



102nd Annual Meeting

Hosted by



**ARKANSAS STATE
UNIVERSITY**

Chairman's Remarks

It is a distinct pleasure to welcome you to the 102nd annual meeting of the Arkansas Academy of Science, and to our wonderful campus at Arkansas State University. This annual meeting is returning to Arkansas State University after 14 years.

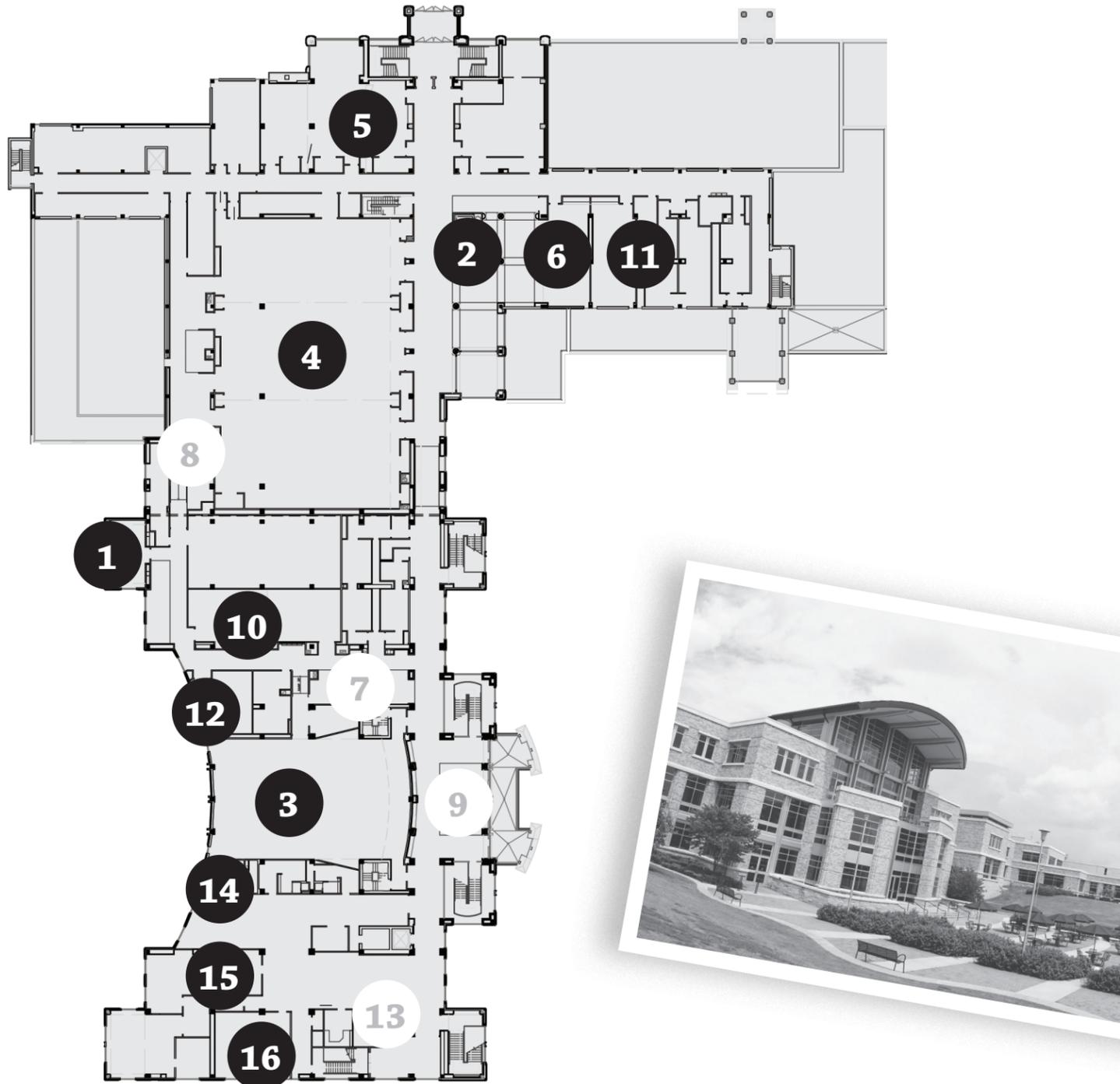
There are more than 170 registrants and approximately 150 technical papers to be presented in 14 sessions during this meeting. There are 18 universities and four government agencies that are represented in this event.

The annual meeting is a gathering of members and guests who work and conduct research in any of the STEM (Science, Technology, Engineering and Mathematics) related areas. The AAS annual meeting emphasizes professional development, learning from experts, sharing of experiences and networking with peers.

We are grateful to the dedicated AAS members who have volunteered to serve as session chairs and/or judge the student papers. The success of this event is not possible without your contributions.

The organizing committee has worked hard to make your stay in Jonesboro pleasant and productive. If there is any way that we can assist you in making your visit more pleasurable, please be sure to let us know. I wish you all a very enjoyable and educational meeting.

Rajesh Sharma
Chairman, 102nd Arkansas Academy of Science Meeting
Arkansas State University



Map (Third Floor, Student Union)



- | | |
|----------------------|----------------------------|
| 1) 1909 Suite | 9) Vaughn Student Lounge |
| 2) Alumni Lounge | 10) Mockingbird Room |
| 3) Auditorium | 11) St. Francis River Room |
| 4) Centennial Hall | 12) Pine Tree Room |
| 5) Spring River Room | 13) Multicultural Center |
| 6) Cache River Room | 14) White River Room |
| 7) Diamond Lounge | 15) Black River Room |
| 8) Green Room | 16) Arkansas River Room |



Organizing Committee

Rajesh Sharma, Chairman rsharma@AState.edu
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 Tanja McKay (Biology) tmckay@AState.edu

Schedule

Friday, April 6

10:00 a.m.	Executive Committee Meeting	1909 RSU
11:00 a.m. - 5:00 p.m.	Registration and Payments	AL-RSU
Noon - 12:30 p.m.	Judges and Session Chairs	RSU
1:00 - 2:30 p.m.	Oral Sessions 1	RSU
2:30 - 3:00 p.m.	Break - Refreshments	
3:00 - 4:30 p.m.	Oral Sessions 2	RSU
5:00 - 6:00 p.m.	Mixer	CBSS
6:00 - 8:00 p.m.	Banquet and Keynote Address	CBSS

Saturday April 7

8:00 - 9:00 a.m.	Continental Breakfast	RSU
8:00 - 10:00 a.m.	Registration and Payment	AL-RSU
8:30 - 10:30 a.m.	Oral Sessions 3	RSU
8:30 - 10:30 a.m.	Posters	CH-RSU
10.30 a.m. - Noon	Tour ACBC	Lab Science East
10:30 - 11:30 a.m.	Meeting of Judges	RSU
Noon - 1:00 p.m.	Awarding of Prizes (<i>AAS Business Meeting</i>)	Auditorium, RSU

AL-Alumni Lounge CH-Centennial Hall RSU-Reng Student Union CBSS-Centennial Bank Stadium Suite

Schedule of Scientific Sessions

* - Undergraduate
 ** - Graduate

Friday Session 1

Aquatic Biology, White River Room

1:00 p.m.	Claire Turkal*	Effects of recreational boat noise on avoidance and feeding behaviors in an important freshwater stream fish
1:15 p.m.	Taylor Stone*	Culture-independent analysis of Hot Springs National Park thermophiles
1:30 p.m.	Dustin Thomas**	Stocking Assessment and Long-Term Impacts of Non-Native Walleye on the Native Population in the Eleven Point River, Arkansas
1:45 p.m.	Jeremiah Salinger**	Distribution Records of the Chestnut Lamprey in Arkansas
2:00 p.m.	David Bowles	Aquatic invertebrate community assessments at Ozark National Scenic Riverways, Missouri, 2005-2014
2:15 p.m.	Charles Gagen	New Applications of Radio Frequency Identification Stations for Monitoring Fish Movement through Headwater Road Crossings and Natural Reaches

General Biology & Ecology, Mockingbird Room

1:00 p.m.	Adam Turner*	Impact of Lespedeza cuneata invasion on arthropod abundance in a tallgrass prairie
1:15 p.m.	Carolina Kirksey*	Patterns of Lespedeza cuneata invasion in tallgrass prairies and arthropod community structure
1:30 p.m.	Varenya Nallur	Unconventional gas development effects on ecosystem services in the Fayetteville Shale of Arkansas
1:45 p.m.	Caleb O'Neal*	Aerobic Pushups: Cutaneous Ventilation in Overwintering Smooth Softshell Turtles, <i>Apalone mutica</i>
2:00 p.m.	Stan Trauth	Germinal Epithelium Cytology during Spermatogenesis in the Alligator Snapping Turtle, <i>Macrochelys temminckii</i> (Reptilia: Chelydridae)
2:15 p.m.	Karen Fawley	Soil Crust Algal Communities of Warren Prairie Natural Area

Medicine, Molecular & Cellular Biology, Black River Room

1:00 p.m.	Malcolm Anderson*	The mechanism of thymoquinone-induced apoptosis in oral cancer cells
1:15 p.m.	Dustyn Barnette**	Terbinafine bioactivation: Determining pathway to reactive metabolite accumulation using computational modeling and experimental approaches
1:30 p.m.	Dakota Pouncey	Coumadin (Warfarin) Pharmacokinetics Change for Pediatric Patients with Single Ventricle Physiology during Initiation of Anticoagulant Therapy
1:45 p.m.	Antoinette Odendaal	Daphnia magna as a model organism for screening the effects of dietary supplements.
2:00 p.m.	Dhaval Shah	CYP3A7 Metabolizes Dextromethorphan Less Efficiently than CYP3A4.
2:15 p.m.	Dennis Richardson	Geohelminth Infection, Anemia, and Malnourishment in Bawa, Cameroon After Ten Years of Intervention by the Bawa Health Initiative

Chemistry & Geosciences, Arkansas River Room

1:00 p.m.	Blake Ludwig*	A Bond Valence / Bond Length Correlation for Tantalum-Oxygen Bonds
1:15 p.m.	Katie Farmer*	Quantification of Brominated Vegetable Oil in Beverages by LCMS
1:30 p.m.	Amberly Vaughan*	Development of a Novel Method for Purification of Recombinant Proteins
1:45 p.m.	Kaylee McAdoo*	Tree Ring Dating of the Ficklin-Imboden Log Structures, Powhatan State Park, Arkansas
2:00 p.m.	Lucia Acosta-Gamboa**	Phenomics Approaches to Elucidate the Contribution of the Four Ascorbate Pathways to Abiotic Stress Tolerance in Arabidopsis
2:15 p.m.	Mary Davis**	CYP2C19 and 3A4 Generate a Potentially Toxic, Reactive Terbinafine Metabolite as Revealed through Modeling and Experimental Methods

