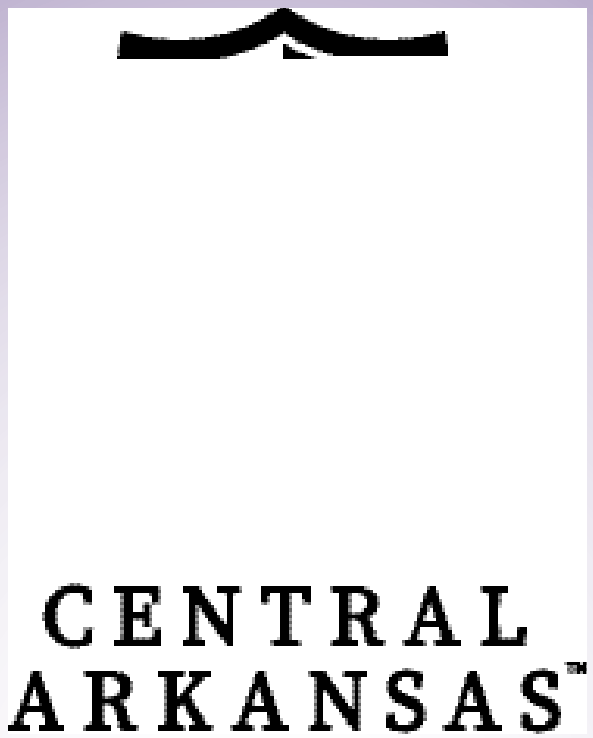

College of Natural Sciences and Mathematics

24th Annual Student Research Poster Symposium

Farris Center
April 20, 2018
1:00 - 3:00 PM

Welcome from the Dean
College of Natural Sciences and Mathematics

Welcome to the 24th Annual College of Natural Sciences and Mathematics Student Research Symposium. Today you will see some of the research that is being undertaken by students in the College. This year we have research from many fields - there are 84 posters involving 110 students mentored by 42 different faculty members. We encourage you to drop by the Farris Center to join us in celebrating the accomplishments of our students.

I look forward to seeing you there.

Cordially,

Stephen R. Addison

Stephen R. Addison, Dean
College of Natural Sciences and Mathematics

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Department of Biology

Effects of Cadherin-18 on Fetal Kidney Cell Aggregation

Andrew Baker
Faculty Mentor: Calin O. Marian

Cadherins are a group of transmembrane calcium-dependent adhesion proteins found in mammalian cells. These proteins are generally categorized into two classes: Type I and Type II cadherins. Type I cadherins (e.g. E-cadherin and N-cadherin) are the best understood, and are well-established as functioning in cell-cell adhesion and recognition. Type II cadherins lack the HAV motif present in Type I cadherins, which is known for playing a signiýcant role in adhesion, so the overall function of these cadherins is still largely unknown. Here we are interested in a Type II cadherin known as cadherin-18 (CDH18). Previous experimentation has shown CDH18 to be associated with other proteins such as ɓ-catenin, which are known to be involved in regulation of cell-cell adhesion. For these experiments, we characterized the adhesive properties of this protein using human embryonic kidney cells that were engineered to over-express CDH18. In these experiments, we attempt to characterize the adhesive properties of CDH18 using a series of cellular aggregation assays.

DNA Isolation from Various Blood Cell Fractions of Red-eared Sliders

David Baker, Emily Chambers, Elias Smith
Faculty Mentor: Calin O. Marian

Red-eared slider turtles (*Trachemys scripta elegans*) have nucleated red blood cells (RBCs), like many other reptiles. Trachemys scripta RBCs can therefore provide ample DNA for analysis. In addition to RBCs, white blood cells (WBCs) can be isolated from

Establishing The Relationships Among Land Use, Nutrients, And Aquatic Communities In Headwater Streams

Danielle Braund
Faculty Mentor: Sally Entrekin

Global hypoxic zones have doubled in area every decade since the 1960s from excessive nutrient inputs. Increased nutrients cause spikes in primary production and heterophic respiration that lead to a depletion in dissolved oxygen and eventual anoxia. Excess nutrients come from point- and nonpoint-source inputs mostly associated with agriculture. The Mississippi River Basin (MSRB) supports the second largest hypoxic zone in the world, spanning 21,000 square kilometers at the mouth of the MSR. The Lake Conway Point Remove watershed (LCPR) was ranked in the top 150 watersheds for the phosphorus exported by streams to the MSR. The origin of this excess phosphorus and its effects on biogeochemical processes and aquatic communities within streams is unclear. Measuring alkaline phosphatase activity (APA), sediment-equilibrium phosphorus concentrations (EPC), and macroinvertebrate community assemblages in 5 agriculturally-dominated and 5 forested watersheds will enhance our understanding of how phosphorus is transformed and transported in stream systems. We predict that phosphorus and nitrogen concentrations will be greater in watersheds with >50% pasture than watersheds that are more forested. Therefore, EPC will

