelley

The interplay between cellular adhesion and proliferation is complex; however, integrins, particularly the α5β1 subset, play a pivotal role in orchestrating critical cellular signals that culminate in cellular adhesion and growth. Retinoids modify the expression of a variety of adhesive/proliferative signaling proteins including, α5β1 integrins; however, the role of specific retinoic acid receptors involved in these processes has not been elucidated. In this study, the effect of all-trans-retinoic acid receptor (RAR) agonists on K562 cellular adhesion, proliferation, and α5β1 integrin cell surface expression was investigated. RAR agonist exposure increased K562 cellular adhesion to RGD containing extracellular matrix proteins fibronectin and FN-120 in a time- and concentration dependent manner, while RAR or RAR agonist treatment had no effect on cellular adhesion. Due to the novel RAR- dependent cellular adhesion response exhibited by K562 cells, we examined 5 and 1 integrin subunit expression when K562 cells were exposed to retinoid agonists or vehicle for 24, 48, 72 or 96 hours. Our data demonstrates no significant differences in K562 cell surface expression of the 5 integrin subunit when cells were exposed to RARα, RARβ, or RAR agonists for all time points tested. In contrast, RAR agonist exposure resulted in a significant increase in cell surface β1 integrin subunit expression within 48 hours that was sustained at 72 and 96 hours. Finally, we demonstrate that while exposure to RARα or RARβ agonists have no effect on K562 cellular proliferation, the RAR agonist significantly dampens K562 cellular proliferation levels in a time- and concentration- dependent manner. Our study is the first to report that treatment with a RAR specific agonist augments cellular adhesion to α5β1 integrin substrates, increases cell surface levels of the β1 integrin subunit, and dampens cellular proliferation in a time and concentration dependent manner in a human cell line.

Joshua Nilz
University of Central Arkansas
Biology (BI)
Undergraduate Student
Yes

Macroinvertebrate Community Response to a Gradient of Urbanization in the White Oak Bayou Watershed

Joshua Nilz, Stephanie Stoughton, Sally Entrekin

Urban development results in the alteration and homogenization of stream and wetland habitats by increasing sedimentation, nutrient loading, and altering water chemistry. Wetlands are susceptible to degradation from urban development through connections with streams that drain urbanized watersheds and proximity to development resulting in altered water quality (e.g. dissolved oxygen, conductivity, sediment loading) and habitat conditions that could affect macroinvertebrate community structure. However, some wetland macroinvertebrate taxa may or may not respond to changes in environmental conditions from urbanization due to their tolerance to low dissolved oxygen, and temperature fluctuations. Macroinvertebrate community structure will be used to demonstrate the impact of urbanization across a gradient (lowest to highest urban cover) on ten wetlands within the White Oak Bayou. Shannon's Diversity; %Ephemeroptera, Plecoptera, and Trichoptera (%EPT); and water quality metrics will be used for assessment. As percent watershed urbanization increases, we predict fewer sensitive macroinvertebrate taxa (%EPT) and lower diversity from habitat homogenization and degraded water quality.

Antoinette Odendaal
Southern Arkansas Unviversity
Biology (BI)
Faculty / Researcher
No

The toxicological effects of dietary supplement additives on Daphnia magna

Antoinette Odendaal, Colton Taylor, Cameron Leach

Daphnia magna, a freshwater microcrustacean, is a model organism used to investigate the potential toxic effects of chemicals. Exposing D. magna to dietary supplement additives can provide insight into the potential adverse effects of such additives on ecosystems and can shed light on the potential harmful effects on humans. Our research evaluates the acute and reproductive toxicity of various supplement additives, such as coffee bean extracts and guarana on D. magna.

Danica Ordonez
University of Central Arkansas
Chemistry (CH)
Undergraduate Student
Yes

Conformational Protein Ensemble of the Calmodulin Ligand PEP-19

Danica Ordonez, Christian Mitchell, Tori Dunlap

Calmodulin (CaM) is a calcium sensing protein performing a regulatory function in an array of cell signaling pathways. CaM has a multitude of binding targets, some binds to its apo form, but CaM binds most targets while also bound to calcium ions. When bound to four calcium ions, calmodulin attains a conformational change that exposes hydrophobic residues, enabling CaM to bind to and induce -helical structure in its intrinsically disordered ligands. Changes in these interactions have been associated with disorders such as Alzheimer's disease, Parkinson's disease, and cardiac hypertrophy. Calcineurin (CaN) is a CaM regulated serine/threonine phosphatase that has an alpha-helix induced binding region once bound to CaM. CaN also has a region C-terminal to its canonical CaM binding site that attains an alpha-helical structure upon CaM binding. We hypothesize that calmodulin has the ability to induce alpha-helical structure in regions outside its primary binding site in other CaM ligands such as PEP-19. PEP-19 is an intrinsically disordered, CaM binding, neuronal protein that when bound, alters the calcium binding kinetics of CaM; this gives PEP-19 protective characteristics against cytotoxicity. A region in PEP-19 N-terminal to the CaM binding region has the potential to form an amphipathic alpha-helix much like the behavior exhibited by calcineurin bound to CaM. We used fluorimetry and FRET to study the conformational ensemble of PEP-19. We labeled the protein with the organic fluorophore IAEDANS in order to utilize FRET in analyzing the conformational ensemble of PEP-19 and the ability of chaotropes and crowders to alter that conformational ensemble. We used the chaotropes urea and guanidine hydrochloride, the crowders Dextran-70, PEG8000 and glucose, and the alpha-helix inducer trifluoroethanol (TFE) to compare the FRET of PEP-19 extended with the protein in a more globular or structure induced state.

James Palmer
University of Central Arkansas
Computer Science (CS)
Graduate Student
Yes

Drone Delivery with a Parrot Bebop 2

James Palmer, Recep Erol, Valentin Velchev, Kirby Shrable

The last mile in delivering goods is the most expensive: a combination of traffic, accelerations and decelerations, and day to day changing delivery destinations all contribute to the high cost. Drones have been proposed as a low cost solution to delivering lightweight cargo to these destinations, as well as for delivering to remote locations. We propose that commercial off-the-shelf drones may be potential candidates for the job of autonomous drone delivery. Utilizing 3D printed parts, we modified the Parrot Bebop 2 drone to carry lightweight cargo under the control of a human pilot from an Android phone. By measuring the battery drain rate, we show that this drone model is able to maintain flight for an acceptable duration even when the drone is carrying cargo. We also attempted to use a MAVlink waypoint flight plan for the drone to execute autonomously, but we were unable to complete this phase of the project due to time constraints and lack of source code for the premium feature: we leave this for future work.

Marcia Polett
University of Central Arkansas
Biology (BI)
Graduate Student
Yes

The influence of embryonic stress hormones on phenotypic variation and fitness in *Sceloporus consobrinus*

Marcia Polett, Matthew Gifford

Maternal effects of stress have been found to contribute to offspring phenotype and potentially influence offspring survival and fitness in many different species. Specifically, stress hormones like corticosterone (CORT) contributed by the mother in an embryonic environment have been shown to influence offspring morphology, growth, physiology, and behavior. Current studies are inconclusive as to the impact CORT has on offspring "personality" and how CORT can differently impact the development of males and females. Using prairie lizards, *Sceloporus consobrinus*, as a model, I determined how exposure to CORT in the embryonic environment influenced offspring morphology, growth, stress response, and boldness. I expect to find significant phenotypic differences between treatments, but the literature is inconclusive as to what those specific differences might be. Preliminary data indicate sex-specific differences hatchling body size among treatments as well as potential differences in early laid and late laid clutches. Expected results can help us understand both short term and long term impacts of embryonic stress. When applied to further studies, these results can also provide a more comprehensive knowledge of underlying mechanisms of maternal stress impacts offspring and help us understand how certain taxa like reptiles could be impacted by stressors they encounter such as climate change.