Engineering, Pine Tree Room

1:00 p.m.	Andrew Lea*	Design and Development of a Self-Driving RC Car
1:15 p.m.	Hamdi Albusasheh**	A Step by Step Design Procedure for Current Control of a 5 MW Three-Phase Grid-Connected Inverter
1:30 p.m.	MM Tariq Morshed**	Prospects of Nanoclay as a Pavement Construction Material
1:45 p.m.	Mohammad Nazmul Hassan**	Effects of Zeolite on Chemical Elements and Glass Transition Temperature of Asphalts
2:00 p.m.	Robert Straitt**	Variable Frequency Drives, Providing Energy Efficiency and Enhanced Crop Production in Agriculture While Improving Water Management Processes

Friday Session 2 General Biology & Ecology, Black River Room

3:00 p.m.	Helena Abad*	Current and future threats to the Chihuahuan Desert bioregion: a landscape-level analysis
3:15 p.m.	Margaret Young*	Valuation of ecosystem services of the Arctic National Wildlife Refuge
3:30 p.m.	Allison Monroe*	A Proposal for Practical and Effective Biological Corridors in Northwest Costa Rica
3:45 p.m.	Benjamin Zamzow*	Terrestrial mammal and bird communities in protected and unprotected lands in Costa Rica
4:00 p.m.	Sarah Nieman*	Terrestrial mammal and bird survey results in the Arenal - Tilarán Conservation Area of Costa
4:15 p.m.	Sofia Varriano*	Migratory birds and nutrient transfer across continents

Molecular & Cellular Biology, Mockingbird Room

3:00 p.m.	Chloe Fitzgerald*	Relative Gene Expression Study on <i>Centruroides vittatus</i> : Investigating Sodium Toxin Gene Activity
3:15 p.m.	Brandon Hogland*	Comparison between environmental bacteria found in the soil and the wolf spider, <i>Rabidosa rabida</i> microbiome using 16srRNA sequencing analysis
3:30 p.m.	Mohammad Fazle Azim**	Production of a Prenylated Stilbenoid in Muscadine Grape Hairy Roots Expressing a Prenyltransferase Gene from Peanut
3:45 p.m.	Neha Verma**	Genetic modification of Switchgrass cell wall for improved biomass processability
4:00 p.m.	Newton Hilliard	Using Proteomics to Investigate Microbial Acid Tolerance Response
4:15 p.m.	David McClellan	Molecular Adaptation of Myoglobin Proteins in Deep-diving Cetaceans

Terrestrial & Wildlife Biology, White River Room

3:00 p.m.	John Veon*	Disturbance of wintering waterfowl by traffic noise
3:15 p.m.	Heather May	New records of distribution of <i>Dracunculus</i> sp. infecting River Otters (<i>Lontra canadensis</i>) in Arkansas
3:30 p.m.	Nathan Taylor*	Wild game harvest and effects on diet-related CO2 emissions in the U.S.
3:45 p.m.	James Gore**	Indiana Bat Occupancy Estimates of Buffalo National River Using a Multi-state Occupancy Model
4:00 p.m.	Renn Tumilson	New Records of the American Badger (<i>Taxidea taxus</i>) in Arkansas, with an updated distribution map
4:15 p.m.	David Sasse	Incidental Captures of Plains Spotted Skunks (<i>Spilogale putorius interrupta</i>) By Arkansas Trappers, 2012-2017

Math, Physics & Computer Science, Arkansas River Room

3:00 p.m.	Zach Rail*	Mathematical Modeling of a rod-beam system
3:15 p.m.	Baylee Landers*	Wave Profile for Current Bearing Lightning Return Strokes
3:30 p.m.	Yosuke Kitakaze*	An Interacting Model between Dark Energy and Dark Matter
3:45 p.m.	Tulin Kaman	Verification and Validation for Turbulent Mixing Simulations
4:00 p.m.	David Peterson	Nutrient Concentrations in Big Creek Correlate to CAFO Presence
4:15 p.m.	Puskar Chapagain	Efficacy of Supplemental Instruction on Algebra and Calculus-Based Physics Teaching-Learning Processes

Saturday Session

General Biology, Mockingbird Room

8:30 a.m.	Brian Wagner	Gene flow and genetic structure of two of Arkansas's rarest darter species (Teleostei: Percidae), the Arkansas darter, <i>Etheostoma cragini</i> , and the least darter, <i>E. microperca</i>
8:45 a.m.	Renn Tumilson	Distribution of <i>Campostoma spadiceum</i> in southern Arkansas
9:00 a.m.	David Jamieson	Notes on Tarantula (<i>Aphonopelma Hentzi</i>) Reproduction in Missouri
9:15 a.m.	Stan Trauth	Distal Urogenital Anatomy in Male Southern Coal Skinks, <i>Plestiodon anthracinus pluvialis</i> (Reptilia: Scincidae)
9:30 a.m.	David Sasse	Early Seasons Primeness in Arkansas Raccoon Pelts
9:45 a.m.	Jack Jackson	Avian Frugivory in a Fruiting Mulberry Tree (<i>Morus</i> spp.) in Arkansas
10:00 a.m.	Renn Tumilson	Vertebrate Natural History Notes from Arkansas, 2018
10:15 a.m.	Heather May	New records of distribution of <i>Dracunculus</i> sp. Infecting River Otters (<i>Lontra Canadensis</i>) in Arkansas

Chemistry & Geosciences, White River Room

8:30 a.m.	Franklin Hardcastle	Bond Valence - Length Relationships and Orbital Exponents for Hydrogen through Fluorine
8:45 a.m.	Mariusz Gajewski	Inhibition of Cystine Transport Leads to Human Glioma Growth Retardation.
9:00 a.m.	Rajib Choudhury	Understanding the Complexation of Small Molecules with a Macromolecule
9:15 a.m.	Michael Davis	Optimum Magnetometer Transect Spacing to Locate Legacy Oil and Gas Wells
9:30 a.m.	Kristin Dooley	Comparison of effective optical properties of two-component internally mixed aerosols using various mixing rules

Engineering & Computer Science, Arkansas River Room

8:30 a.m.	Richard Segall	Steps Toward Measuring World Space Exploration Activity
8:45 a.m.	Xin Yang	Deep Learning-based framework for fMRI Autism Image classification
9:00 a.m.	Ashokkumar Sharma	RAM pump, an energy independent solution to improve water accessibility to underdeveloped inhabitants in the world – A performance improvement study
9:15 a.m.	Brandon Kemp	Applications of theoretical advances in the optical energymomentum debate: invisibility cloaks, tractor beams, and reversed radiation pressure
9:30 a.m.	Cheyenne Sheppard	The Electrodynamics of Kinetic, Canonical, and Hidden Systems Under Relativistic Motion
9:45 a.m.	Muhammad Safeer Khan	Investigation of Acoustic-Based Crack Detection in PVC Pipes
10:00 a.m.	Ismaeel Al-Baidhany	A study of M and Mdyn masses at the different of the dynamical parameters of the spiral host galaxies
10:15 a.m.	Sami Chiad	Optical Properties and Dispersion Parameters of PMMA-MnCl2

Parasitology, Black River Room

9:30 a.m.	Chris McAllister	Parasites of the Spotted Sucker, <i>Minytrema melanops</i> (Cypriniformes: Catostomidae) from Arkansas and Oklahoma
9:45 a.m.	James Daly Sr.	Prevalence as a Predictor of other Helminth Population Descriptors (Mean, Standard Deviation, Maximum Number) is Relatively Inaccurate at High Parasite Densities in the Hosts.
10:00 a.m.	Chris McAllister	Additional Records of Acanthocephalan Parasites from Arkansas Fishes, with New Records from Missouri Fishes
10:15 a.m.	James Daly Sr.	Proportionality of Statistical Parameters for Helminth Parasite Populations in Smallmouth Bass (<i>Micropterus dolomeiu</i>) from the Buffalo National River in Arkansas

Schedule of Scientific Sessions

* - Undergraduate
** - Graduate

Poster Session, Centennial Hall

Biology - Medicine, Molecular & Cellular Biology

1	Jasleen Saini**	Generation and Analysis of chromosomal gene deletion mutants of two putative thiosulfate sulfurtransferases in Mycobacterium smegmatis
2	Saroj Mahato**	Investigation of the function of a putative cysteine synthase homolog in Mycobacterium smegmatis using unmarked gene deletion mutation
3	Kelsey Martin**	The Effect of SLCO Transporter Polymorphisms on Prostaglandin Levels in Healthy Postmenopausal Volunteers
4	Mason Rostollan**	Characterization of Biomass Smoke Particles via Scanning Electron Microscopy and Energy-Dispersive X-Ray Spectroscopy
5	Nirman Nepal**	Molecular Mechanisms Underlying the Higher Biomass and Abiotic Stress Tolerance Phenotype of Arabidopsis MIOX Overexpressers
6	Brenna Walters*	Exposure to carbon black nanoparticles during larval development affects adult physiological stress tolerance in wild type isolates of Caenorhabditis elegans
7	Spencer Long*	A Retrospective Multistate Analysis of Influenza Pandemic Deaths
8	Ryan Williams	Transient Receptor Potential Channel 3 And its Effects On Systemic Blood Pressure Regulation in Diseased Versus Healthy Mesenteric Arteries
9	Spencer Sanson**	Detection of Ten Antineoplastic Drugs in a clinical setting by Wipe Test and LC-MS/MS analysis
10	Malynn McKay	A comparison of Japanese and American children's diets, and a literature review of diet and disease.
11	Antoinette Davis*	The effect of green tea extract on Daphnia magna
12	Jeremy Brown*	Genetic engineering of the Mad locus using CRISPR/Cas-9 and Phi-C31 recombination
13	Jeremy Brown*	Identify Microbes in Drinking Water using PCR