Morphological Evolution of Fish Caused by Changing Stream Habitats

Walker Culp
Faculty mentor: Ginny Adams

Fish shape is known to exhibit both phenotypic plasticity and a rapid response to alterations in habitat. Most research on ýsh shape change has examined the impact of habitat alteration from a lotic to lentic system after construction of dams. In the White River watershed in north Arkansas, the Kings River þows directly into Table Rock Dam, potentially isolating lotic ýshes. We are investigating how this potential barrier to movement (Table Rock Dam) could potentially affect morphology of ýsh species in this watershed. We were speciýcally interested in the morphology of *Lepomis megalotis*, *Lepomis macrochirus*, and *Notropis greenei* as these species were noted as looking superýcially different in the Kings River. Although current studies on anthropogenic alteration to aquatic habitats in Arkansas have shown community level responses, no research has been done on individual ýsh morphology. Photographs of the target species were digitally landmarked with TPS software and morphometric data analysis was conducted using the R program suite. The MANOVA statistical analysis done on the geometric coordinates proved signiýcant results in the variance between the populations separated by the dam. On average, *L. megalotis* showed the least amount of variation and *N. greenei* had the highest variance factor. The predominant changes in the greenei were shortening of body length with slightly = ɤ ʌ ns i Ď e esu Õ es$s in the ƻ _ o ʻ

Host Specificity of the *Burkholderia – D. discoideum*: Artificial and natural *Burkholderia* infections in *D. purpureum*

Habitat Associations Of Riffe Fishes In An Ozark River Having A Dynamic Gravel Bed Load

Chance Garrett
Faculty Mentors: Ginny Adams, Reid Adams

Streams of the Arkansas Ozarks have experienced extensive erosion and gravel intrusion due to changing land use. As a result, modiýcations to instream habitat have resulted in an increase in transverse and diagonal gravel bars along with associated shallow, low þow rifþes. This study was conducted to determine if variation in rifþe habitat (depth, velocity, substrate size) affects rifþe ýsh communities. Understanding how ýshes are using different rifþe habitats is crucial to ensuring restoration efforts provide the necessary habitats for ýshes throughout their various life history stages. For this study 22 rifþes were sampled in the Kings River, Arkansas using seines and kick set methods. Fishes were preserved in 10% formalin and identiýed in lab; standard lengths of benthic ýshes were taken. Habitat data were collected at each rifþe including velocity, pebble count, depth, and water quality. The
"

The Effect Of Simulated Microgravity On The Biophysical Properties Of The Tibia

Kristen Jones, William Fuell
Faculty Mentors: Rahul Mehta, Brent Hill

Simulated microgravity has been linked to a decrease in bone density and strength. Because most bone density studies have utilizing the male sex, challenges may exist if spaceþight is not also investigated in the female sex. 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

Host Specifcity of *Burkholderia-Dictyostelium discoideum* Symbiont and Identifcation of *Burkholderia* Symbionts from other Social Amoeba Species

Alexandria Melton
Faculty Mentor: Tammy Haselkorn

Symbiosis can be observed diversely across eukaryotic life, impacting the health, ecology, and evolution of both host and symbiont. The relationship identiýed between the soil-dwelling amoeba, *Dictyostelium discoideum* (

Is The Leafy Gene A Single Copy Gene? A Test In The Asteraceae Tribe Astereae

Miguel Mercado
Faculty Mentor: Richard Noyes

The tribe Astereae of the sunþower family (Asteraceae) is predominantly North American in distribution and includes the familiar goldenrod and aster genera, among many others. Evolutionary relationships for the group are poorly resolved; however, the nuclear gene Leafy (LFY) has successfully been used in some plant groups (Lu et. al., 2012). It is a single copy gene consisting of 3 exons and 2 introns. Previous research done in our lab made use of exon 1 of the LFY gene for 12 different species, and yielded some degree of success. This experiment seeks to expand on our past research by making use of exon 3 for the same 12 species and 2 additional outgroup species. The results suggest that LFY may be present in more than one copy, possibly as a result of whole genome duplication prior to the origin of the Astereae tribe. Future analyses will have to carefully take in to account two or more paralogous copies of LFY.