Mohammad Habibur Rahaman
Arkansas State University
Engineering (EN)
Graduate Student
Yes

Radiation pressure on core-shell nanoparticles

Mohammad Habibur Rahaman, Brandon A. Kemp

We theoretically demonstrate the Lorentz force on core-shell nano-particle using the separation of bound and free currents and charges by expanding Mie theory. Mie scattering theory of homogeneous isotropic sphere for negative index media can describe plasmonic resonance of metal nanoparticle without fundamental correction of Mie scattering theory using time reversal viewpoint. This scattering theory is further expanded for the core-shell homogeneous particle. This solution can explain resonance condition of metal nanoparticle either the core or shell is metal. We have also validated our analytical simulation results with finite element results in COMSOL Multiphysics.

Royer Ramirez Ruiz
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

Maximizing Wind Power

Royer Ramirez Ruiz, Michael Hammer

The Oklahoma Mesonet is a network of environmental stations that monitor and measure the environment. This wealth of information has many applications for those that are not only looking to prevent damage to investments like crops and livestock, but also applications in clean energy. This is readily available to individuals to determine where the wind is the greatest in Oklahoma, or where the sun shines the brightest. Having this data, allows companies, homeowners, and the government determine where it would be the most beneficial to build green energy projects. This project will apply the data found on the Mesonet to determine the best place to build a windmill farm in Oklahoma based on several factors, wind speed, location, building materials, transportation, and the numerous cost associated with the construction of a windmill. These factors are crucial, but the most essential factor is wind speed. By determining the spot in Oklahoma that has the highest wind speeds, then that will be the place that produces the most energy out of any other place in Oklahoma. This project will also look into the consistency in direction of the wind at that given location. Therefore, this project will optimize the energy production, while minimizing construction and operations cost. This project will give back to the community by bringing awareness of where the next wind mill farm should be constructed.

Isaac Raphael 110
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

Impact of Mesonet on Oklahoma Agricultural Processes

Seth Barr, Isaac Raphael

Agriculture is a $6.7 billion a year industry in Oklahoma. Among the top agricultural products are beef cattle and dairy products, corn, and peaches. The effects Mesonet data has had on these products since its implementation in 1993 are examined in this study. Several factors including overall yields, yields per acre, and cost will be researched as well as changes in agricultural practices and methods. Past agricultural censuses 20 years prior to and 20 years after the adoption of the mesonet will be examined. Changes resulting in greater efficiency which can be attributed to Mesonet availability are identified as well as their impacts.

Nicholas Rathke
University of Central Arkansas
Chemistry (CH)
Undergraduate Student
Yes

Altering the Conformational Ensemble of Pep-19 using Calcium

Nicholas Rathke, Victoria Dunlap

PEP-19 is a small, intrinsically disordered protein found primarily in the Purkinje cells of the cerebellum. PEP-19's only known function is to regulate calcium binding to the protein calmodulin (CaM), and it does this by binding CaM, which in turn calmodulin's calcium binding kinetics. Upon CaM binding, Pep-19 develops α-helical structure. CaM binds to over 300 known targets, with most of these interactions taking place when CaM is bound to calcium, making PEP-19's regulatory function critical to biological processes. Despite being intrinsically disordered PEP-19 has been shown to weakly bind calcium ions even in the absence of CaM, possibly contributing to its ability to protect against calcium fluctuations. Pep-19 has also been known to counteract the progression of several disorders, including Alzheimer's disease and Downs syndrome, because of its ability to regulate calcium sensing when bound to CaM. We utilized fluorometry to investigate possible differences in the conformational ensemble of PEP-19, in the presence and absence of calcium. Upon addition of calcium, FRET and anisotropy measurements indicate that calcium does slightly alter the conformational ensemble of PEP-19.

Jess Ray
Arkansas Tech University
Physics (PH)
Undergraduate Student
No

Creation of Image Masks for Barred Spiral Galaxies using Source Extractor

Jess Ray, Amber Harrington

We have selected ground-based ugriz waveband images of twenty barred spiral galaxies from the EFIGI galaxy survey. Galaxy images can contain stars or other non-galactic objects. Before the galaxy can be analyzed, these extra objects need to be isolated and removed from the image. We used the program Source Extractor to identify the extra objects and to create masks for each of our selected barred spiral galaxies.

Harleigh Robbins
University of Central Arkansas
Biology (BI)
Undergraduate Student
No

Epidemiology of Pandemic Influenza in Missouri

Harleigh Robbins, Metu Osele, Maison Mitchell, Kaitlyn Kemp, Martha Kabengele, Adam Davidson, Anna Blach, Laura Lin, Abigail Galicia-Romero, Ben Rowley

There have been four major influenza pandemics in the last century: 1918-1919, 1957-1958, 1968-1969, and 2009-2010. Although there were numerous deaths in each of these pandemics, the years 1918-1919 were recorded as the deadliest virus-spread pandemic in modern history. It is estimated 30 to 50 million people died globally in this single pandemic. Relatively few studies have been conducted on the death records from these outbreaks to analyze distribution of deaths by geographic region, age groups, and gender. This study investigates influenza pandemic death records in Missouri, with comparisons to demographic death data for the same pandemics in Arkansas. By evaluating how the virus spread across Missouri and Arkansas in the past, a better understanding of how a future influenza outbreak may spread may be obtained. By comparing these two states' influenza pandemic deaths, new information can be obtained on if and how significant influenza death pattern differences occurred.

Mason Rostollan
University of Central Arkansas
Biology (BI)
Undergraduate Student
Yes

Recruitment and survival in Ligustrum sinense

Mason Rostollan, Katherine Larson

Ligustrum sinense (Chinese privet) is an invasive, evergreen, woody species that has invaded much of the southeastern United States since its introduction in 1852. It reproduces both sexually through bird-dispersed seeds and through root suckers. Little is known about the establishment and growth rate of Chinese privet from seeds. The goal of my research was to 1) determine the recruitment and survival of seedlings in a natural setting, 2) quantify the impact of native plant competitors on Chinese privet seedling recruitment and survival, and 3) quantify growth rate through the first year of growth in the field. In a prairie ecosystem, two blocks were divided into 20 plots; 10 containing privet seeds only, 10 containing privet seeds and a mixture of seeds from the local seed bank. Control plots were planted similarly in 3 gallon pots and watered as needed. Overall, survival of all planted seeds that emerged in the field was 81%, compared to 100% in control pots when planted with native seeds, and 83% in the field compared to 62% in the control when planted without native seed competition. The fastest growing plants in the field were in plots with no added native seed and reached an average height of 10 cm, compared to the potted control of 29 cm. The slowest growing plants in the field were the plots with native seed and grew to an average of 7.4 cm, compared to the control with an average height of 4 cm. In germination, the plots with native competitors had the lowest germination rate with an average of 30%, compared to the control pots with an average of 42%. The highest germination rate from field plots were those with no native seeds and had an average germination rate of 42%, compared to the control pots with an average of 82% germination. We will continue to monitor the plots to determine age at first reproduction and optimal age of privet removal before facing further invasion, which will aid in conserving invaded ecosystems.