Biology - General Biology & Ecology

14	Kimberly Smith	House Finch (Haemorhous mexicanus) nesting in December in Arkansas
15	Kimberly Smith	Observations of Townsend's Solitaires (Myadestes townsendi) on Mount Magazine in Logan County, Arkansas
16	Kimberly Smith	Second record of the Gray-headed Junco (Junco hyemalis caniceps) in Arkansas
17	Amanda Trusty*	Does frequently visiting a Bluebird nest increase predation risk?
18	Michael Trusty*	Does axle grease effectively protect bluebird nests from predators?
19	Edgar Sanchez*	Developing Microsatellite Markers for Genetic Identification of Songbirds
20	Gary Graves	Winter surveys of Cotinus obovatus (American smoketree) in the Ozark Mountains
21	Zac Campbell	High-throughput Plant Phenotyping at the A-State Phenomics Facility
22	Leila Henning	Novel nuclear and plastid loci and their utility for inferring relationships among species of the genus Streptanthus (Brassicaceae) found in Arkansas and adjoining states.
23	Jennifer Bryant*	The Hunt for Bigleaf
24	Emma Martin**	Assessing Mitigative Properties of Vegetation in Northeast Arkansas Agricultural Ditches using Biotic and Abiotic Measures
25	Chris McAllister	A Preliminary Checklist of the Stoneflies (Arthropoda: Insecta: Plecoptera) of Arkansas
26	Chris McAllister	Additional County Records of Invertebrates from Arkansas
27	Brian Staley	Biological and ecosystem-level changes from the addition of reservoirs to headwater streams
28	Sierra Hubbard*	Biodiversity of Hymenoptera across sky islands of Arkansas
29	Brianna Trejo**	Energetic cost of girdling in the notodontid caterpillar, Oedemasia leptinoides
30	John Hunt	Organochloride Pesticides Present in Animal Fur, Soil, and Streambed in an Agricultural Region of Southeastern Arkansas
31	Stacy Scherman**	Southeastern Myotis Rafinesque's Big-eared Bats Switch their Roosting Habits Seasonally in Arkansas Bottomlands
32	Andrew Feltmann	Serial founder effects in Crotaphytus collaris: the influence of genetic drift on phenotypic diversification
33	Hilary Canada*	Phylogeographic analyses suggest cryptic diversity within the Bluntnose Darter, Etheostoma chlorosoma

Chemistry

34	Ben Quattlebaum*	Effects of NIR Fluorophores in Selective Biological Scenarios
35	Gray Orman*	The Purification of Sodium Channel Toxin from <i>Centruroides vittatus</i>
36	Ryan Coleman*	Testing the re-usability of defined medium for an effective incorporation of unused ¹⁵ N label into recombinant proteins
37	Harper Grimsley	Application of ROMP Catalysts to Homo-Coupling
38	Sydne Shuttleworth	Isolating a Fat Mobilizing Substance from a Fasting Individual
39	Conner Breen*	Iron reduces mitochondrial DNA damage induced by mitochondrial reactive oxygen species in HepG2 cells
40	Eliza Hanson*	Novel Peptoids as Antimicrobial Agents
41	Emily Joy Seminara*	Extraction and Quantitation of Heterocyclic Aromatic Amines from Cooked Bacon using Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry
42	Kylie Cleavenger*	The Isolation and Characterization of a Recombinant Fibroblast Growth Factor-1
43	Peyton Munch*	Analyzing composition of plaster from Tel Beth-Shemesh archaeological site
44	Pooja Lukhi*	A New and Simple Method for the Purification of Recombinant Proteins from Inclusion Bodies
45	Trevor Loew*	Mitochondrial CYP2E1 activates antioxidant and mitochondrial biogenesis signaling in hepatocytes.
46	Kaleb Reid*	Preparation of 3-Phenyl-2-Propynoic Acid Using Undergraduate Organic Chemistry Lab Techniques
47	Ayesha Siddiqua**	Morphological Investigation of Mammalian Cancer Cells
48	Alexander Rothenberger**	Characterization of Goldenseal Product Quality by Dissolution Studies
49	Sarah Phillips	Development and Validation of an LC-MS/MS based Method to Quantitate Octreotide in Mouse Plasma
50	Divya Kandanoor**	Structure, composition, and oligosaccharide profiles for hemicellulosic polysaccharides isolated from rice bran fiber
51	Kan Takahashi**	Identification of a novel glucan crosslink to feruloylated arabinoxylan in rice bran fiber

Engineering

52	Kaushik Luthra**	Maintaining Quality of Rough Rice Dried in a Fluidized Bed by adding Hold-up periods
53	Kazi Tamzidul Islam**	Scaling Resistance of Industry Waste Modified Concrete Exposed to Deicing Chemicals
54	Md Saber Nazim**	Rayleigh Scattering in Multiple Nanoparticle Systems: A Study of the Scattered Magnetic Fields
55	Summon Roy**	Quantification of Moisture Effects on Adhesion and Modulus Properties of Paving Asphalts
56	Tamal Sarkar**	Anomalous electrostatic nature of charged particles: An approach towards stable equilibrium in inverted systems
57	Obande Ikwuyum*	Development of a Pedot:pss Buffer Film for an Organic Solar Cell

Geosciences

58	Haylee Campbell*	Variation in Soil Moisture Levels in No-till, Cover Crop, and Conventional Tillage Systems in NE Arkansas Cotton
59	Megan Cassingham*	Qualitative Analysis of PM2.5 Organic Compounds in Conway, Arkansas
60	Ryan Tumminello*	Quantification of Soluble Ions in Atmospheric Particulate Matter Using Ion Chromatography

Physics

61	Sonja Wagner*	Gamma-Gamma Angular Correlation
62	Timothy Brown* & Jealen Greer*	X-Ray Fluorescence
63	Trae Stagers*	Development and Testing of a Scientific Payload and Ground-Based Tracking System for High-Altitude Balloons.
64	Jackson Mixon*	Development and Testing of a Scientific Payload and Ground-Based Tracking System for High-Altitude Balloons.
65	Jake Bass*	Gamma-Gamma Angular Correlation
66	Nicholas Scoles*	Development of an Acoustic Scanner
67	Samantha Dix*	Generation of Generalized Gaussian Beams Via a Spatial Light Modulator
68	Yassamine Ghazzali*	Effect of simulated microgravity on radiation-induced endothelial dysfunction markers
69	Patrick Tribbett*	Stratospheric Ballooning RGB System for LiDAR Measurements
70	Paul Niyonkuru*	Rutherford Backscattering Spectrometry
71	Paul Niyonkuru*	Analyzing the Changeover from a Macroscopic System to a Nanosystem by Investigating the Moving Boundary Between Two Phases.

Keynote Speaker



Our keynote speaker is Dr. Travis Marsico, an associate professor of botany in the Department of Biological Sciences at Arkansas State University.

Marsico's research focuses on biogeography, biodiversity conservation, natural history and species invasions. He currently researches risk associated with hitchhiking plant propagules at U.S. shipping ports, invasion of herbivorous insect pests, plant diversity patterns in fragmented landscapes of the Upper Mississippi River Alluvial Plain, and plant diversity patterns along elevation gradients in the Neotropics. His work emphasizes making and utilizing natural history collections in research. He also studies

biology education and improvements to university-level education, utilizing specimen-based projects in coursework. Marsico has been a faculty member at Arkansas State University for eight years, where he teaches Curation of Collections, Dendrology, Global Change Biology, Mechanisms of Speciation, Natural History Collections Research Design, and Plant Systematics. At A-State, Marsico curates the herbarium and manages the Laboratory Sciences Greenhouse.

“Natural History Collections and their Role in Arkansas Science and Education” For the plenary session on Friday evening, Marsico will discuss the important role that natural history collections have played in shaping scientific knowledge in Arkansas. In his talk, he will also address current biodiversity research being conducted by students and faculty members associated with the newly formed Arkansas Center for Biodiversity Collections (ACBC) at Arkansas State University. He will highlight expanded opportunities for educating students in basic and applied biodiversity science through the ACBC. Finally, Marsico will share his vision for how research utilizing natural history collections is as relevant as it has ever been on a planet with natural ecosystems threatened by anthropogenic pressures.

Oral Presentation Abstracts

Aquatic Biology Session (Friday, Session 1) **Room: White River Room**

AQUA BIO – 01 – Claire Turkal

Hendrix College, Undergraduate Student

Judge: Yes

Effects of recreational boat noise on avoidance and feeding behaviors in an important freshwater stream fish

(Co-Authors: *Trystin F. Anderson, Maureen R. McClung*)

As anthropogenic noise continues to increase across the globe alongside human development, conservation scientists seek to understand how noise impacts ecological communities. Both terrestrial and aquatic species have been shown to exhibit physiological stress, greater mortality rates, and avoidance behaviors in the presence of noise. However, research has yet to extensively investigate how noise impacts not only the behavior of individual species, but the nature of food webs and ecological systems. Our research investigates whether stonerollers (*Campostoma* spp.), common freshwater fish in Arkansas that act as keystone species in stream ecosystems, avoid recreational boat noise and thus modify stream algal communities through avoidance behavior. We captured highland stonerollers (*Campostoma spadiceum*) from streams in central Arkansas and placed them within experimental tanks both with and without intermittent playback of a small, recreational boat motor. By monitoring algal feeding behaviors and tank location occupation in each trial, we compared control and experimental trials to detect the impacts of boat noise on stoneroller feeding and avoidance behavior. Preliminary results will be presented that highlight the importance of considering human impact on entire ecological communities in wildlife management decisions to ensure minimal negative consequences in light of increasing anthropogenic noise in the future.

AQUA BIO – 02 – Taylor Stone

Hendrix College, Undergraduate Student

Judge: Yes

Culture-independent analysis of Hot Springs National Park thermophiles

(Co-Author: *Matthew Moran*)

The thermal water systems of Hot Springs National Park (HSNP) in Hot Springs, Arkansas exist in relative isolation from other North American hot water systems. The HSNP waters could therefore serve as untapped reserves of biodiversity. However, these springs remains largely unexplored for species of thermophilic bacteria with culture-independent next generation sequencing. Additionally, HSNP has been the focus of anthropogenic development, capping-and diverting the springs for use in recreational bathhouse facilities. Human modification of these springs may have impacted the structure of these bacterial communities compared to springs left open to the air. The goal of this study was to compare the community structure in two capped springs and two uncapped springs in HSNP. To this end, we used Illumina 16S rRNA sequencing of water samples from each spring, used the QIIME workflow for sequence analysis, and generated measures of genera and phyla richness, diversity, and evenness. In total, over 700 genera were detected and most individual samples had more than 100 genera. There were also several novel genetic sequences that could not be placed in known taxa, indicating that HSNP contains undescribed bacteria. There was great variation both between sites and within samples, so no significant differences were detected in community structure between sites. Our results suggest that these springs, regardless of their human modification, contain a considerable amount of biodiversity, some of it potentially unique to the study site.

AQUA BIO – 03 – Dustin Thomas

Arkansas State University, Graduate Student

Judge: Yes

Stocking Assessment and Long-Term Impacts of Non-Native Walleye on the Native Population in the Eleven Point River, Arkansas (Co-Authors: Brook Fluker, Brett Timmons)

The spring fed Eleven Point River contains a natural population of Walleye, *Sander vitreus*. Supplemental stocking of Walleye in Arkansas has occurred in the Eleven Point River since 1986. The river is managed for multiple sport fish species, but it was not until 2002 that researchers began to investigate the complexities of Walleye stocking programs in the Eleven Point River. Researchers discovered a unique mitochondrial DNA haplotype for the native population in the Black River drainage. The native haplotype is identified as haplotype C or Black River Strain Walleye. From 1986 to 2011, a non-native northern strain known as White River Strain Walleye or haplotype A were stocked into the Eleven Point River. This project will assess the impact and success of the Walleye stocking program. It will also assess the impact of the non-native strain on the native strain and other sport fish species such as Smallmouth Bass, *Micropterus dolomieu*. Preliminary data will be presented from 2017 sampling in the Eleven Point River, which follows a 6-year gap in Walleye stocking from 2011 to 2017, and will be compared to data collecting during 2011.