Sub-Lethal Ion Concentrations Alter Shredder Performance And Leaf Litter Processing

Anastasia Mogilevski
Faculty Mentors: Sally Entrekin

Streams in the Arkansas Valley have naturally low ion concentrations (~30 εS/cm). However, ion concentrations are increasing because of agriculture, wastewater efþuent, and resource extraction (1.26-533 mg/L Cl-). The state only regulates chloride ions despite the rise of other major ions (e.g. Na+, Mg2+, Cl-, K+, HCO3-), and ion-speciýc biological effects are largely unknown. Conductivities above naturally occurring ion concentrations could induce sub-lethal effects in aquatic organisms. Sub-lethal ion concentrations may slow leaf litter processing via reduced detritivore feeding or growth. We predict sub-lethal salt concentrations may change litter-processing rates by altering the energy required by microbes and shredders for osmoregulation, and by altering litter quality for shredders. Here, we predict salt-induced changes in microbial community composition and activity will decrease processing rates by reducing shredder litter palatability or nutrition. Isopods, a crustacean, were fed leaves incubated in natural streamwater (~3 mg/L NaCl), and leaves incubated in one of six NaCl or NaHCO3 treatments (16, 32, 64 mg/L). Isopods grew ~20% less in the intermediate salt concentrations compared with natural streamwater. The rate of respiration and amount that isopods ate did not differ between natural and intermediate salt concentrations. Therefore, we predict insect shredder growth will also decrease from altered nutrition when fed salt-incubated leaves using the same salt treatments as above with a common shredding caddisþy. Results will further support that sub-lethal salt concentrations can indirectly alter stream detrital processing.

The Growth Of Glyphosate-Resistant *Amaranthus palmeri* In Response To

Cellular scaling in brain of the nine-banded armadillo (*Dasypus novemcinctus*)

Nicole Poling
Faculty Mentor: Jeffrey Padberg

The distribution of neurons and non-neurons in mammalian brain structures varies across species. The cellular distributions of mammalian brains have been widely studied, but quantitative examination of cellular composition of xenarthran species has not been described. In this study, we used isotropic fractionation to determine the number of neuronal and non-neuronal cells in the nine-banded armadillo, *Dasypus novemcinctus*. The right and left sides of each structure were processed separately. Cellular nuclei were identiýed by staining with 4ô,6ô-diamidino-2-phenylindole (DAPI), and all neuronal nuclei were identiýed by immunocytochemistry for the neuronal nuclear antigen (NeuN). Neuronal nuclei were secondarily stained with AlexaFluor 555 or 594 for visualization. Here we present the ýrst quantiýcation for neuronal and non-neuronal cell counts for the armadillo brain. The armadillos used in this study had body masses ranging from 5.0-6.1 kg and brain masses ranging from 10.7-13.9g. We observed that the armadillo brain ranges from 36-44.1 million non-neuronal and 4 million neuronal cells in the cortex, 49-55.7 million non-neuronal and 4.8-5.6 million neuronal cells in the pyriform cortex, and 15.5-33.5 million non-neuronal and 3-5 million neuronal cells in the hippocampus. Based on these results, the cortex is 9-10% neurons, the pyriform cortex is 8-10% neurons, and the hippocampus is 14-18% neurons. The neuron densities in these structures ranged from 1.2-1.9 million neurons per gram in the cortex, 1.8-1.9 million neurons per gram in the pyriform cortex, and 4.8-6 million neurons per gram in the hippocampus. With these data, we can add xenarthrans to the large number of species whose brain cellular compositions have been previously studied. Studying the cellular distribution of the armadillo brain not only provides insight into the brain structure and function of a xenarthran species, but also enhances our understanding of cellular scaling rules across mammalian clades and the evolution of brain structures in general.