Mitchell Rowland 27
Southern Arkansas University
Biology (BI)
Undergraduate Student
Yes

Bioremediation of Petrochemicals from Soil

Mitchell Rowland, Dr. Antoinette Odendaal, Antoinette Davis

Petrochemicals are used in a range of manufacturing processes, including crude oil refining, and the production of plastics and industrial dyes. Petroleum hydrocarbons can make their way into the environment through improper storage, disposal, and mishandling. Environmental accumulation of aromatic hydrocarbons poses a risk to human health and leads to the disruption and destruction of ecosystems. Additionally, these compounds are known to have carcinogenic effects in humans and animals. The goal of this research is to investigate the bioremediation of contaminated soil using microorganisms and grasses. Pot-culture experiments were carried out in which commercial soil was artificially contaminated with benzene, toluene, and xylene (200 ppm each) and exposed to combinations of four pasture grasses, two bacterial species, and one fungal species.

Camryn Ruggeri
Ouachita Baptist University
Biology (BI)
Undergraduate Student
Yes

Optimum Lighting for Oxygen Production of *Arthrospira platensis*

Camryn Ruggeri, Jim Taylor

Arthrospira platensis (commonly known as spirulina) is a strain of photoautotrophic, non-toxic cyanobacteria (blue-green algae). Spirulina is a known health food grown in an axenic environment with a high photosynthetic rate and is being tested to examine its potential development in space travel. Pure oxygen production was evaluated by trapping the gas. This experiment will be conducted using different wavelengths of LED lights (red, blue, and a combination of red and blue) to test the oxygen production. Previous results, with *Selenastrum capricornatum*, have shown that blue light is most effective with that algae species. However, spirulina has demonstrated the best results in a combination of blue and red light. The chamber containing this combination lighting included blue light with the intensity of 20 umols/m^2/s at 460 nm, and red light at an intensity of 40 umols/m^2/s at 630 nm. The intensities were chosen to correspond with the intensities of the other light boxes containing the red and blue LED lights alone. Every eight hours, the combination lighting showed the rate of oxygen being produced at five cm^3/250mL spirulina solution. The red light alone produced a rate of four cm^3/250mL spirulina solution, while blue light alone produced a rate of two cm^3/250mL spirulina solution. The increase in cell number showed the combination light's cell count was one point three times greater than the red light and one point five times greater than the blue light within a twenty-four-hour time frame.

Misuk Saha
Arkansas State University
Engineering (EN)
Graduate Student
Yes

Analytical modeling of microscopic and macroscopic analysis of dielectric material.

Misuk Saha, Dr. Brandon Kemp

Optical scattering is one of the most important paradigms of interaction of light at microscopic scale. For example, the structure of atomic nucleus and even its discovery was the consequence of scattering experiments. Besides, the scattering analysis has provided many of our contemporary knowledge of elementary particle physics. Rayleigh approximation is one of the basic methods to study the electromagnetic (EM) scattering of light for spherical particles and it is appropriate to the condition when the particle radius is very small compared to its incident wavelength. We studied electric and magnetic field equation of a small spherical particle using Rayleigh approximation. We consider a large sphere consisting of many small Rayleigh particles and then calculate the electric and magnetic fields of the large sphere using the discrete dipole approximation (DDA) method. The DDA method gives the microscopic analysis of material. Then, we simulate the macroscopic EM field pattern of the large sphere using Mie theory. Mie theory gives the macroscopic analysis of the material. For both analyses we get identical results using same parameter.

Samia Sanjari
Arkansas State University
Engineering (EN)
Graduate Student
Yes

Image Analysis Toolboxes for Finding the Mean Pore Size of Scaffolds and Diameter Distribution of Fibers

Samia Sanjari, Brandon Kemp

Mean pore size of scaffolds and diameter of fibers are the major considerations for designing a suitable fibrous scaffold for any tissue engineering application. A number of studies have shown that fiber diameter has a pronounced influence on cell attachment, differentiation, and proliferation, and the pore sizes of scaffolds should be in a range to facilitate the cell penetration and migration during cell seeding. Thus, knowledge of the pore-size distribution of scaffolds and diameter distribution of fibers are very important in order to generate a suitable engineered tissue. Image analysis technique plays a vital role to achieve this aim. In this study, standalone image analysis toolboxes are developed by using the Graphical User Interface (GUI) and the deployment toolbox of Matlab software to find the mean pore diameter of scaffolds and diameter distribution fibers from the microscopy Image. The develop toolboxes are very flexible to use as changing or manipulating the code inside the algorithms are not required for analyzing different fibrous scaffold images. Thus, any untrained user can easily use the toolboxes to extract information (mean pore size, diameter of fibers) from a microscopy image.

D. Blake Sasse
Arkansas Game and Fish Commission
Biology (BI)
Faculty / Researcher
No

Distribution of the Eastern Spotted Skunk, *Spilogale putorius*, in the Early Twentieth Century

D. Blake Sasse

The eastern spotted skunk (*Spilogale putorius*) is a small carnivore that was once common across the eastern United States but which apparently has experienced significant population declines across much of its range that have resulted in the plains spotted skunk subspecies being considered for federal protection as an endangered species. These declines followed apparent expansion to the north between the Mississippi River and the Rockies in the first half of the twentieth century. However, early range maps were published without methodological information and combine ranges of the eastern and western spotted skunk (*Spilogale gracilis*), which were considered a single species making it difficult to ascertain the true extent of range expansion of the eastern spotted skunk during this period. In order to document the range of the eastern spotted skunk at the beginning of the twentieth century historic records were obtained by compiling records of spotted skunk, reported in Hunter, Trader, Trapper magazine from 1903-1919 and Fur News from 1907-1920. Magazine records were supplemented with museum specimens identified as eastern spotted skunks that were collected prior to 1920 that were published to VertNet. A total of 690 magazine records and 243 museum specimens were collected. The range map upon which this is based indicates that the spotted skunk was firmly established in southern Minnesota, southeastern South Dakota, and eastern Nebraska at this time, but with a large gap between along the Mississippi River valley. The species appeared to have been absent from the Gulf Coastal Plain of eastern Texas, northern Louisiana, and southern Arkansas and along the Gulf Coast and most of Georgia; areas that seem to have been colonized in the subsequent forty years.

Audrey Schucker
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

Tomato Growth in Oklahoma

Audrey Schucker, Daniel Toomer

Tomatoes are a fruit that have been linked to a decreased risk for heart disease and cancer. They are commonly grown in many areas of the United States, including Oklahoma. The purpose of this research is to identify which months in Oklahoma are best suited for tomato plantation and growth based on the average soil moisture and temperature data from the Mesonet website. Tomato production depends greatly on the microclimate. If the plant experiences stress, such as too warm a climate, it will develop growth problems as a result. This research can be used by Oklahoma farmers to determine the optimal times for plantation and to get the best results for tomato growth.

Nick Scoles
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

Design and Development of an Acoustic Field Scanner

Nick Scoles, Carl Frederickson

A system has been designed to scan a microphone over a 30x30 cm plane to image an acoustic wavefield. The system uses two PI translation stages to provide motion in both the x and y directions. The scanners are controlled and data is collected using a Labiew vi developed for this system. A G.R.A.S. quarter inch microphone is scanned through the acoustic wavefield. This system will allow the characterization of acoustic sources as well as the wavefields scattered from target surfaces used to study acoustic caustic foci

Nick Scoles
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

100

Mapping the Influence of Weather on Concrete

Nick Scoles, Jordan Rhoades

Concrete is one of the most commonly used materials in construction. During design, from bridge building to sidewalk construction, an engineer must keep in mind that concrete will expand and contract due to local weather conditions. This project will explore just how much certain weather conditions, such as temperature and relative humidity, affect thermal expansion/contraction of concrete formed from various types of aggregates. Through the use of the extensive weather data on Oklahoma, provided by Mesonet.org, the variation in concrete volume can be monitored for several locations over a year.