AQUA BIO – 04 – Jeremiah Salinger

University of Arkansas at Pine Bluff, Graduate Student

Judge: Yes

Distribution Records of the Chestnut Lamprey in Arkansas

(Co-Author: Ron Johnson)

Lampreys other than sea lampreys have been poorly studied in North America. The Chestnut Lamprey, *Ichthyomyzon castaneus*, has a distribution within the Mississippi River drainage system ranging from Canada to Texas. Since the text *Fishes of Arkansas* was published in 1988, few papers have been published reporting on updating the statewide distribution of this lamprey. We incorporated gray and published literature in taking a watershed approach for the distribution of lampreys within the state. Reported are 274 records of Chestnut Lampreys over a 60-year period encompassing 40 streams and/or reservoirs.

AQUA BIO – 05 – David Bowles

U.S. National Park Service, Faculty Researcher

Judge: No

Aquatic invertebrate community assessments at Ozark National Scenic Riverways, Missouri, 2005-2014

(Co-Authors: Lloyd W. Morrison, Janice A. Hinsey, J. Tyler Cribbs)

Aquatic invertebrate community structure was used to assess long-term water quality integrity in mainstem rivers located at Ozark National Scenic Riverways, Missouri from 2005 to 2014. Benthic invertebrate samples and associated habitat and water quality data were collected from each of nine sampling sites using a Slack-Surber sampler. The Missouri Stream Condition Index (SCI) was used to assess integrity of the invertebrate communities. This index is calculated using taxa richness, EPT (Ephemeroptera, Plecoptera, Trichoptera) richness, Shannon's diversity index, and Hilsenhoff Biotic Index (HBI). The benthic invertebrate fauna was diverse with 155 distinct taxa identified from among all sites, with similarities ranging from 72% to 86%. Mean taxa richness was high among sites ranging from 22 to 30, and EPT richness values ranged from 11 to 16. Shannon's diversity index values generally ranged from 1.9 to 2.5 among sites and years indicating moderate diversity. The invertebrate taxa of the Current River and Jacks Fork are largely intolerant across all taxa represented (mean tolerance value= \sim 4.25). Mean HBI did not exceed 3.9 in the Current River or 4.4 for the Jacks Fork. SCI scores were relatively high among sampling sites and generally were well above 16 indicating they are not impaired. Habitat and water quality data were summarized, but found to be poorly correlated with individual invertebrate metrics (<30% significant). Sørensen's similarity index was used to assess community similarity among sites, and similarity scores were then analyzed using ascendiant hierarchical cluster analysis. Similarity among sites was 72% or greater. Cluster analysis showed that Current River and Jacks Fork sites clustered separately and in a downstream progression, with those sites closest to one another in linear distance generally being the most closely related. The uppermost collection site on the Current River was most unlike the other sites, which probably relates to the distinct physical features of that site compared to the others. NMDS was used to evaluate the relationship of invertebrate metrics to habitat and water quality. The NMDS model was found to be a good fit (stress=0.04) and specific conductance, temperature and discharge were among the most important factors in defining the relationship among upper and lower Current River sites and Jacks Fork sites. The three lower Current River and Jacks Fork sites each were closely ordinated, but the three lower Current River sites were poorly ordinated. The punctuated influence of several large volume springs near those sites is suspected of producing such disparity. Although the condition of invertebrate communities and water quality in the Current River and Jacks Fork are largely sound and have high integrity, ongoing and projected threats to these resources remain, and those threats largely originate outside of the park's jurisdictional boundaries. Inherent variability of invertebrate community diversity and density across sites and years highlights the importance of using multi-metric assessments and multiyear monitoring to support management decisions.

AQUA BIO – 06 – Charles Gagen

Arkansas Tech University, Faculty Researcher

Judge: No

New Applications of Radio Frequency Identification Stations for Monitoring Fish Movement through Headwater Road Crossings and Natural Reaches

Headwater streams in the Ouachita National Forest intersect with roads resulting in thousands of low-water crossings that potentially alter hydrology and reduce longitudinal fish movement. During 2012 and 2013, we monitored movements of three native fish species individually tagged with radio frequency identification chips (RFID; n = 2,171) to investigate the potential impacts of road crossings on fish passage. We established solar powered RFID stations in two streams with road crossings and two reference streams without road crossings. Each of the four continuous monitoring stations included a pair of antennas bracketing a crossing or similarly-sized natural reach. When fish passed both antennas, upstream passage could be distinguished from downstream passage based on timing of detections. We explored new applications of RFID technology by direct in-stream installation of half-duplex, figure-eight crossover antenna designs to avoid the need for rigid in-stream structures required to apply the more common full-duplex technology (half-duplex appeared particularly suited to natural reference streams). This technique appears promising, but technical difficulties limited the consistency of fish passage detection and consequently limited the strength of ecological conclusions. Even so, we will report evidence that fish passed at significantly higher rates across reference reaches than reaches with road crossings. Furthermore, Creek Chub passed reference reaches at significantly higher rates than Highland Stonerollers, which passed at higher rates than Longear Sunfish. Stream intermittency appeared to exacerbate reduced passage rates associated with the road crossings.

General Biology & Ecology Session (Friday, Session 1) Room: Mockingbird Room

BIO/ECO – 01 – Adam Turner

Hendrix College, Undergraduate Student

Judge: Yes

Impact of *Lespedeza cuneata* invasion on arthropod abundance in a tallgrass prairie

(Co-Author: Caroline Kirksey)

Invasive plants are a severe threat to biodiversity around the world. In North American tallgrass prairies, one of most invasive species is Chinese bushclover (*Lespedeza cuneata*). *Lespedeza cuneata* can reduce native plant diversity and biomass, interfere with pollination, and reduce seed germination in other species. How the presence of *L. cuneata* indirectly affects consumers is less well-studied. We investigated the effects of *L. cuneata* presence on the arthropod communities in an Oklahoma tallgrass prairie by sampling arthropods in plots with considerable *L. cuneata* invasion, plots without *L. cuneata*, and plots with *L. cuneata* manually removed. The arthropod community was examined at multiple trophic levels and feeding guilds. There was much seasonal variation in the response of the different arthropod groups. In the early portion of the season, herbivores tended to be more abundant in plots with *L. cuneata*, while later in the season, this difference largely disappeared. This trend was strongest for those herbivores that are phloem feeders. Carnivores, in particular specialists such as parasitoid hymenoptera, were generally lower in plots with *L. cuneata*, although this effect disappeared by the end of the season. There was no effect of *L. cuneata* on detritivore abundance. Our results show that an invasive plant can cause complex and seasonally variable effects on other consumers. This invasive species is therefore likely to cause a variety of changes in the tallgrass prairie food web.

BIO/ECO – 02 – Carolina Kirksey

Hendrix College, Undergraduate Student

Judge: Yes

Patterns of *Lespedeza cuneata* invasion in tallgrass prairies and arthropod community structure

(Co-Author: Adam Turner)

Chinese bushclover (*Lespedeza cuneata*) is an invasive plant species that is a serious threat to the tallgrass prairies of North America. It is known to alter plant community structure, but its effect on consumers is less well understood. We studied the relationship between *L. cuneata* density and the abundance and diversity of arthropods in different feeding groups during the entire growing season at the Tallgrass Prairie Preserve. Abundance of arthropods in all feeding groups (herbivores, carnivores, and detritivores) showed no relationship to *L. cuneata* density. Similar patterns were found for arthropod diversity, although overall species richness during the May sample indicated a quadratic relationship where the highest number of arthropod species were found in plots with moderate levels of *L. cuneata* invasion. Considering that this invasive plant tends to have profound effects on native plant species, it was surprising to find such weak responses from the arthropod community. Several possibilities may explain this pattern including how *L. cuneata* invasion changes soil chemistry or how it affects habitat use by consumers other than arthropods. Our results suggest that while this plant can have serious negative effects on other plant species, its effects on consumers may be weaker and therefore not disrupt native food webs as much as feared.

BIO/ECO – 03 – Varenya Nallur

Hendrix College, Undergraduate Student

Judge: Yes

Unconventional gas development effects on ecosystem services in the Fayetteville Shale of Arkansas

Unconventional oil and gas development, defined as the combination of horizontal drilling and hydraulic fracturing (fracking), has expanded dramatically across the United States in recent years. This change in the fossil fuel industry is causing a rapid transformation of landscapes across many regions and modifying much natural habitat. The natural world provides many free goods and services to humans, which are characterized as ecosystem services. Presumably, the extensive landscape alteration effects of unconventional oil and gas are having negative effects on these ecosystem services. We studied land-use patterns and subsequent loss of ecosystem services in the Fayetteville Shale, an important unconventional gas field located in north-central Arkansas. We found that habitat development and modification is causing ecosystem services losses in the tens of millions of dollars annually, costs that are concentrated in agricultural and climate regulation services. Estimates for agriculture alone indicate more than \$25 million USD are lost each year in the Fayetteville Shale due to gas development. Since these gas wells are predicted to produce for decades, these ecosystem services costs are likely to continue. The costs associated with ecosystem services loss due to fossil fuel development are not typically included in cost-benefit analyses, but are likely to be an important economic externalities reducing the overall benefits from unconventional gas development and causing detrimental, but underappreciated, effects on human well-being.

BIO/ECO – 04 – Caleb O’Neal

Harding University, Undergraduate Student

Judge: Yes

Aerobic Pushups: Cutaneous Ventilation in Overwintering Smooth Softshell Turtles, *Apalone mutica*

(Co-Author: Michael V. Plummer)

We observed the behavior of overwintering Smooth Softshell Turtles *Apalone mutica* in an outdoor simulated pool with remote cameras. Submerged overwintering turtles buried themselves shallowly in a sand/mud substrate where they periodically raised and lowered the posterior portion of their shells into the water column in a “pushup” fashion. Pushups were separated by regularly spaced intervals and were similar in appearance and amplitude within and among individual turtles. Pushup frequency was positively correlated with water temperature and was paused more often at lower water temperatures. We also observed pushup behavior of *A. mutica* under simulated winter conditions in laboratory aquaria. Turtles maintained in water with high dissolved oxygen content executed pushups less frequently than turtles in water with lower oxygen content. Our observations of pushup behavior in *A. mutica* in a semi-natural enclosure and laboratory are consistent with a respiratory ventilation function. Softshell turtles, known to be highly intolerant of anoxia, ostensibly sustain aerobic metabolism by creating currents that replenish the oxygen-depleted boundary layer between the turtle’s thin vascularized skin and oxygenated water.