Comparison Of Antimicrobial Properties Of Different Beer Brewing Methods

Harleigh Robbins
Faculty Mentor: Benjamin Rowley

Bryophyte Diversity Of Arkansas

Shelby Ruple
Faculty Mentor: Richard Noyes

Bryophytes are a diverse group of land plants that comprise approximately 20,000 species and are divided into three main divisions: Marchantiophyta (liverworts), Anthocerotophyta (hornworts), and Bryophyta (mosses). Bryophytes are found worldwide, but the highest level of bryophyte diversity is found in tropical and temperate regions. Diversity of bryophytes in Arkansas is poorly known because a large-scale accounting of bryophyte diversity for Arkansas is lacking. The Ozark region has been sampled much more extensively than other regions of the state, such as the Arkansas River Valley or the Ouachita Mountains. There are approximately 376 known bryophyte species in Arkansas, which include 254 species of mosses, 115 species of liverworts, and 7 species of hornworts. However, this total is likely an underestimate of the actual bryophyte diversity in Arkansas. In addition to organismal diversity, population level studies help to gain a better understanding of how these plant populations are inþuenced genetically by sexual and asexual reproduction. In this study three markers, rcbL, trnL-F, and nuclear ITS, will be used to examine the gene þow between 12 populations of a native leafy liverwort, Frullania inþata. The objective of this research is to characterize the bryophyte þora in Cove Creek Natural Area and understand the genetic structure of several populations of *Frullania inƒata*.

The Effects of Microgravity on the Vascular Tone in Female Mice

Sage Shaddox
Faculty Mentor: Brent Hill

Microgravity has been previously demonstrated to reduce vascular tone in male mice. However, few studies have evaluated the effect of microgravity on vascular function in female mice. Simulated microgravity was induced for 4 weeks using tail-ring, hind limb unloading (HLU) in female mice (4 months old). We hypothesized that removal of gonadal estrogen via an ovariectomy (OVX) would exacerbate the aortic contractile response in HLU mice. We tested four treatment groups of mice: (1) SHAM ground/non-HLU, (2) SHAM HLU, (3) OVX ground/non-HLU, and (4) OVX HLU. Isometric tension measurements were determined in response to the Ca2+ channel agonist, FPL64126, and the Ŭ1-adrenergic agonist, phenylephrine, and the Ca2+ channel antagonist, nifedipine. Our results suggest that OVX HLU mice have a greater aortic contractility to phenylephrine, but not FPL64126; thus, suggesting an enhanced SR Ca2+ release mechanism. There was a decline in body weight due to the HLU treatment in both groups of mice; however, the daily food and water consumption was similar. Using magnetic resonance imaging, fat and lean mass were measured in all groups. With OVX mice, HLU treatment induced less fat accumulation than the ground mice. Also, the OVX mice lost lean mass. Plasma corticosterone was elevated in HLU mice compared to the ground mice. This study provides foundational knowledge about how microgravity may exacerbate vasoconstriction, and limit energy reserves (fat accumulation) in female mice with reduced gonadal estrogen production. Thus, impacting potential countermeasures for female astronauts entering peri-menopause or menopause. Support: Arkansas Space Grant Consortium & UCA Student Research Funds.

Energetic cost of girdling in the notodontid caterpillar, *Oedemasia leptinoides*

Brianna Trejo
Faculty Mentor: David Dussourd

Some caterpillars cut a ring around the rachis, petiole or stem of a plant before feeding on distal leaf blades. This girdling behavior has been observed in multiple species of the lepidopteran family, Notodontidae. In one study, caterpillars of *Oedemasia leptinoides* (Notodontidae) spent up to 11% of their time girdling over a 12 hour observation period, whereas another notodontid, *Lochmaeus manteo*, did not girdle at all (Grimpe et al., 2012). Girdling i

Regulation Of Gene Expression In Rice Roots During Interactions With Nitrogen-Fixing Bacteria

Grant Wiggins, Qinqing Yang, Ha Ram Kim, Christian Melendez, Charlie Wilson, Allee Haynes
Faculty Mentor: Arijit Mukherjee

Biological Nitrogen Fixation (BNF) is increasingly viewed as a viable alternative to fertilizers for supplying nitrogen to plants. Several reports have shown that the BNF in cereals (e.g., rice, corn, wheat, etc.) comes from nitrogen-ýxing bacteria. For instance, major cereal crops can form beneýcial associations with nitrogen-ýxing bacteria like *Azospirillum* and *Herbaspirillum*. Interestingly, these bacteria induce no specialized root structures (e.g., root nodules in legumes) and use different mechanisms to colonize plant roots. Our current understanding of the molecular aspects and signaling that occur between important crops like rice and these nitrogen-ýxing bacteria is limited. In this study, we used an experimental system where the bacteria could colonize the plant roots, and then used this colonization model to identify regulation of gene expression at different stages of symbiosis. We used RNA sequencing to identify 1622 differentially expressed genes (DEGs) in rice roots 1day post inoculation (dpi) and 1995 DEGs at 14dpi with *Azospirillum brasilense*. Similarly, we identiýed 1688 DEGs in rice roots 1dpi and 1515 DEGs at 14dpi with *Herbaspirillum seropedicae*. We identiýed several host pathways that could be potentially involved in these symbiotic interactions. Our data also suggest the presence of a molecular dialogue between the symbiotic partners that might be crucial for recognition and initiation of these symbioses. Also, we validated the RNA sequencing gene expression results of a few genes via reverse transcriptase polymerase chain reaction (RT-PCR). Findings from this study will improve our understanding of the regulation of gene expression occurring in rice roots during beneýcial interactions with nitrogen-ýxing bacteria.