Justin Seymour
University of Central Arkansas
Physics (PH)
Undergraduate Student
No

Optimal Locations for the Generation of Renewable Energy

Gage Gould, Justin Seymour

As the global population continues to increase, the demand for energy becomes greater. The trend towards renewable energy is at an all time high now with the understanding that nonrenewable energy is both very limited and harmful to the environment. The production methods of renewable energy each require different environmental conditions in order to maximize the amount generated. Data found on the Mesonet such as solar radiation levels, wind speed, and rainfall will enable the formulation of a more accurate prediction as to where solar cell power plants, wind farms, hydroelectric power plants, etc., should be located.

Justin C Seymour
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

The Effect of Model Atmosphere Parameters on the Elemental Abundances in Halo Stars

Justin C Seymour, Kenneth A Jumper, Debra L Burris

In this research the researchers will be performing error analysis on the chemical abundance of Europium, a neutron-capture (n-capture) element that is present in poor-metal massive stars, found in six different stars that are accompanied in the inner galactic halo. The inner galactic halo is home to many of our local poor-metal stars that they will be capable of analyzing using LTE fine-analysis techniques with both line analysis and spectral synthesis through a program known as MOOG. Where the researchers will be able to manipulate four different parameters: metallicity, temperature, micro turbulent velocity, and surface gravity to determine the effects each parameter has on the element distribution throughout the star. Using a Kurucz model atmosphere for each star, which assumes LTE the abundances acquired from changing the parameters are compared to the abundances previously given in the known model atmosphere. This allows an error analysis of the abundances to be conducted.

Sage Shaddox
University of Central Arkansas
Biology (BI)
Graduate Student
No

The Effects of Microgravity on Vascular Tone in Female Mice

Sage Shaddox, Brent Hill

Background: Hind Limb Unloading (HLU) is a laboratory technique that can be used to simulate microgravity, or reduced gravity in rodents. Microgravity research using HLU has been extensively studied since the 1980's, generally focusing on bone decalcification and cardiovascular deconditioning. These studies have shown to decease contractile response in blood vessels due to microgravity particularly in the abdominal aorta. Until recently, this field of research has mainly focused on using male rodent models, and have not evaluated the impact of in vivo estrogen on cardiovascular function.

Objective: The purpose of this study is to observe the effects of microgravity on the abdominal aorta between HLU control (SHAM) and ovariectomized (OVX) female mice. This study will determine the differences between heart size, plasma estradiol concentration, and corticosterone concentration.

Methods: Female mice will undergo control (SHAM) and ovariectomy (OVX) surgeries once sexual and skeletal maturity has been reached at 4 months of age. After 28 days of HLU, mice will be sacrificed and abdominal aorta segments will be collected. The aorta segments will be mounted in organ baths to measure isometric contraction phenylephrine (an α agonist) and to FPL64126 (a calcium channel agonist). Relaxation responses will also be measured to nifedipine (a calcium channel antagonist).

Results: Data collection has just begun so no inferences can be made about the preliminary data. It is expected that OVX groups will have a greater magnitude of contractile response to the SHAM groups.

Conclusions: This study will determine the cardiovascular adaptations that occur in female astronauts who have reduced gonadal estrogen production due to menopause or health related issues, and to combat these effects with potential estradiol therapy.

Once females undergo menopause gonadal estrogen production decreases, or halts all together significantly increasing the risk for cardiovascular disease

Spencer Sherwood
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

Using a Photon Beam for Thermal Nociceptive Threshold Experiments

Spencer Sherwood, Jeff Anderson

In humans, risk of diabetes and diabetic complications increases with age and duration of prediabetic state. In an effort to understand the progression of this disease scientists have evaluated the deterioration of the nervous system. One of the current methods used in the evaluation of the deterioration of the nervous system is through thermal threshold experiments. An incremental Hot / Cold Plate Analgesia Meter (IITC Life Science,CA is used to linearly increase the plate temperature at a rate of oC min-1 with a cutoff temperature of 55oC. Hind limb heat pain threshold (HPT) will be defined as a plate temperature at which the animal abruptly withdraws either one of its hind feet from the plate surface in a sharp move, typically followed by licking of the lifted paw. One of the disadvantages of using this hot plate method is in determining the true temperature at which the paw was withdrawn. While the temperature of the plate is known the position of the paw on the surface may vary; occasionally being cupped resulting in a temperature differentiation between the plate and the paw. During experiments the rats may urine onto the plate changing the temperature of the surface again resulting in reduced accuracy as to the withdrawal threshold. We propose here a new method for nociceptive somatic experiments involving the heat pain threshold experiments. This design employs the use of a photon beam to detect thermal response from an animal model. The details of this design is presented.

Ross Shiery
University of Arkansas
Biology (BI)
Undergraduate Student
Yes

Prey items impaled by Loggerhead Shrikes in northwestern Arkansas

Ross Shiery, Kimberly Smith

Loggerhead Shrikes (*Lanius ludovicianus*) are the only shrike endemic to North America. While listed as least concern by the International Union for Conservation of Nature (IUCN), shrike populations have been in decline since the 1960s. The purpose of this study is to determine what items are being impaled or cached by loggerhead shrikes, and if any spatial patterns are present. A weekly roadside survey is being conducted along four transects in northwest Arkansas over the course of a year. Between 24 May 2016 and 5 March 2017, a total of 548 prey items have been observed. Of these, 71% were arthropods, with grasshoppers being the most common. Of the 29% vertebrate prey items, 12% were mammals, 9% were reptiles, 7% were amphibians, and avian species consisted of the remaining 1%. Six different snake species have been observed during this period, including the speckled kingsnake (Lampropeltis getula). The most active month was November, when 175 prey items were found, probably corresponding to an influx of wintering birds. The least active month was June, when only 27 prey items, which corresponds with the end of the breeding season.

Olivia Sims
Hendrix College
Biology (BI)
Undergraduate Student
No

Swimming Preferences of Guinea Pigs

Olivia Sims, Jennifer Dearolf

It is known that guinea pigs, among other rodents, are able to swim. However, in previous studies, rodents were forced to swim by being placed into water, and therefore, the investigators may have been determining the effects of stress and exercise on their characteristics of interest, rather than just exercise. Thus, it is currently unknown whether or not rodents would choose to swim in a laboratory setting. The goal of this study is to determine if young female guinea pigs will choose to swim. If they do, swimming can be used as a form of exercise in future studies. In this pilot study, swimming preferences of the guinea pigs were determined using a y-maze. The animals were acclimated to the maze in which both arms were dry paths to a reward (timothy hay) over a 3-day period (30 min/day). Any animal that moved off the platform of the maze on 2 of the acclimation days continued on to the choice study. Initially, both arms of the y-maze contained dry paths to a reward, and the position of the guinea pig was recorded every minute for 45 min. The following day, the same procedures were utilized, but one of the arms of the y-maze contained warm water (between 35 and 40°C) deep enough to require the guinea pig to swim. In the first group of twelve guinea pigs, only six moved off the platform during the acclimation period, and during testing, four of these animals entered the water. However, none of these guinea pigs spent a significant amount of time in the water (average: 3.0 ± 5.2% of the testing period). Based on our results, we now plan to modify the maze to have a smaller platform and conduct the same tests. We hope that this change will encourage the guinea pigs to leave the platform and choose a path. If we can identify females that choose to swim, we will be able to use them in future studies on prenatal exercise and its effects on neonatal muscle physiology.