BIO/ECO – 05 – Stan Trauth

Arkansas State University, Faculty Researcher

Judge: No

Germinal Epithelium Cytology during Spermatogenesis in the Alligator Snapping Turtle, *Macrochelys temminckii* (Reptilia:Chelydridae)

We investigated the cytology of the seminiferous epithelia of the Alligator Snapping Turtles (*Macrochelys temminckii*). Spermatogenic and regressed testes were assessed from 2 large individuals collected in Arkansas in May and September of 1993. Specifically, we focused on the cellular phases of germ cell development and maturation. The germ cell morphology and developmental strategy within the germinal epithelium of *M. temminckii* appear similar to that of other genera of turtles previously studied. Interestingly mitotic, meiotic, and spermiogenic cells are nearly identical to that of other studied turtles. There are also 6 recognizable steps to spermiogenesis, which is slightly different than the 7 steps of most turtles. Although this study only uses two individuals (because of its endangered status), *M. temminckii* appears to start spermatogenesis in the spring and the climax of spermiogenesis occurs in the fall similar to that of other temperate turtles studied to date. Peculiar to both turtles in this study were the regular appearance of very large germ cells in the basal compartment of the germinal epithelium. Based on previous research and our histological analysis, these enlarged spermatogonia exhibit hypertrophic characteristics typical of cells undergoing apoptosis.

BIO/ECO – 06 – Karen Fawley

University of Arkansas at Monticello, Faculty Researcher

Judge: No

Soil Crust Algal Communities of Warren Prairie Natural Area

(Co-Authors: Rachel Knight, Caleb Lamb, Brent Baker, Marvin Fawley)

Warren Prairie Natural Area in Bradley and Drew Counties, Arkansas, is a strange mosaic of saline slicks that form flat, crusty depressions in a central area with a zone of lichens and a few rare angiosperms, and an outer zone of cyanobacterial mats. The edges of the saline slicks are home to the rare, diminutive vascular plant, *Geocarpon minimum* Mackenzie (Caryophyllaceae), which is a federally protected threatened species. The main objective of this project is to characterize the soil crust eukaryotic algal communities from two sites in Warren Prairie Natural Area using morphological and molecular techniques. We have characterized strains isolated from samples collected in February, 2016 and December, 2017. The eukaryotic algae of Warren Prairie slicks are highly diverse and include taxa from the Trebouxiophyceae and the Chlorophyceae (Chlorophyta), the Zygnematophyceae and the Klebsormidiophyceae (Streptophyta), and the Eustigmatophyceae and Xanthophyceae (Stramenopiles). Most of the genera are widely distributed in many types of soil, but a number of new species are present. We found several species of the genus *Interfilum* (Klebsormidiophyceae), including new records for North America. Another strain related to *Bracteacoccus* (Chlorophyceae) is likely a new genus. Our results show that the unusual chemistry of the barrens soil of Warren Prairie harbor unusual algae in addition to rare plants.

Medicine, Molecular & Cellular Biology Session (Friday, Session 1) Room: Black River Room

MED/MOL/CELL BIO – 01 – Malcolm Anderson

University of Arkansas at Pine Bluff, Undergraduate Student

Judge: Yes

The mechanism of thymoquinone-induced apoptosis in oral cancer cells

(Co-Author: Selma Dagtas)

Oral cancer is a challenging medical problem with disappointing survival rates. Despite the successful treatment of the initial lesion, new lesions appear under the influence of the same predisposing factors that caused the initial lesion at the first place. Leukoplakia is a clinical condition characterized by pre-malignant gray or white patches of the oral mucosa. As one fourth of these cases are dysplastic, they are removed with surgery. About 8-15% of the remaining cases may undergo cancerous transformation. Treatment of these lesions is difficult because there is no effective chemotherapy and surgery is not justified for widespread lesions. Many cases are simply followed without intervention. Development of tolerable, non-toxic treatment agents that would prevent the occurrence of new lesions from the affected mucosa following the treatment of an initial lesion would improve the survival rates of oral cancer. There is growing interest in naturally occurring phytochemical compounds over the recent years. Compared to conventional anti-cancer medications, natural compounds are relatively non-toxic and inexpensive. *Nigella sativa*, also known as the black seed or black caraway, is an herb that has attracted attention with its anti-cancer, anti-inflammatory, immunomodulatory, anti-allergic and anti-oxidant effects. The best studied bioactive component of the *N. sativa* oil, thymoquinone, has been shown to have anti-cancer effects on many cancer types in in vitro and in vivo studies. In this study, thymoquinone resulted in apoptosis in murine squamous cell carcinoma (SCC VII) cells and human leukoplakia (LEUK 1) cells in vitro. Thymoquinone induced cytotoxicity was prevented by n-acetyl cysteine as well as glutathione ethyl ester (bioavailable form of glutathione) treatment. Glutathione was decreased and reactive oxygen species (ROS) were increased in thymoquinone treated cells. These findings suggest that thymoquinone induced cytotoxicity in SCC VII cells were mediated by ROS induction and glutathione depletion.

MED/MOL/CELL BIO – 02 – Dustyn Barnette

University of Arkansas for Medical Sciences, Graduate Student

Judge: Yes

Terbinafine bioactivation: Determining pathway to reactive metabolite accumulation using computational modeling and experimental approaches

(Co-Authors: Mary Davis, Lena Dang, Tyler Hughes, S. Joshua Swamidass, Grover P. Miller)

Lamisil (terbinafine) is a widely prescribed and effective antifungal drug that causes idiosyncratic liver toxicity. Terbinafine undergoes extensive metabolism including N-dealkylation to yield 6,6-dimethyl-2-hepten-4-ynal (TBF-A). This reactive allylic aldehyde was proposed to transiently form a glutathione conjugate that enables off target damage leading to liver toxicity. Nevertheless, TBF-A toxicological relevance remains unclear due to lack of identification of pathways leading to TBF-A formation. We resolved this knowledge gap by combining experimental and computational modeling of in vitro hepatic

N-dealkylation of terbinafine. In previously published work, we modeled terbinafine metabolism to determine preferred N-dealkylation steps leading to TBF-A. As a complement to modeling, we carried out steady-state kinetic studies with pooled human liver microsomes (HLM150) to determine the mechanisms and corresponding kinetic constants for terbinafine metabolism, and thus the concentration-dependent metabolic efficiency of N-dealkylation pathways. Based on liquid chromatography and mass spectrometry, we identified primary and secondary metabolites of terbinafine N-dealkylation. Aldehydes, such as TBF-A, were not observed directly, so dansyl hydrazine was used to label them for detection. Our identification of highly efficient desmethyl-terbinafine formation from terbinafine supports rapid initial N-demethylation; however, TBF-A formation efficiency was similar from terbinafine and desmethyl-terbinafine substrate. Furthermore, N-methyl-1-naphthyl methylamine was observed from terbinafine reactions, but not 1-naphthyl methylamine. Analysis of TBF-A stability under experimental conditions revealed rapid depletion independent of enzyme activity. Overall, the data suggest preference for a single-step N-dealkylation from terbinafine, with N-methyl-1-naphthyl methylamine as a cometabolite, being the most efficient pathway to TBF-A formation under steady state conditions. Additionally, accumulation of TBF-A is determined by the balance between its formation by the dominant pathway and its depletion under biological conditions. Knowledge of these mechanistic details will inform the most probable model prediction for TBF-A formation and experimentally demonstrate whether the efficiency of the pathway could contribute to liver toxicity.

MED/MOL/CELL BIO – 03 – Dakota Pouncey

University of Arkansas for Medical Sciences, Faculty Researcher

Judge: No

Coumadin (Warfarin) Pharmacokinetics Change for Pediatric Patients with Single Ventricle Physiology during Initiation of Anticoagulant Therapy

Background: Following the Fontan surgery, patients with single ventricular physiology require lifelong anticoagulant therapy with Coumadin (R/S-warfarin) to minimize thrombotic risk. Our pilot study is the first to assess the effect of Fontan physiology on R- and S-warfarin metabolism and clearance for pediatric patients with single ventricle physiology during initiation and maintenance. Methods: Patients scheduled for Fontan palliation were enrolled preoperatively from July 2016 to January 2017. Patients were genotyped for CYP2C9 polymorphisms due to its impact on warfarin metabolism and dose-response. During Coumadin initiation, blood samples were collected at 2, 12, 21, 22, 23 & 24 hr post dose on Days 1 and 3 along with two more samples during maintenance phase. Plasma samples were analyzed by LC-MS to measure 18 warfarin analytes to estimate changes in drug clearance during initiation based on dose-adjusted time curves (AUC) assuming 40 hr elimination half-life. Results: Five patients were enrolled prospectively with median age of 2.58 y (4 males, 1 female; 4 Caucasian, 1 Hispanic). Two patients were homozygous for wild type CYP2C9 (*1/*1) while three were heterozygous (*1/*2). Plasma analyses yielded levels of parent drugs and 12 metabolites. From Day 1 to 3, the AUC ratio mostly increased for R- and S-warfarin and the metabolites, although the magnitude depended on the individual patient and respective metabolite. At maintenance, R- to S-warfarin ratios correlated positively with the international normalized ratio (INR), a measure of therapeutic response. Conclusion: During Coumadin initiation, AUC values for parent drugs increased leading to higher exposure, while that for metabolites varied significantly indicating changes in metabolism and/or distribution early in the therapy that could complicate predictions of drug-drug interactions. CYP2C9 polymorphisms did not likely explain differences in response due to similarity in final maintenance doses. Importantly, the positive correlation for the R to S-warfarin ratio suggests therapeutic responses arise from both drugs rather than S-warfarin alone.

MED/MOL/CELL BIO – 04 – Antoinette Odendaal

Southern Arkansas University, Undergraduate Student

Judge: Yes

The effect of green tea extract on Daphnia magna

We investigated the effect of commercial green tea extract (GTE) on Daphnia magna by means of acute and reproductive toxicity tests. We found that GTE significantly reduces the reproductive output of D. magna over a 21-day test period.

MED/MOL/CELL BIO – 05 – Dhaval Shah

University of Arkansas for Medical Sciences, Faculty Researcher

Judge: No

CYP3A7 Metabolizes Dextromethorphan Less Efficiently than CYP3A4.