Department of Chemistry

Improving Student Success On Lewis Structures, VSEPR Theory, Polarity, And VB Theory

Morgan Burke, Eric Wilcox
Faculty Mentor: Faith Yarberry

Lewis Structures, VSEPR theory, VB theory, and molecular polarity prove to be difýcult concepts for students in freshman-level chemistry courses. Split-screen lecture videos on these topics have been developed with the overall goal to improve student success in the classroom and on the nationally standardized American Chemical Society (ACS) exam. Student success has been evaluated using their test scores on the end-of-course exam and the ACS exam after completion of an online lab dedicated to viewing the lectures through EdPuzzle.

A Blackboard quiz, administered following the completion of the EdPuzzle video, was used to determine students scores for the online laboratory. End-of-course exam questions and ACS exam questions, related to the videos, was analyzed and compared against the previous three years of student success on these topics. Our data demonstrates the effectiveness of the video tutorials.

Nickel-Nickel Dimers Structurally Reminiscent Of Common Nickel Scorpionates

Triston J. Clements
Faculty Mentors: Patrick J. Desrochers, Nikolay Gerasimchuk

As part of our work on nickel scorpionate complexes, a new class of nickel-nickel dimers was discovered in our laboratory. These [Cl-Ni(mu-pz)$_3$Ni-Cl] anionic dimers were synthesized by direct reaction of sodium pyrazolide and tetrachloronickelate(II) ion in DMF. This general synthetic approach was used for a variety of pyrazoles: pyrazole, 3,5-dimethylpyrazole, 3,4,5-trimethylpyrazole, and 4-chloro-3,5-dimethylpyrazole. Dimer formulations were conýrmed by MALDI-TOF mass

Synthesis Of Aryl Selenide Amino Acid Radical Precursors

Eriq D. Deaver, Jarett D. Duvall
Faculty Mentor: K. Nolan Carter

Proteins and other biomolecules are subject to damage by reactive oxygen species such as hydroxyl radical. This process is believed to play a role in aging and diseases such as cancer. The reaction of hydroxyl radical with proteins is complex since hydroxyl radical is non-speciýc and can attack many sites within the polypeptide chain. Due to this issue, studying the role played by speciýc radical intermediates in protein damage is difýcult. To facilitate the study of this process, a strategy using aryl

Fd&C Dye Content Of Popular Beverages

Evaluation Of Potential Pre-Requisites In Determination Of Student Success In Freshman-Level Chemistry Courses

Jordan Preston
Faculty Mentor: Faith Yarberry

Synthesis Of Multi-Modal Drugs Toward The Treatment Of Chagas Disease

Rachel Senn
Faculty Mentor: Gregory Naumiec

Neglected tropical diseases affect over one billion people per year, causing effects that range from fever to heart and bowel failure. Chagas disease manifests itself in two forms, the acute phase which causes fever and swelling of the spleen and liver, and the chronic phase which is thought to be the leading cause of heart disease in Latin America, in countries such as Argentina,

Improving Success In Freshman-Level Chemistry Laboratories Through Online Procedural Videos

Department of Computer Science

A Task And Performance Analysis Of Endoscopic Submucosal Dissection (ESD) Surgery

Berk Cetinsaya, Doga Demirel
Faculty Mentor: Tansel Halic

ESD is an endoscopic technique for en bloc resection of gastrointestinal lesions. ESD is a widely-used in Japan and throughout Asia, but not as prevalent in Europe or the US. The procedure is technically challenging and has higher adverse events (bleeding, perforation) compared to endoscopic mucosal resection. Inadequate training platforms and lack of established training curricula have restricted its wide acceptance in the US. Thus, we aim to develop a Virtual Endoluminal Surgery Simulator (VESS) for objective ESD training and assessment. In this work, we performed task and performance analysis of ESD surgeries.