Brooke Skinner
University of Central Arkansas
Biology (BI)
Graduate Student
Yes

Effect of Styrofoam Diet on the Gut Protists of Mealworms (*Tenebrio molitor*)

Brooke Skinner, Kara Helton, Austin Goldsmith, Ben Waggoner

In 2016, researchers announced that mealworms, the larvae of the flour beetle *Tenebrio molitor*, were capable of eating, digesting, and assimilating styrofoam, a common polystyrene plastic product that is otherwise resistant to degradation. Mealworms break down styrofoam thanks to their gut bacteria, notably a species of Exiguobacterium that can degrade styrofoam in vitro. Mealworm gut communities also contain protists, notably three known species of gregarines (Apicomplexa). Gregarines are often considered parasitic, but they seem to have little negative effect on the host. We tested whether a styrofoam diet might affect gregarine populations within mealworm guts, as a first step towards examiningstyrofoam's effect on the gut ecosystem as a whole. We found that there was no significant difference in the incidence of three gregarine species in the guts of mealworms on a styrofoam diet, as compared to a control population that was fed on oat bran. Our preliminary results suggest that, if we assume that gregarines serve as a proxy for the state of the entire mealworm gut microbial ecosystem, a styrofoam diet does not cause obvious changes in the gut biota.

Elias Smith
University of Central Arkansas
Biology (BI)
Undergraduate Student
Yes

Isolation of Erythrocytes from Freshwater Turtles for Use in Telomere Length Analysis

Elias Smith

Most mammalian red blood cells (RBCs) are anucleated as opposed to reptilian RBCs which are nucleated causing them to sediment at differing rates. Reptilian erythrocytes provide a reliable source of genetic material, without sacrificing the animal. However, successful isolation of RBCs from reptiles provides unique challenges. Here we attempt to use a Percoll gradient to separate freshwater turtle RBCs from other whole blood components to use or subsequent DNA extraction and telomere length analysis. Successful isolation of freshwater turtle RBCs using a Percoll gradient could lead to future studies that will try to assess a correlation between telomere length and age in these species. This data can then be used in other environmental and physiological studies.

Elias Smith 112
University of Central Arkansas
Physics (PH)
Undergraduate Student
Yes

Optimal Crop Growing Seasons Determined Using Mesonet

Elias Smith, Zach Brawley

Wheat, by acreage, represents the largest exportable crop in the state of Oklahoma. Being the main export, it is necessary for farmers to accurately predict the average time it takes to grow and harvest said crop along with the optimal time of year to plant. Recent advances in data collection from the Mesonet, Oklahoma's statewide meteorological data collection system, allow farmers to predict temperatures based on previous year's data. Growing degree days (GDD) give an estimate of when farmers should plant and harvest their crops based on the temperatures experienced each day the crop is growing. Through use of the mesonet it is possible to give a more accurate estimate for the best days to plant a variety of crops, including wheat. Once the data is compiled it is simple to extend the data to other commercial crops grown within the state. This study will analyze the data given by Mesonet to provide a rough model for farmers that represents an average optimal growing season within the state.

Kimberly Smith
University of Arkansas
Biology (BI)
Faculty / Researcher
No

Sunbathing in the Northern Roadrunner: An unexplored trait for their range extension

Kimberly Smith, Joseph Neal

The Northern Roadrunner was historically a bird of the southwest United States, but it has expanded its range eastward in the last 50 years. In response to cold nights in the Southwestern deserts, its behavior of sunbathing in the morning has been well documented as a way to rapidly warm its body temperature. Roadrunners are apparently poor thermoregulators, and populations decrease significantly during very cold winters in recently expanded areas such as Missouri. With the advent of more mild winters in Arkansas in recent years, sighting of roadrunners has increased. here we report on 3 incidences of observing roadrunners sunbathing after a cold night in northwestern Arkansas. While severe winters may decimate populations, sunbathing may allow individuals to survive cols nights in the Ozarks.

Aaron Stebbins
University of Central Arkansas
Chemistry (CH)
Undergraduate Student
No

Impact of chemistry/mathematical video-lectures on student-based learning in a freshman level chemistry course

Faith Yarberry, Aaron Stebbins, Lisa Christman

The research presented uses split screen chemistry/mathematics video-lectures to improve student understating and performance on mathematical concepts presented in a first semester freshman-level chemistry course. The students were required to complete a pre-video and post-video assessment quiz that asks questions involving material taught in the video. EdPuzzle© was used as the vehicle for the delivery of the videos. Utilization of EdPuzzle© allows for the acquisition of data regarding how long and how many times a student watched the videos. Additionally EdPuzzle© has the ability to pause the video at certain points within the lecture and ask questions over the material. If the students answered the question incorrectly students could review the lecture material that discussed a particular concept by rewinding the video to the time code indicated in the video. If the students answered the problems correctly then they were allowed to proceed. Finally, EdPuzzle© prevents students from simply skipping ahead to answer questions without watching the applicable video. Previous research within our group has demonstrated that incorporation of the video-lectures improved the students' performance on examinations. We expect that the data obtained will show a continuation of this trend. The new methodology presented will provide a greater amount of information that will allow us to alter the videos to further enhance the students' academic success in future classes.

McKenzie Stribling
Hendrix College
Biology (BI)
Undergraduate Student
No

Analysis of the Oxidative Enzymatic Properties of the Bottlenose Dolphin Diaphragm and Scalenus Muscle

McKenzie Stribling

Bottlenose dolphins come up to the surface only briefly to exhale explosively and inhale in less than 0.3 seconds before diving back underwater. Despite their rapid inhalation, the bottlenose dolphin diaphragm, the main muscle of inspiration in terrestrial mammals, is not composed of enough fast-twitch fibers to be the primary muscle of inspiration in these animals. However, it is possible that their diaphragm is being assisted by another muscle that is predominately composed of fast-twitch fibers. Previous research has identified the scalenus muscle, which originates on the cervical vertebra and inserts on the ribcage, as a good candidate for this assisting muscle because it is ~60% fast-twitch. Thus, we hypothesize that the scalenus muscle is, in fact, working together with the diaphragm to drive the bottlenose dolphin's specialized ventilation. I will test this hypothesis by comparing the oxidative potentials of slow- and fast-twitch fibers in the dolphin diaphragm and scalenus muscle, because breathing muscles that work together have fibers with similar enzymatic properties. To investigate the enzymatic properties of the dolphin diaphragm and scalenus, I will stain serial sections of them for their NADH (oxidative enzyme) and myosin ATPase activities and capture images of the stained muscles. These images will be converted to grayscale, and the NADH staining density of individual muscles fibers will be measured using Image J. The average NADH staining densities of the slow- and fast-twitch fibers in the two muscles will be compared, as well as the average percentages of each type of fiber staining darkly and lightly for this enzyme. If similar values are found, then the two muscles are probably working together. This research will lead to more insights about which muscles drive the bottlenose dolphin's unique breathing event.

Jenna Suen
University of Central Arkansas
Biology (BI)
Undergraduate Student
No

Epidemiology of Pandemic Influenza in Arizona

Jenna Suen, Ashton Purtle, Spencer Long, DeShauna Tucker, Ben Rowley

Influenza is a virus that causes a respiratory tract infection. It infects 10-20% of the United States population each year with approximately 36,000 deaths. The virus has many different strains due to its mutating surface antigens. Occasionally more virulent strains become dominant. A result of this is the four pandemics (global infections) that have occurred since 1900 (1918, 1957, 1968, and 2009). The 1918 pandemic was the most deadly of the four, with an estimated 600,000 deaths in the U.S. alone. Nation-wide data has been collected on the death rates of the influenza pandemics, and it has been studied. Less attention has been given to analysis of influenza pandemic death rates and demographic differences on the smaller (county/state) scale. Demographic data, including age, cause of death, sex, and location of death can be obtained and analyzed from death records. This research project will analyze Arizona death records, comparing them to the U.S. trends as well as to those from the state of Arkansas.