(Co-Author: Grover Miller)

Dextromethorphan is a widely used over-the-counter cough suppressant. Dextromethorphan has recently been associated with adverse outcomes in pediatric populations despite being on the market for six decades. We hypothesize that the toxicity of several drugs in children is due to underappreciated differences in the expression and efficiency of hepatic enzymes early in life. CYP2D6 is the primary hepatic enzyme that metabolizes dextromethorphan to dextrorphan in adults, with minor contributions from the

CYP3A family (CYP3A4 and CYP3A7) to form 3-methoxymorphinan. Recent studies suggest that children have low CYP2D6 and CYP3A4 protein levels, with markedly higher CYP3A7 protein levels. CYP3A7 protein levels are thought to decline during the first two years of life as CYP2D6 and CYP3A4 gradually increase. The purpose of this study was to determine the kinetic parameters of recombinantly expressed CYP3A7 and compare them to the kinetic parameters of CYP3A4 and CYP2D6. CYP2D6 was found to have the greatest intrinsic clearance as expected, however CYP3A7 was substantially less efficient than CYP3A4. Kinetic studies were also performed using human liver fractions to confirm non-Michaelis Menten kinetics by recombinant CYP2D6. This in-vitro study suggests that clearance of dextromethorphan and other drugs by CYP3A enzymes may initially be impaired in children.

MED/MOL/CELL BIO – 06 – Dennis Richardson

Quinnipiac University, Faculty Researcher

Judge: No

Geohelminth Infection, Anemia, and Malnourishment in Bawa, Cameroon After Ten Years of Intervention by the Bawa Health Initiative

(Co-Author: Sara Karr)

The Bawa Health Initiative (BHI) was established in 2005 with the goal of initiating a comprehensive public health care program in Bawa, a rural village in the West Province of Cameroon. Interventions undertaken include a comprehensive helminth control program, provision of water filters, sanitary latrines, insecticide treated bed nets, and a health education program. Data gathered from citizens of Bawa during Dec 2017, were obtained from the Sophine Awonke Healthcare Center in Bawa, Cameroon. These data including prevalence of geohelminth infection, morphometric data, and hemoglobin concentrations were compared to data gathered in previous surveys conducted by BHI in 2007 and 2010 to assess the effectiveness of interventions implemented by BHI. All metrics indicate substantial improvement in the overall health of the citizens of Bawa, evidenced by decreases in the occurrence of anemia, prevalence of malnourished, undernourished and stunted individuals and in the prevalence and intensity of geohelminths. These data strongly suggest that public health interventions implemented by BHI have been exceedingly effective in reducing the burden of disease and increasing the overall well-being of the citizens of Bawa, Cameroon and surrounding villages.

Chemistry & Geosciences Session (Friday, Session 1) Room: Arkansas River Room

CHEM/GEO – 01 – Blake Ludwig

Arkansas Tech University, Undergraduate Student

Judge: Yes

A Bond Valence/ Bond Length Correlation for Tantalum-Oxygen Bonds

Linus Pauling developed an empirical dependence between bond valence (bond order) s , and bond length R , where R_0 is the unit bond length and b is a fitting parameter, in 1947. Hardcastle has since derived his own expression to calculate the b fitting parameter for systems of any oxidation state, bonding type, or environment. With a more concrete way to determine b , R_0 and the orbital exponent can be calculated experimentally for Ta-O environments. Experimentally determined Ta-O bond lengths were used for R_0 and orbital exponent optimization.

CHEM/GEO – 02 – Katie Farmer

Harding University, Undergraduate Student

Judge: Yes

Quantification of Brominated Vegetable Oil in Beverages by LC-MS

A method for the quantification of triglycerides using liquid chromatography–electrospray ionization mass spectroscopy (LCMS) was adapted for simple and rapid analysis of brominated vegetable oil (BVO) in beverages. Unlike more common methods, this method does not require sample dilution or derivatization steps which presents a clear advantage. Triglyceride ionization often requires derivatization; however simple ionization was achieved through the formation of an adduct ion using ammonium present in the mobile phases. The quantification was conducted by mass spectrometry in selective ion recording mode combined with a single point standard addition procedure. This method was evaluated through a linear regression analysis of mass peaks (m/z 1856, m/z 1698, and m/z 1540) stemming from synthetic samples prepared with a commercial BVO-free citrus soft drink matrix spiked with commercial BVO. All beverage samples containing BVO were found to contain less than the legal limit of 15 ppm established by the US FDA for fruit-flavored beverages in the US market. The estimated limit of detection for this method was experimentally determined to be 0.01 ppm.

CHEM/GEO – 03 – Amberly Vaughan

University of Arkansas, Undergraduate Student

Judge: Yes

Development of a Novel Method for Purification of Recombinant Proteins

(Co-Authors: Musaab Al-Ameer, T.K.S. Kumar)

Since the first successful expression of recombinant DNA human insulin in 1978, research with and use of protein drug therapy has advanced rapidly 1. In the United States alone, the \$92 billion dollar market of 2015 was projected to follow a 10.9% compound annual growth rate over five years 4. Significant advantages of protein therapy drugs, particularly proteins' specificity which reduces the risk of side effects, have made protein therapy a more attractive alternative to small molecule drugs 5. In addition, the discovery of E. coli as expression host cells in 1983 opened the door for rapid, large-scale production of proteins with the opportunity to alter proteins through recombinant DNA technology 1. In E. coli, the fewer post-purification modifications, the opportunities to improve activity, and the stabilization by protein engineering make these prokaryotic cells a more attractive option than eukaryotic hosts. However, the tremendous advantages of proteins in drug therapy are not without inconveniences, specifically the many processing steps required to purify protein produced by bacteria 5. The cost of common purification techniques for recombinant proteins, involving expensive column resins for affinity chromatography, constitutes a significant portion of the multi-billion dollar pharmaceutical industry 2. Multiple steps leading to lower yield of pure protein have hindered the study of many proteins and driven up the cost of many pharmaceuticals. This project is an investigation of the development of a more cost-effective and less labor-intensive method for purification of recombinant proteins, utilizing a small affinity tag protein. This protein is the ideal tag due to its low molecular weight, red color for easy identification, and extreme thermostability 3. The specific aims of the project are to overexpress and purify the affinity tag protein, to determine the effects of temperature and pH on its stability by monitoring changes at the secondary and tertiary structure levels using circular dichroism and steady-state fluorescence measurements, and to understand the changes in the structure of the protein at the residue level using multi-dimensional NMR spectroscopy. For this project, the affinity tag was tested in the purification of an antifungal peptide synthesized by the Kumar Group at the University of Arkansas. Affinity column purification of the antifungal tagged with the affinity tag protein indicated the reliability of the tag. After characterization of the protein's secondary structure by circular dichroism, the antifungal was successfully purified by affinity tag without a column. Future work will involve cleaving the tag from the antifungal by the Tobacco Etch Virus protease, testing the antifungal's bioactivity by antibiotic sensitivity testing, and characterization of the affinity tag protein. Works Cited 1. Biotechnology. "1977-1999: The Dawn of Biotech." Retrieved from <http://www.cccbotechnology.com/RC/AB/BC/1977-Present.php>, 5 March 2018. 2. Jenney, F.E. and Adams, M.W.W. (2001) Rubredoxin from *Pyrococcus furiosus*. *Methods in Enzymology*, vol. 334, pp. 45-55. 3. Blake, P.R.; Park, J.; Zhou, Z.H.; Hare, D.R.; Adams, M.W.W.; Summers, M.F. (1992) Solution-state structure by NMR of zinc-substituted rubredoxin from the marine hyperthermophilic archaeobacterium *Pyrococcus furiosus*. *Protein Science*, 1508-1521 4. Dewan, Shalini S. and Sullivan, Laurie, L. "Protein Therapeutics Market – Technology Advances Spur Market Growth of Protein Therapies." (2016). *Drug Development and Delivery*. Retrieved from <http://www.drug-dev.com/Main/Back-Issues/PROTEIN-THERAPEUTICS-MARKET-Technology-Advances-Sp-1211.aspx> 5. Lagassé, H.A.; alexaki, Aikaterini; Simhadri, Vijaya L.; Katagiri, Nobuko H.; Jankowski, Wojciech; Sauna, Zuben E.; and Kimchi-Sarfay, Chava. "Recent advances in (therapeutic protein) drug development." *F1000Research* 2017; 6:113. National Center for Biotechnology Information, U.S. National Library of Medicine. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5302153/>, 5 March 2018.

CHEM/GEO – 04 – Kaylee McAdoo

University of Arkansas, Undergraduate Student

Judge: Yes

Tree Ring Dating of the Ficklin-Imboden Log Structures, Powhatan State Park, Arkansas

(Co-Author: David Stahle)

Powhatan State Park in Powhatan, Arkansas preserves and interprets five historical structures from 19th century Arkansas, including the Ficklin-Imboden Log House. This structure, which is actually two separate log buildings with uncertain construction dates and functions, is believed to be the earliest surviving structure at Powhatan State Park and is on the National Register of Historic Places. Powhatan State Park contracted with the University of Arkansas Tree-Ring Laboratory to develop a more accurate dating and interpretation of the log structures. Dendrochronology (treering dating) was used to determine the true felling dates of logs in both buildings. Core specimens were extracted from 22 wall logs and 16 were dated with dendrochronology. The measured ring width data were used to develop a chronology for the buildings that was then correlated against other absolutely dated tree-ring chronologies from the region. The strong correlation among the ring width time series from both structures provided evidence that the trees from which the logs were cut grew contemporaneously in the same area. The derived mean ring width chronology is highly correlated with tree-ring reconstructions of the Palmer drought severity index (PDSI) across Arkansas and the central US from 1726 to 1846 and with other regional tree-ring chronologies, particularly one created from living bald cypress trees at Allred Lake in southeast Missouri. Correlation analyses between the derived Ficklin-Imboden chronology and every possible year in the Allred Lake chronology over the past 808 years (1185-1992) indicates that the highest correlation ($r = 0.45$) is observed precisely where the log specimens were dated based on microscopic analysis and skeleton plot crossdating. The derived cutting dates extended from 1837 to 1846, with logs in both structures cut as late as 1846. Because the structures are in situ and the wall logs have not been extensively repaired or replaced, the cutting dates

indicate that the structures were likely erected during or soon after 1846. This is slightly earlier than the current interpretation by Powhatan State Park, but still consistent with the documentary evidence that Andrew Imboden and his wife used the building as a home around 1848. The current interpretation indicates that the larger southern room was the main living quarters and the smaller north structure was a later kitchen addition. The new tree-ring dates indicate that these two structures were likely built contemporaneously. Archaeological explorations would be useful for testing the proposed function of each log structure.