Partition-Based Optimization Model For Generative Anatomy Modeling Language (POM-GAML) For Anatomy Modeling

Doga Demirel, Berk Cetinsaya
Faculty Mentor: Tansel Halic, Sinan Kockara, Shahryar Ahmadi

In our prior study we developed a constraint based (e.g. joints) human anatomy modeling language (GAML). In this paper, we

Arkansas Telemedicine Platform Design And Development For Dermatology: A Secure Cloud Based Skin Cancer Melanoma Detection System For Arkansas

Recep Erol
Faculty Mentor: Sinan Kockara

In this study, we develop a system to help dermatologists to diagnose melanoma in its early stages. Accurate diagnoses of

Imbalanced Learning - Smote

Padma Priya Jaladi
Faculty Mentor: Victor S. Sheng

Everything in todayôs world deals with data and most of the data is imbalanced data. Imbalanced data problem is often found in real world applications, it causes seriously negative effect on performance of machine learning algorithms. There have been many attempts at dealing with imbalanced data sets There are different algorithms for classiýcation of imbalanced datasets out of which smote algorithms is used the most. The synthetic minority oversampling technique (smote) oversamples the minority group in the dataset for better prediction. There is another algorithm developed based on smote algorithm called borderline smote. In this paper I want to apply these tow algorithms on 10 different datasets and compare the results. By this we can know which is better algorithm among them.

Multi-Target Classiﬁcation and Regression in Wineinformatics

James Palmer
Faculty Mentors: Bernard Chen, Victor Sheng, Sinan Kockara

Wineinformatics is the ýeld which uses machine learning and data mining techniques to glean useful information from wine. In this work, attributes extracted from wine reviews are used to make predictions on three key targets/ labels: price per 750mL bottle, quality based on a 100 point scale, and style derived from the region of origin. Using support vector machines and support vector regression, binary and multiclass classiýcation and regression schemes are applied to price and grade, while binary classiýcation is applied to origin. Several different implementations and techniques are explored to achieve good performance, including both single label and multi-label approaches. Additionally, a class imbalance problem is explored and partially mitigated for the grade label. This work is able to achieve binary classiýcation accuracies of 85.9%, 75.89%, and 88.52% on grade, price, and region, respectively; multi-class classiýcation accuracies of 76.21% and 48.71% on grade and price, respectively; and mean absolute error for regression of 1.59 points and $12.94 for grade and price, respectively.

Using Computer Vision Techniques for Parking Space Detection in Aerial Imagery

Dynamic Voxelization For Virtual Rotator Cuff Surgery

Mustafa Tunc
Faculty Mentors: Tansel Halic, Sinan Kockara

Arthroscopy is a minimally invasive surgical procedure for diagnosis and treatment of joints. Arthroscopic Rotator Cuff (ARC) is a surgical treatment for the group of muscles and tendons that connect the upper arm to the shoulder blade. Surgery training for ARC is challenging due to constrained instrument controls, non-natural hand-eye coordination and limited ýeld of view.

Department of Geography

Vegetation Cover And Erosion Vulnerability In The Lake Maumelle Watershed, Arkansas

Ashley R. Barto
Faculty Mentor(s): Matthew H. Connolly

What Level Of Complexity Is Necessary? A Comparion Of Runoff Potential Modeling Techniques In A Small Watershed

Mark E. Mahar
Faculty Mentor: Matthew H. Connolly

In hydrological studies, or studies with a hydrological component, a lot of time can be spent selecting and running models to determine precipitation potential runoff path and intensity. Runoff potential estimates are useful for understanding water quality, sediment transport, and potential þood zones. This study examined whether or not a generalized runoff potential layer created using relatively simple inputs such as elevation data, land use data, and soil data is statistically similar to runoff potentials created using more complex models. Runoff potential estimates for two different models: SWAT (speciýcally ArcSWAT) and HEC-GeoHMS were compared to the generalized model for a single subbasin in the Lake Maumelle Watershed in Central Arkansas. This subbasin is a good example of a small hydrological project which can be challenging for some complex models to process.. Random points were selected with ArcGISô Create Random Points tool, and assigned the runoff potential value for each method.