Binqi Sun
University of Central Arkansas
Computer Science (CS)
Graduate Student
Yes

Orion Rover Maze solver and Object Detection

Binqi Sun, Ethan Mckee, Alexandr Dementyev, Tyler Velasco, Yu Sun

Modern autonomous robotic system are capable of performing a number of labor-intensive work involving a risk to human life, such as demining, repairing of pipelines, monitoring in harsh environments, processing automation in manufacturing. All these tasks can be easily done on Earth. It will be easier to find solutions, even if people make mistakes in the production of robots. If we talk about the performance of robots in space, or for example on the planet Mars, the error correction will be costly. For example, according to a report from the Washington Post, NASA's Mars Climate Orbiter was lost in space. Engineers failed to make a simple conversion from English units to metric units, which cost NASA $ 125 million. In order to reduce errors in the algorithm and errors in the robot's structure, scientists need to conduct tests on earth. The objective of this project is to use a MakeBlock robot to solve a maze and to detect and retrieve an object. This MakeBlock robot is controlled by an Arduino code, which is built from SmallTalk-80 coding language. The main modification to the MakeBlock robot is an arm to grab a designated object and an algorithm to continue to solve a maze. We use one sensor with three stages of functionality to stay within a maze and a separate sensor that is used to detect an object at a set given distance for retrieval.

Nathan Taylor
Hendrix College
Biology (BI)
Undergraduate Student
Yes

Land-use and Ecosystem Services Costs of Unconventional Oil and Gas in the U.S

Matthew D. Moran, Nathan T. Taylor, Tabitha F. Mullins, Sehrish S. Sardar, Maureen R. McClung

The dramatic expansion of unconventional oil and gas development in the United States has been controversial because of numerous environmental and social issues, including the conversion, fragmentation, and degradation of natural habitats. Here we describe land-use impacts and ecosystem services costs of recent energy development in the eight major unconventional oil and gas production regions of the U.S. From 2004-2015, there were over 200,000 hectares of land developed or modified. By 2015, the estimated annual ecosystem services costs of this habitat change had risen to 272 million USD, which resulted in a cumulative total of almost 1.4 billion USD, costs that were concentrated in deciduous forest and grasslands/pastures. Depending on future well drilling rates, cumulative ecosystem services costs projected to the year 2040 range from 9.4 billion USD to 31.9 billion USD. These environmental and economic impacts should be considered when governments perform cost-benefit analyses and create regulatory oversight.

Terri Teague
University of Central Arkansas
Biology (BI)
Graduate Student
No

Characterizing the Persisting Cortical Subplate in Rats Across Development, Maturation, and Aging

Terri Teague, Barbara Clancy

Subplate neurons guide the formation of all mammalian brains by participating in the development of the cortex (gray matter), a layered region involved in cognition. Some of these cells then die, but some remain in the adult cortex across aging where they assume positions in connective pathways and project into the cortex itself. In conventional models of cortical function, these persisting subplate cells are considered a “remnant” even though they remain functional across brain regions. The precise location of these persisting subplate cells has never been systematically studied until now. We reconstructed the subplate population from rat cortex sections on postnatal days (P) 0, P7, P30, 6 months, and 1 year using three-dimensional imaging software, generating the first models of this population from early through late ages (a rat brain at one year is similar to a middle-aged human brain). The persisting subplate varies in thickness and distribution but a number of these cells exist at all ages, located between the grey matter and the white matter. In this unique position, they are able to receive and transmit information to and from the cortex. Cell counts and volumes were compared, and our statistics indicate that despite a decrease in subplate cell numbers across aging (from 234,414 at P7 to 119,684 at 1 year), the persisting subplate itself increases in volume (from 0.89 mm3 at P0 to 3.10 mm3 at 1 year). Indeed, we find that this brain area appears to be remarkably resilient across aging, thus contradicting conventional brain models, and suggesting a role for these cells in mature cortical function.

Dustin Thomas
Arkansas State University
Biology (BI)
Undergraduate Student
Yes

Analysis of body shape variation among restricted and widespread populations of the Southern Redbelly Dace, *Chrosomus erythrogaster*

Dustin Thomas, Brook Fluker

The Southern Redbelly Dace (*Chrosomus erythrogaster*) has a widespread distribution throughout most of the eastern United States, with several disjunct populations in midwestern states and in the lower Mississippi River drainage. Of particular interest are potentially isolated populations on Crowley's Ridge in Arkansas and the Bluff Hills in Mississippi. Currently, it is unclear whether these populations share connections with larger core populations in the nearby Ozark and Eastern highlands, or represent isolated populations on these "upland islands" within the Gulf Coastal Plain. This study used geometric morphometric techniques to evaluate body shape differences among *C. erythrogaster* from loess habitats of Crowley's Ridge and the Bluff Hills of Mississippi. In order to determine variation in body shape, focal populations were compared to populations from the Ozark and Eastern highlands, as well as populations from the Ohio, Green, and Rock River drainages. A Southwestern population was also included in the study for further comparisons. Preliminary analyses revealed variation in body shape across the geographic range, and the populations of interest seem to be showing patterns of intermediate body depth compared to other populations. In conjunction with an ongoing population genetic study, results from this study will provide valuable information about the distinctiveness of potentially isolated populations in Arkansas and Mississippi.

Lauren Toivonen
University of Missouri - Columbia
Biology (BI)
Graduate Student
Yes

A Habitat Suitability Analysis of the Red Wolf across its Historic Range

Lauren Toivonen, Matthew Gompper, Hong He

The red wolf is a critically endangered species endemic to the southeastern United States. The world's only wild population resides on the Albemarle Peninsula of North Carolina. It is therefore imperative to identify potential sites that may be suitable for additional wild populations. The goal of this study is to provide analysis of available data to identify and rank suitable habitat sites. We used Geographic Information System to develop a habitat suitability model based on indices of landscape, road distance, and population distance. Because occurrence data has only been documented in the North Carolina population, we identified habitat used by red wolves from the published literature as well as from expert opinion. Experts were requested to rank habitat preferences of red wolves and this information was used to create a landuse index. We incorporated human population and roads to create an initial weighted model of ranked suitability throughout their historic range. The next phase of the study is to survey human populations to measure carnivore perception and interest of reintroduction. This information will be incorporated into the habitat suitability model to assess how site rankings change based on human perception.

Samuel Treece 88
University of Central Arkansas
Geosciences (GS)
Undergraduate Student
Yes

Bridging Technology and Community using Web-based GIS

Samuel Treece

Geospatial technologies allow for data to be collected, stored, managed, and displayed spatially for use in a variety of applications. Web-based GIS takes highly technical processes, and displays them on an easy to access medium. These web-based platforms permit people to access different maps, layers, and applications, without having to download software or learn specialized skills. This gives an advantage when dealing with problems that would best be solved from the direct input of the end-user. As a part of a service learning program, an application was created that allowed Conway Corporation customers to report outages of the different utilities the company provides. Creating the Conway Corp Outage Reporter app is just one of many ways that web-based GIS can be utilized. Skills acquired from the service learning experience allowed for a similar application to be created for the EAST Initiative, a non-profit organization that places students in a project oriented program that provides access to high-end technology used in some of the most progressive fields in the world today. The app allowed for facilitators in the EAST program from 230 different schools across the state of Arkansas to log on and update contact information. The application created will facilitate future user account management, and consolidates important account data to a master spreadsheet. Using geospatial technology to transmit important feedback and solicit information from the general public allows for the community to be more involved in the choices that affect it.