CHEM/GEO – 05 – Lucia Acosta-Gamboa

Arkansas State University, Graduate Student

Judge: Yes

Phenomics Approaches to Elucidate the Contribution of the Four Ascorbate Pathways to Abiotic Stress Tolerance in Arabidopsis

(Co-Authors: Nirmal Nepal, Zachary C. Campbell, Shannon Cunningham, Karina Medina-Jimenez, Argelia Lorence)

L-Ascorbic acid (AsA, vitamin C) is a key antioxidant and enzyme cofactor in plants. Ascorbate controls cell division, cell expansion, and plays an important role in modulating plant senescence and photosynthesis. Ascorbate also protects plants from reactive oxygen species that are produced in response to stresses. Biosynthesis of AsA in plants is carried out by a complex metabolic network involving D-mannose/L-galactose, D-galacturonate, L-gulose, and myo-inositol as main precursors. We have previously shown by manual phenotyping that Arabidopsis lines over-expressing enzymes in the myo-inositol pathway have elevated AsA, accumulate more biomass of both aerial and root tissues and are tolerant to abiotic stresses including salt, cold, heat, and environmental pollutants. Manual phenotyping is time consuming, low throughput, subjective, and limited to the resolution of the human eye. On the other hand, high throughput phenotyping technologies are accurate, non-destructive, and more sensitive, allowing the detection of subtle phenotypes. We have used a Scanalyzer HTS system to phenotype our high AsA Arabidopsis lines with visible, fluorescence, and near infrared cameras. We have shown that by using this approach, high AsA lines grow faster, accumulate more biomass, and display healthier chlorophyll fluorescence and water content profiles than controls. By studying abiotic stress in a high throughput fashion using optimized protocols, we have also shown that these high AsA lines are tolerant to salt and drought stresses. Our ongoing experiments aim to dissect the contribution of the various AsA pathways to abiotic stress tolerance using a combination of genetic, transcriptomic, and phenomic approaches.

CHEM/GEO – 06 – Mary Davis

University of Arkansas for Medical Sciences, Graduate Student

Judge: Yes

CYP2C19 and 3A4 Generate a Potentially Toxic, Reactive Terbinafine Metabolite as Revealed through Modeling and Experimental Methods

(Co-Authors: Anirudh Pidugu, Dustyn Barnette, S. Joshua Swamidass, Grover P. Miller)

Lamisil (terbinafine) is an effective, widely-prescribed antifungal drug that causes idiosyncratic liver toxicity in rare cases. The proposed mechanism of toxicity involves a reactive metabolite, 6,6-dimethyl-2-hepten-4-ynal (TBF-A), that forms transient glutathione adducts capable of off-target damage leading to hepatotoxicity. We employed deep learning neural network modeling and in vitro experimental steady-state approaches to identify and characterize three P450-catalyzed N-dealkylation pathways leading to TBF-A formation in one or more steps. We initially modeled terbinafine Ndealkylation by CYP1A2, 2A6, 2B6, 2C9, 2C19, 2D6, 2E1, and 3A4. Of these, all P450s except CYP2A6 were predicted to Ndemethylate terbinafine for one pathway, while CYP1A2 and 2D6 were the only P450s capable of directly generating TBF-A during metabolism. None of the models predicted P450s N-denaphthylate the parent drug. The modeling captured the broad specificity of P450 N-demethylation of terbinafine but was less predictive for the other N-dealkylation pathways. Experimental studies with P450-specific inhibitors demonstrated CYP2B6, 2C19, 2D6 and 3A4 directly generate TBF-A from terbinafine. Subsequent preliminary kinetic studies with the recombinant enzymes revealed the order of catalytic efficiency (V/Km) for that reaction was CYP3A4>2C19>2B6~2D6. For the other pathways, Ndemethylation by CYP2C19 was much more efficient than 3A4, and the order of efficiency for N-denaphthylation was CYP2C19~3A4>>2B6~2D6. The actual contributions would also depend on the relative expression levels of the isozymes. Overall terbinafine N-dealkylation was dominated by CYP2C19, which catalyzed all three pathways. Nevertheless, CYP3A4 was the most efficient at generating TBF-A. As the most highly expressed hepatic P450, CYP3A4 would then likely play a significant role in generating and driving TBF-A toxicity with other P450 contributions potentiating those effects. On-going kinetic studies will provide further data to confirm these findings and improve a relative comparison of the individual pathways. Taken together, knowledge of these P450s responsible for overall terbinafine metabolism and TBF-A formation provides a foundation for investigating the impact of variations in their contributions to toxic risk posed to patients and hence developing strategies to decrease that risk.

Engineering Session (Friday, Session 1)

Room: Pine Tree Room

ENG – 01 – Andrew Lea

Arkansas Tech University, Undergraduate Student

Judge: Yes

Design and Development of a Self-Driving RC Car

Self-driving technology is one of the attractive and successful application areas of general AI. Major automobile manufacturers and a number of high-tech companies have timelines for self-driving cars and have put great efforts into the development of driverless-car technology. The objective of this project is to build a scaled-down self-driving car based on an Artificial Neural Network(ANN) model. The developed RC car drive autonomously via a single front-facing camera sensor. The designed ANN model maps the raw video frames captured by the camera directly to the steering commands and achieves autonomous driving. The project also aims to aid the undergraduate students' understanding of the principles of AI and ultimately empowers the current generation of engineering students with the state-of-the-art AI technology.

ENG – 02 –Hamdi Albusashee

University of Arkansas , Graduate Student

Judge: Yes

A Step by Step Design Procedure for Current Control of a 5 MWThree-Phase Grid-Connected Inverter

(Co-Authors: Manar Alzahlol, Roy McCann)

PV connected inverters hold the promise for the growth of using renewable resources that are connected with the power grid. Due to the complexity of controlling the inverters when they are connected to the power grid, a step by step design procedure is illustrated for controlling the output current of a 5 MW- three-phase grid-connected inverter. The illustrated procedure clarifies the ambiguity of how to derive a transfer function that relates the inverter output current and the control input, which is the reference three-phase sine wave voltage that is used in generating the pulse width modulation for the switch devices. Using the MATLAB/SimPower Systems Toolbox, the mathematical derivation is validated and showed accurate results.

ENG – 03 – MM Tariq Morshed

Arkansas State University, Graduate Student

Judge: Yes

Prospects of Nanoclay as a Pavement Construction Material

(Co-Author: Zahid Hossain)

The main goal of this study is to assess the feasibility of the use of nanoclay as an alternative polymer. In this study, three types of nanoclay (Cloisite 10A, Cloisite 11B, and Cloisite 15A) and an unmodified Performance Grade (PG) binder from two sources (Source 1 and Source 2) were selected for laboratory investigation. Nanoclays at 1%, 2% and 3% by weight of base binder were blended for 2 hours using a high shear mixture with rotation 2000 rpm at 1500C. Then the nonaoclay-modified asphalt binder was characterized by using Rotational Viscometer (RV), Dynamic Shear Rheometer (DSR) and Atomic Force Microscope (AFM). It was found that the viscosity values of the modified asphalt binders were significantly higher than those of neat binders. From DSR test it can be observed that the complex shear modulus (G^*) increased, but the phase angle (δ) decreased for modified binders. Therefore, the rutting factor ($G^*/\sin\delta$) increased for nanoclay-modified binders and maximum rutting resistance was observed for Source 1 binder modified with 1% Cloisite 11B. On the other hand, the maximum rutting resistance was found for Source 2 binder modified with 1% Cloisite 10A. Morphological and three nanomechanical properties, namely, DMT (Derjaguin–Muller–Toporov) modulus, adhesion, and deformation parameters were measured for unmodified and nanoclay-modified asphalt binders. Preliminary results showed that DMT moduli increased and deformation values decreased for nanoclay-modified asphalt binders compared to unmodified binders. Based on the experiments, it may be said that nanoclay has a great chance to become a pavement construction material.

ENG – 04 – Mohammad Nazmul Hassan

Arkansas State University, Graduate Student

Judge: Yes

Effects of Zeollite on Chemical Elementals and Glass Transition Temperature of Asphalts

(Co-Author: Zahid Hossain)

The usage of Warm mix asphalt (WMA) in the United States has increased significantly in recent years. It is a common practice to modify the asphalt of WMA with certain additives. In this study, a performance grade (PG) binder (PG 64-22) was modified using different percentages of Aspha-min, which is a zeollite based additive. Differential scanning calorimetry (DSC) tests were conducted on these samples to find relationships between the low temperature cracking properties and physical hardening properties, which can be expressed with the term glass transition temperature (T_g). It was found that the Carbon percentage in the whole asphalt binder decreases with the higher content of Aspha-min. It was also observed that the Carbon, Hydrogen and Nitrogen percentages decrease and the Oxygen content increases with the increased amount of Aspha-min for the Asphaltene fractions. On the other hand, these percentages remain almost same for the maltene fractions. There was also an effort to find a relationship between the low temperature cracking properties and the results of chemical analyses. It was found that the stiffness and rate of stress relaxation values decrease the most for the optimum percentage of Aspha-min. Reproducibility test results suggest that chemical analyses from two different laboratories produced almost similar results. It was also observed that the T_g maintains a linear relationship with the stiffness of the asphalt binder. It is expected that this study will be useful for evaluating low-temperature behavior of Aspha-min modified asphalt binders from a chemical perspective.

ENG – 05 –Robert Straitt

Arkansas State University, Graduate Student

Judge: Yes

Variable Frequency Drives, Providing Energy Efficiency and Enhanced Crop Production in Agriculture While Improving Water Management Processes

(Co-Authors: Robert Straitt, Rajesh Sharma, Paul Mixon, Dr. Steve Green, Dr. Andrzej Rucinski, Dr. Nadya Reingand, Dr. Christophe Paoli, and Mr. Dwight Ellis)

Irrigation on today's large agricultural operations can be one of the most energy demanding agricultural tasks performed, where it can contribute to excessive water table draw down and surface water degradation. While electric motors are used in a small percentage of irrigation operations, diesel driven pump systems still make up the bulk of irrigation power supplies, due to limited utility provided 3-phase electrical power at irrigation sites. VFD controlled electrical pumps allow for use of existing utility provided electrical service to power irrigation pumps, while also allowing for improved irrigation practices that increase crop production and help reduce unnecessary runoff and downstream degradation of surface waters. Ongoing research at Arkansas State University is addressing a variety of energy efficiency and environmental quality potentials using VFD systems.