Department of Mathematics

Modeling Insulin Negative Feedback Production

Thomas Banh
Faculty Mentor: Weijiu Liu

Diabetes is a pandemic. The problem with diabetes originates from the blood glucose regulation system not functioning properly. The goal of this research is to develop a linear mathematical model of this regulation system. A linear mathematical model will

Kernel Density Estimation

Nathaniel Gregg
Faculty Mentor: Janet Nakarmi

Estimates of the probability density function of a random variable are used to detect skewness, multimodality, and anomalies. Histograms are the simplest tools used for density estimation, but they are slow to approximate the underlying distribution for

Nonclassical Symmetries of a Harry Dym Equation

Andrea Weaver
Faculty Mentor: Danny Arrigo

It is generally known that classical point and Lie symmetries of differential equations can be different. It has recently been shown for a general class of nonlinear Convection-Diffusion equations and nonlinear Wave equation, that their nonclassical symmetries are contained within the nonclassical symmetries of equivalent systems. We ask if this is true for the power law Harry Dym equation. We calculate the classical and nonclassical symmetries of both the original equation and the equivalent system. We show that both the original equation and equivalent system possess their own special separate symmetries.

Simulating Spatial Spread Of Epidemics Using Mathematics

Azaryah Wilson
Faculty Mentor: Long Le

Department of Physics & Astronomy

Using An Xrf To Investigate The Effects Of Cosmic Radiation On Ion Channel Proteins

Seth Barr, Maria Neal
Faculty Mentor: Azida Walker

Gamma-Gamma Correlation

Jake Bass, Sonja Wagner
Faculty Mentor: Rahul Mehta

The sodium isotope we analyzed in this experiment, Na-22, undergoes ϐ-- decay, which results in a positron being ejected from the decaying atom. This resulting positron is captured by another electron in the sample, resulting in their mutual annihilation.

X-Ray Fluorescence

Timothy Brown, Jalen Greer
Faculty Mentor: Rahul Mehta

X-ray þuorescence is used to identify elemental and chemical make-ups of materials such as metals, building materials, and soil samples. A sample is bombarded with X-rays, exciting the particles that make up the material. These X-rays cause photoelectric interactions in the sample. The characteristic X-rays that are produced by these photoelectric interactions are then counted by a low-energy X-ray detector, and through examination of the energies, the elements within the material can be identiýed as each element emits photoelectric interactions at a different energy value. Samples of known compositions were tested and the emission energy values were recorded. After plotting the known values, a best-ýt line was used to ýnd the composition of unknown samples

Effects of Simulated Microgravity and Cosmic Radiation on the Mechanical and Chemical Properties of Rat Femur and Tibia Bones†

Sidney G. Freyaldenhoven, Jordan S. Barajas, Hayley N. Heacox
Faculty Mentor: Rahul Mehta, Brent Hill

It is accepted that the skeletal system of humans is susceptible to space conditions such as microgravity and cosmic radiation, with effects such as decreased bone mineral density and strength. This research analyzes rat femur and tibia bones when exposed to hind-limb suspension (HLS) for 14 days and 0.5 GY x-ray irradiation (IR) administered over 10 days, thus simulating microgravity and cosmic radiation; then, quantiýes mechanical and chemical properties, elasticity of bones and calcium and phosphorus content,respectively. It is hypothesized that if microgravity and cosmic radiation lead to decreased bone mineral density, then these conditions will produce weakened bones, lower elastic moduli and abnormalconcentrations of calcium and phosphorus, as compared to bones not subject to these conditions.

To assess the physical changes of the bones, a three-point bending technique was employed to estimate the Youngôs (elastic) modulus for the leg bones. There was no statistical difference in the elastic modulus for data sets 1, 2, or 3. However, trends suggest that the IR, HLS, and HLS-IR produced lower elastic moduli.To investigate the chemical nature of the bones, a Scanning Electron Microscope (SEM) was used to take cross-sectional images and an Energy Dispersive x-ray Spectroscopy (EDS) was used to perform elemental analysis. Elemental changes vary not very signiýcantly between CON and IR in data set 1; while, the elemental composition is lowest in joint proximities (hip and knee) in CON and IR. Currently, data sets 2 and 3 are undergoing SEM-EDS analysis. Ultimately, the results produced by this research will aid in quantifying the effects of spaceþight on the strength and composition of the human skeletal system.

À Supported by a RID and CRP grant (Grant Number: UCA26844) from ASGC. Authors acknowledge our mentors Parimal Chowdhury and Max Dobretsov from UAMS.

Cooperative Student-Built Multi-Payload Balloon-Satellite Eclipse Measurement

Russell Jeffery
Faculty Mentor: William V. Slaton

Six high altitude balloon payloads were built and þown in the path of totality on during the 2017 total solar eclipse across the US. The payload þight controllers consisted of Raspberry Pi computers running code written in Bash and Python 3.4 to collect and store data from sensors. The program on each payload collected data from an external temperature sensor, an internal temperature sensor, a pressure sensor, a light sensor, a GPS unit, and a camera. The design also incorporated a smart internal heater to prevent the payload from freezing. The payload design, circuit, and code will be presented along with lessons learned and plans for future work. This project was made possible by a Robert Noyce Teacher Scholarship, a subaward from the Arkansas Space Grant Consortium, and Student Research Funds from the Department of Physics and Astronomy at the University of Central Arkansas.