DeShauna Tucker
University of Central Arkansas
Biology (BI)
Undergraduate Student
No

A Qualitative Analysis Of Macroinvertebrates In The UCA Vernal Ponds

DeShauna Tucker, David Dussourd

The health of five vernal ponds east of Stone Dam Creek on the UCA campus will be measured using the Index of Biological Integrity (IBI). Invertebrate samples will be collected monthly from the ponds, which are close to softball and soccer fields that are regularly treated with herbicides that may run off into the ponds. A vernal pond in the UCA nature reserve that is more remote and subjected to less herbicide runoff will serve as a control. Three samples each 1 meter in length will be obtained from each pond using 250 micron D frame nets. The samples will be sorted by size and identified at least to order. Initial samples document the presence of water fleas, ostracods, amphipods, isopods, crayfish, and fingernail clams with striking differences between ponds in community composition.

Ryan Tumminello
Hendrix College
Geosciences (GS)
Undergraduate Student
Yes

Water adsorption on goethite: CCN activation from Frenkel, Halsey and Hill Activation Theory

Ryan Tumminello, Rebecca Meredith, Courtney Hatch

Adsorbed water on the surface of atmospheric mineral dust has recently been shown to significantly affect the ability of mineral dust aerosol to act as cloud condensation nuclei. We have studied water adsorption as a function of relative humidity (RH) on goethite (α-FeO(OH)), a common component of atmospheric mineral dust. The goethite surface area and particle size was determined using BET analysis and with N2 as an adsorbate and scanning electron microscopy, respectively. Water adsorption on the sample was monitored using horizontal attenuated total reflectance Fourier transform infrared (HATR-FTIR) spectroscopy equipped with a flow cell. Water content was determined using Beer's law and the optical constants for bulk water. The results were analyzed using Type II adsorption isotherms to model multilayer adsorption, including BET (Brunauer, Emmet and Teller) and FHH (Frenkel, Halsey and Hill). BET fits to experimental data provide parameters of monolayer coverage, while the FHH provides insight into multilayer adsorption mechanisms. Results indicate that goethite contains 5% H2O by mass at ~50% RH, which increases to 12% by mass at ~90% RH. FHH adsorption parameters are used in FHH Activation Theory (FHH-AT) to predict goethite cloud condensation cuclei (CCN) activation. Experimental water adsorption results, theoretical adsorption parameters, and CCN activity for goethite aerosol will be presented.

Mustafa Tunc 73
University of Central Arkansas
Computer Science (CS)
Graduate Student
Yes

Virtual Arthroscopic Tear Diagnosis and Evaluation Platform (VATDEP)

Doga Demirel, Seth Cooper-Baer, Aditya Dendukuri, Jake Farmer, Mustafa Tunc, Tansel Halic, Sinan Kockara, Nizamettin Kockara, Mark Edward Rogers, Shahryar Ahmad

Conventional arthroscopy training methods in surgery training use cadavers, mannequins, or old-aged apprenticeship model. All these methods have limitation in realism and cost efficiency or incurring high risk. Although the arthroscopy based surgeries have dramatically increased over years, the efficient, risk-free and cost-effective training and assessment platform methods yet remain lacking. We therefore proposed VATDEP to develop virtual reality based arthroscopy simulator in collaboration with expert orthopaedic surgeons. VATDEP is designed for arthroscopic repair of crescent shaped rotator cuff tears. The simulator allows physics simulation of surgery such as fluid flow, air bubbles, tear shaving, bleeding, tissue deformation, drilling and tool-tissue interactions. We incorporated haptic (tactile) interaction to provide realistic force feedback. To build operating room setting, an adjustable frame structure has been built to mimic the operation table. A physical human torso and the arm with three portals openings are used to increase the realism for face validation. Additionally, arthroscopy, shaver, burr and anchor placement instruments has been interfaced to VATDEP via the haptic devices to perform the training with actual instruments. The VATDEP simulator provides a combination of actual operating room and virtual reality environment for surgeons to train and assess their skills. We will further perform face, content, and construct validation studies with human subjects to evaluate the efficacy of the simulator.

Victoria Veerhusen
University of Central Arkansas
Biology (BI)
Graduate Student
No

Understanding Confrontational Behavior of the Rainbow Lorikeet (*Trichoglossus haematodus*) as a Strategy to Reduce Its Impact as an Invasive Species

Victoria Veerhusen

The Rainbow Lorikeet (*Trichoglossus haematodus*), a member of the parrot family Psittaciformes, has become a pest even in its native range of Australasia. It poses an even larger threat as an invasive species due to its highly confrontational behaviors before and during its breeding season, which are so intense that captive individuals must be kept separate from other species of birds. My project is composed of three parts: observation of intraspecific nesting behaviors before, during and after the breeding season; observation and comparison of behavioral patterns when Rainbow Lorikeets are exposed to simulated visual and audial nesting behavior of other bird species before, during and after the breeding season; and finally, using data collected, observe Rainbow Lorikeet behavior while using several innovative and ethical techniques aimed at deterring Rainbow Lorikeets from competing with interspecific species for similar ecological nesting sites . All observation and experimentation will be done on captive lorikeets. Digitally recorded visual and audial behavior patterns will be analyzed and quantified by acoustic and visual pattern analysis computer software. Data and results of this project will be distributed to breeding, holding and wildlife agencies that will be impacted by these probable avian invasives in Australasia and potentially elsewhere.

Valentin Velchev 75
University of Central Arkansas
Computer Science (CS)
Graduate Student
Yes

Analysis and Comparison of Wine Experts with Wineinformatics

Valentin Velchev

Wineinformatics has developed as a study using data science to further the understanding of wine related data for domain knowledge. The goal of this knowledge is to give other researchers a backbone of understanding for future applications in the area of wine. This form of wine research contains useful information for producers and consumers alike; producers may gain an improved understanding of the preferences of consumers so that the market provides a product more appropriately suited to their interests.

One of the goals of Wineinformatics is to use the wine reviews that the judges collect for domain knowledge. The reviews would be scanned into a dataset that would then be used as a basis for data mining algorithms that would attempt to make predictions based on the qualities of the wines. These data include the aforementioned “flavors and aromas” as well as “acidity, tannin, weight, finish, and structure.”

This study applies data mining algorithms such as white-box testing with association rules, k-nearest neighbor, naÃ¯ve Bayes as well as black-box testing with support vector machine in order to predict the qualities that a certain wine would possess. This also involves making a comparison of the different preferences of wine judges in order to determine which qualities a particular judge has a bias toward or against. For example, one wine judge may have a bias toward blueberry while another may have a bias toward raspberry. This information is useful in finding what attributes judges find lead to a higher wine rating.

The results suggest that the support vector machine provides the highest accuracy in predicting various wine attributes for particular reviewers while naïve Bayes is a close second. In addition, it demonstrates that some of the reviewers did not have very strongly correlated positive attributes, which may imply that they have less of a bias toward a certain type of wine.