Effects Of Autistic Youth In Science

Garrett McKamie
Faculty Mentor: Debra Burris

Autism and other varying disorders who qualify on the autistic spectrum have been a topic of growing biological and neurological research in the past decade. Theories propose that many of the greatest minds weôve ever encountered through time were actually on the autistic spectrum in some way or another. Some of the names related directly to science who were believed to be on the spectrum were Sir Isaac Newton, Albert Einstein, Nikola Tesla, and Paul Dirac to name a few. As research into autism grows, so has the understanding of the historically unknown genetically induced syndrome. Autism is now believed to be the overuse of parts of the brain compared to people who are not believed to be autistic. This overuse of the brain is linked to phenomenal academic abilities some autistic people exemplify. But society has vast a dark shadow over people with autism and limited them to conýned boundaries that could be limiting our scientiýc success up to date. The subject of this research is to determine if this societal conýning of autistic people has conýned our autistic youth leading them to believe that no matter their interest level in science, they will never be ab le to be a scientist because theyôre ñspecialò. The test performed will be for the students to create an image of what they believe to be a scientist through a stick ýgure. There are two expected results, one being that the students build a stereotypical mad scientist they may have seen on TV and other media outlets. The alternate expected result of the

Rutherford Backscattering Spectrometry

Paul Niyonkuru
Faculty Mentor: Rahul Mehta

In Rutherford backscattering spectrometry the energy ratio of the emitted to the scattered particle beam, called the kinematic factor K, shows that the energy after scattering is determined only by the masses of the particle and the target atom and the scattering angle. This result allows to determine the mass, hence, the chemical nature of the target atom by only knowing the kinetic factor, the mass of the particle and its scattering angle. In this project we determine the chemical composition of an unknown sample by shooting it with an incident 1MeV particle beam of He+ scattered at an angle of 135 degrees.

Drake Equation

Clifton Peck
Faculty Mentor: Debra Burris

In this study the researchers will be ýnding the probability of another habitable planet in the Milky Way Galaxy by analyzing the Drake equation. This equation considers all the variables relevant to ýnding another civilization, then multiplies the variables together to form a realistic probability. The researchers will use the equation to form their own ýgures for each variable. The new equations will consists of the seven variables that make up the Drake equation and will be compared to the original probability outcome. Once the new equation is obtained, the researchers will perform error analysis to determine the accuracy of the outcome.

Thermodynamics Of CPU Cooling Solutions

Austin Rutledge
Faculty Mentor: William Slaton

With the widespread usage of computers today, it is important to study the effects of thermodynamics on a per component level. The objective of this research is to look at the ways common Computer Processing Units (CPU) coolers dissipate heat. High temperature damages silicon components leading to failure of the CPU. This project will give a better understanding behind why many CPUs die with coolers that seem adequate but are not good enough to dissipate the heat produced. The recent increase in the average power output of modern CPUs makes this an interesting case, as many of these are being slowly damaged by the heat they produce. An apparatus was custom made for testing the cooling power capability and the temperature of three modern CPU coolers. Temperature was measured in four different locations. Each location has a speciýc importance, but the block temperature and cooler core temperature were used for this analysis. Each cooler used the same thermal interface material between each test to limit cooler disparity. Pulse width modulation of a 100 watt heater core was used to accurately test different power levels representing CPU power output. Using a simple power equation the temperature and thermal constants can be found. Both modulated power and temperature difference values can be used to predict what CPU power maximum each cooler can theoretically dissipate at a given temperature difference. This research will detail why certain coolers fail to keep temperatures of modern CPUs in check by using tested temperature differences, analysis of these temperatures, and input power.

Development Of An Acoustic Scanner

Nicholas Scoles
Faculty Mentor: Carl Frederickson

Hardware and software are being developed to create a system that can be used scan a 2-dimensional acoustic wave ýeld. The system consists of two linear actuators aligned perpendicular to each other. Mounted on the scanner is a 1/4ò microphone. The system can scan a region 30 cm x 30 cm. Software has been developed in Python to control the position of the microphone, the source signal, and the recorded signal. This system can be used to produce acoustic holograms as well as 2-D images of acoustic wave ýelds.

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