Samantha Wacaster
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Geosciences (GS)
Undergraduate Student
Yes

Utilizing karst features to account for differences in water quality in the Ozark Plateaus in northern Arkansas

Samantha R. Wacaster, Timothy M. Kresse, Katherine J. Knierim, Kristin S. Dooley

The occurrence of sinkholes and springs, in karst topography may produce local and regional differences in groundwater quality that challenge routine use and management. Within the Ozarks Plateau three physiographic sections (Boston Mountains, Springfield Plateau, and Salem Plateau) comprise one of the largest karst regions in the United States. A joint investigation by US Geological Survey and the University of Central Arkansas is evaluating differences in aqueous geochemistry (such as pH and major cations and anions) as a function of occurrence and density of karst features in the three sections in northern Arkansas. One objective of this study is to produce a large-scale hydrogeologic map that combines what is known about groundwater flow-paths with quality data for wells and springs in the study area. Initial summaries of previous data of the National Water Quality Database showed little difference in pH and a relatively neutral pH of 7.3 for wells and springs across the area. In comparison, sulfate concentration were consistently higher in wells than in springs across all sections and chloride concentrations differed by water source but less consistently. Within the Boston Mountains median sulfate concentrations were 14.0 mg/L for wells compared to 9.7 mg/L for springs, concentrations were lower within the Springfield Plateau but in the same order by source (13.0 mg/L for wells compared to 5.2 mg/L in Springfield Plateau springs), and were still lower within Salem Plateau (8.8 mg/L wells compared to 5.3 mg/L for springs). In contrast, median concentrations of chloride showed a similar order by source for Boston Mountains (8.4 mg/L for wells compared to 2.0 mg/L for springs), but were almost the same for wells and springs in Springfield Plateau (5.5 mg/L for wells and 5.2 mg/L for springs), and were in reversed order within Salem Plateau (2.8 mg/L in wells compared to 7.5 mg/L for springs). Observed patterns in constituent concentrations across the three section

Kaitlyn Walden
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Chemistry (CH)
Undergraduate Student
Yes

The Effect of Video-Based Instruction on Student Performance in a College Chemistry Laboratory

Kaitlyn Walden, Dr. Faith Yarberry, Dr. Marsha Massey

In this experiment, a series of College Chemistry I procedural and conceptual pre-laboratory videos were developed and embedded as QR codes within the laboratory handout. The effectiveness of the videos was evaluated using a variety of tools. One group, the test group, received handouts containing the embedded videos, while a second group, the control group, did not have access to the embedded videos. A pre-laboratory quiz was administered to both groups to evaluate the students initial understanding of the material presented in the laboratory handout. Additionally, the faculty member and teaching assistants of the test group identified the type and frequency of questions asked, regarding the procedure, throughout the laboratory. Finally the test group was given a Likert-scale survey to determine their procedural understanding before, during, and after the laboratory. Currently, we have accumulated anecdotal evidence to indicate that the test group, who received the QR codes, required less guidance during the lab to perform the experiment compared to previous sections of the course under the same instructor. Additionally the quiz grades indicate that the test group performed better, on most questions, than the control group.

Lauren Westwood
University of Central Arkansas
Biology (BI)
Undergraduate Student
No

Lipid Extraction of C. Elegans

Lauren Westwood

Caenorhabditis elegans are nematodes that have a life span of 2-3 weeks and a small body size of about 1 mm as an adult. These nematodes are great to use for lifetime experiments because of their short-lived lives. The overall objective of my experiment is to test and extract the lipids from C. elegans in three different strains, N2 (wild type), mutant hsd-2 (tm 1858) and mutant hsd-2 (tm 1941). After extracting the lipids by a chloroform extraction method, I can use MALDI to obtain the results. Observation of the three different MALDI results for each strain can be compare to see what differences in the lipids are seen. Variation in lipids can be observed and lead to other research in the this field. Other researchers have led to thinking that one difference in the mutants compared to the wild type could be a molecule like cholesterol.

Qinqing Yang
University of Central Arkansas
Physics (PH)
Undergraduate Student
No

The Impact of Weather on Music Festivals in Oklahoma

Qinqing Yang, Jake Bass

During the summer, there are many musical festivals and outdoor events occurring in Oklahoma. Prolonged exposure to summer weather in Oklahoma can be detrimental to the health of those attending the festival. Small changes in the environment can result in major problems with tuning, tone, or even one's ability to play at an outdoor event for those with instruments. Our task is to determine the risk taken by an attendee of a festival and how sensitive instruments are to changes in humidity and temperature and use the data from Mesonet to determine for what conditions an orchestra should prepare. The information regarding health and tuning impacts will be found from various online sources such as the U.S. Global Climate Research Program. Furthermore, we may use the Mesonet data to determine how other factors, such as sun exposure and level of drought, could impact an outdoor concert at one of these festivals for both the players and the audience.

Jessica Young
Arkansas Tech University
Physics (PH)
Faculty / Researcher
No

Generation of Mixed-Parity Ince-Gauss Laser Beams

Jessica Young

Typically, laser beams can be described in terms of the paraxial wave equation (PWE). Beams with Cartesian symmetry can be described in terms of the Hermite-Gauss (HG) solution and beams with cylindrical symmetry can be described in terms of the Laguerre-Gauss (LG) solution. These two families of solutions are well known and are of theoretical and experimental interest because they form a complete base of orthogonal solutions to the PWE and are normal resonating modes of typical laser cavities. There is a third, less-known family of solutions with elliptic symmetry, the Ince-Gauss (IG) family solutions. Because HG and LG beams are solutions to the PWE and are orthogonal, each can be written as a linear combination of the other with a phase difference of pi/2 between successive terms. IG beams create a continuous transition between HG and LG beams. HG and LG beams are the limiting cases of IG beams. Similar to when the eccentricity of an ellipse goes to zero it becomes a circle, as the elliptic perimeter of an IG beam goes to zero it becomes an LG beam. At the other extreme, as the elliptic parameter goes to infinity, the IG beam becomes an HG beam. Experimentally, LG beams can be generated from HG beams via an astigmatic mode converter (a set of specifically arranged cylindrical lenses) with its axis rotated 45 degrees from the beam axis. When the mode converter is rotated at any angle other than 45 degrees, an IG beam of mix parity is generated. The degree parity mixing is dependent on the angle of the mode converter. In this work, we investigate the relationship between the angle of the mode converter and degree of parity mixing.

Andrew Zhou
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Engineering (EN)
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No

Evaluation of a 3D metal-organic framework Cu(bpy)V4O10 as a cathode material for Li-ion batteries

Huajun Zhou, Taylor D. Young, Simon S. Ang, Tom H. Froedge, Bangbo B. Yan

Vanadium-based compounds with channels and layered structures have long received intensive interest as candidates of electrode materials for lithium-ion batteries (LIBs) due to their high capacities and wide redox potentials, making them promising candidates as both anode (e.g. Li3VO4) and cathode (e.g. LiVOPO4) materials. Recently extensive interest has been directed toward developing vanadium-based metal-organic frameworks (MOFs) such as VO(bdc) and K2[(VO)2(HPO4)2(C2O4)] as cathode materials due to their larger and tuneable channel sizes and interlayer distances. Here we report the exploration of the electrochemical performances of a three-dimensional (3D) MOF, namely Cu(bpy)V4O10 (bpy = 4,4'-bipyridine), toward Li-ion insertion and deinsertion. This compound features a novel 3D structure build of stacked vanadate layers [V4O10]- that are connected by [Cu(bpy)]+. It delivers 23 mAh/g and 19 mAh/g during the first discharge and charge respectively in the range of 1.5-3.3 V. In subsequent cycling processes, while the discharge capacities remain around 17 mAh/g. Its relatively low capacities compared to the theoretical capacities (138 mAh/g) & the mechanisms underlying its electrochemical performances are further revealed by crystallography, cyclic voltammetry, ex-situ PXRD, and impedance measurements.