General Biology and Ecology Session (Friday, Session 2)

Room: Black River Room

BIO/ECO – 01 – Helena Abad

Hendrix College, Undergraduate Student

Judge: Yes

R Current and future threats to the Chihuahuan Desert bioregion: a landscape-level analysis

(Co-Author: Nathan Taylor)

The United States portion of Chihuahuan Desert is a highly diverse and relatively intact bioregion. However, the region is being impacted by human activity, including energy, urban, and agricultural development. The goal of this study is to determine the current land use impacts and ecosystem services costs of these developments in the Chihuahuan Desert, and predict future impacts and subsequent implications on ecosystem function. We measured the proportion of land developed by agriculture and urbanization, and we analyzed both development and fragmentation levels by multiple energy sources. The oil and gas industry has developed and fragmented about 27% of the Chihuahuan Desert. Wind and solar currently comprise a very small amount of desert development, but these industries are growing rapidly. We estimated the total ecosystem services costs of the energy industry at \$180 million USD per year. Urbanization and agriculture together have developed about 4% of the Chihuahuan Desert. Two-thirds of the desert remains relatively intact in a contiguous corridor stretching northwest from the Big Bend region to southern New Mexico and eastern Arizona. However, this corridor is threatened by expanding oil and gas drilling, potential expansion of wind energy, and the proposed border wall. If this expansion of human activity occurs, the entire bioregion could become highly fragmented and the continuity of these habitats permanently compromised. We suggest conservation efforts be focused on the remaining corridors and development be concentrated in areas already highly fragmented.

BIO/ECO – 02 – Margaret Young

Hendrix College, Undergraduate Student

Judge: Yes

Valuation of ecosystem services of the Arctic National Wildlife Refuge

(Co-Author: Matthew Moran)

Ecosystem services are goods and services that nature provides to humans at no cost. Human activity that modifies the environment can cause reductions in these services which have a measureable impact on human economies and well-being. While ecosystem services have been well studied in most biomes, the arctic tundra has received little attention, despite covering a large proportion of the Earth's land area. Using established methodology for estimating ecosystem services, we calculated the values for the Arctic National Wildlife Refuge (ANWR), a region that is virtually undisturbed by human activity, but one that is slated for oil and gas drilling in the future. We found that the refuge is worth over \$2,000 USD per hectare per year, which translates to over \$15 billion USD annually for the entire study area. Most of the ecosystem services values are concentrated in climate regulation (i.e. carbon storage), storage of soil nutrients, and aesthetic values. Our results suggest that arctic tundra has similar ecosystem services values compared to temperate ecosystems (e.g. temperate forest). Our analysis also indicates that the economic value of the ANWR to the world is greater than the economic benefits that may be realized from fossil fuel development. Strikingly, the survey we conducted of U.S. residents found that their willingness to pay (i.e. a contingency valuation) to maintain the refuge in its current state, exceeds the estimated value of the recoverable oil and gas deposits. Therefore, our study suggests that maintaining the ANWR in its current natural condition (i.e. de facto wilderness) is more beneficial to the world compared to development of the area for oil and gas resources.

BIO/ECO – 03 – Allison Monroe

Hendrix College, Undergraduate Student

Judge: Yes

A Proposal for Practical and Effective Biological Corridors in Northwest Costa Rica

Habitat fragmentation is a major factor causing animal population reductions and extirpations from remaining forested areas of the world. This problem extends to protected areas which are often well conserved, but too small and isolated to maintain species that exist at low densities and require large contiguous areas of habitat (e.g., large mammals). Costa Rica has been at the forefront of tropical forest conservation and has a large proportion of the country's land area under protection. One such region is the northwest portion of Costa Rica, which is an extremely biodiverse region with several noteworthy national parks and other protected areas. However, each protected area is isolated natural habitat in a sea of deforestation. We propose four biological corridors that would connect five major protected areas in northwest Costa Rica to each other and all of them to larger protected areas in the central portion of the country, while causing limited disruption to local human populations. After natural reforestation of the corridors, the result would be a contiguous protected area of 348,000 Ha. The proposed corridors would only be a 3.7% increase in total protected area size in the region and only 0.2% of Costa Rica's total land area. Using the jaguar (*Panthera onca*) as a model umbrella species, we found that each current isolated protected area could support between 8-104 individuals (using mean estimates). Assuming lack of dispersal between protected areas, these populations' sizes are unlikely to be viable in the long term. However, the combined protected areas, including the proposed corridors could support about 250 jaguars, a population size more likely to be viable (although still tenuous). Our study shows that land conservation efforts focused on a relatively small area of Costa Rica could create a large landscape level conservation area, while having very limited effects on the human population.

BIO/ECO – 04 – Benjamin Zamzow

Hendrix College, Undergraduate Student

Judge: Yes

Terrestrial mammal and bird communities in protected and unprotected lands in Costa Rica

(Co-Author: Lindsay Stallcup)

Protected land are important for conservation of biodiversity. However, most protected areas are too small to support viable populations of some species causing species loss over time. Privately held lands can sometimes provide suitable habitat for species and help promote biodiversity maintenance. In northwestern Costa Rica, there are a variety of isolated protected areas (mostly forested) that are surrounded by privately held partially deforested landscapes. The goal of this study was to study the terrestrial mammal and bird communities in these two areas and ascertain whether the privately held properties help support biodiversity within the protected areas. We established camera traps in the protected areas of the Arenal – Tilarán Conservation Area and adjacent privately held lands. Animal detections were generally lower in unprotected lands, and this pattern was true for most feeding groups. Most species, even large predators such as the Puma (*Puma concolor*) were present in both locations, but had lower detection frequencies. However, collard peccaries (*Tayassu tajacu*), which were very abundant in the protected areas, were never detected in the private lands. Similarly, no terrestrial birds were detected outside of protected areas. Our results suggest that the private land areas in the vicinity of the Arenal – Tilarán support a depauperate terrestrial mammal and bird community and are providing only small contributions to biodiversity support of this animal group.

BIO/ECO – 05 – Sarah Nieman

Hendrix College, Undergraduate Student

Judge: Yes

Terrestrial mammal and bird survey results in the Arenal – Tilarán Conservation Area of Costa

(Co-Author: Lindsay Stallcup)

The establishment of parks and preserves has been the major strategy in reducing biodiversity loss in tropical forests. Costa Rica has been a model country in protecting landscapes and promoting conservation. However, many protected areas exist in areas surrounded by highly modified habitat, and may be losing species either because they are too small to support viable populations or too isolated to allow for population connectivity. Using camera traps, we studied the terrestrial mammal and bird populations in portions of the Arenal - Tilarán Conservation Area of northwestern Costa Rica. This area is noted for its high biodiversity and is an important ecotourism location. Of the 33 species historically found in the region, we detected 25, including species from all parts of the food web. However, most were very rare, and only five were detected more than once per 30 days of camera time. Interestingly, the commonly detected species included all major feeding groups including obligate herbivores, omnivores, and obligate carnivores. Large herbivores were rare and may not have viable population sizes. One of the largest carnivores, the puma (*Puma concolor*) however, was quite commonly detected. Our results suggest that conservation efforts in the area are protecting some terrestrial mammals and birds well and that there is a functioning food web. However, many species are either rare or extirpated, indicating that this region represents a partially defaunated ecosystem.

BIO/ECO – 06 – Sofia Varriano

Hendrix College, Undergraduate Student

Judge: Yes

Migratory birds and nutrient transfer across continents

(Co-Author: Maureen McClung)

Migratory animals have been drastically affected by human activity and generally seen major population declines. Reasons for these declines include direct human-caused mortality during migration, blocking of migration routes, and habitat loss at distant locations. Migrating animals can transfer nutrients between distant habitats, which can have important ecosystem function implications. We modelled the nitrogen transfer from Eurasia to naturally low nitrogen deposition areas of Africa by Palarctic – African migrant birds. According to our analysis, migrating birds annually move about 21,000 kg of N from Eurasia to these low nitrogen areas of Africa. This amount only accounts for 0.2% of total nitrogen deposition. However, in pre-industrialized times, when nitrogen deposition was much lower and migrating bird populations were much higher, these birds may have accounted for up to 2% of total N deposition. Our study therefore provides an example of how human activity has shifted a portion of global nutrient transfer from a biological to an industrial process.

Molecular and Cellular Biology Session (Friday, Session 2) ***Room: Mockingbird Room***

MOL/CELL BIO – 01 – Chloe Fitzgerald

Arkansas Tech University, Undergraduate Student

Judge: Yes

Relative Gene Expression Study on *Centruroides vittatus*: Investigating Sodium Toxin Gene Activity

(Co-Authors: Ashlyn Tedder, Alyssa Kool, Aimee Bowman, Taylor Bishop, Cody Shivers, Tsunemi Yamashita)

Scorpions release venom when capturing prey or fighting off predators, and a large portion of this venom consists of neurotoxins. The area in the tail where the venom is produced and housed is called the telson gland. The neurotoxins produced are mostly composed of a combination of different sodium toxins which alter the kinetics of sodium channel gating in the nervous system cells where they have been injected. This exploratory study on the sodium β toxin gene activity for the striped bark scorpion, *Centruroides vittatus*, specifically focused on gathering relative quantification data for eight neurotoxin variants in particular: Na668, Na667, Na654, Na689, Na1210, CsBeta, CvAlpha, and Na3066. This was accomplished by quantitative reversetranscriptase polymerase chain reaction, or qRT-PCR. Preliminary experiments have been conducted on both male and female organisms by which threshold values yielded from these have been statistically analyzed within biological replicates as well as computationally analyzed through the $\Delta\Delta C_t$ method, which has gathered a tentative ratio of activity for these gene variants. The goal of this study was to determine the level of expression for the different sodium β toxin genes in the telson gland relative to body tissue in male and female scorpions of the eastern population. This information may be relative to help develop anti-toxins for medical use.

MOL/CELL BIO – 02 – Brandon Holand

Harding University, Undergraduate Student

Judge: Yes

Comparison between environmental bacteria found in the soil and the wolf spider, *Rabidosia rabida* microbiome using 16srRNA sequencing analysis

(Co-Author: Ryan Stork)

The national microbiome initiative has been enacted to encourage all researchers to study organisms relative to human health. Many arthropods are known to carry microorganisms important to human health, yet not all groups have been focused on. Previous studies on arthropods indicate the presence of a bacterial microbiome that have the possibility of contributing to disease. However microbiome data on spiders is lacking. *Rabidosia rabida* is a common terrestrial Wolf spider found in many parts of Eastern North America. We hypothesized that *R. rabida* would have a microbiome consisting of common microbes found in soil due to its natural habitat of fields and low grasses. We also hypothesized that *R. rabida* could potentially have microorganisms living in and on its surface that could be pathogenic to humans. We isolated 47 different bacterial samples from 7 spiders, and 20 bacterial samples from the soil where we obtained the spiders. 16s rRNA sequences were obtained and BLAST analysis was performed. Organisms were then compared for similarities to organisms found in various vertebrate taxa using previously published data. Analysis indicated that spiders carry bacteria on and within them that include microbes in the soil and an assortment of bacteria not found in the environmental samples. Bacterial phyla were also similar to phyla found in the human microbiome.

MOL/CELL BIO – 03 – Mohammad Fazle Azim

Arkansas State University, Graduate Student

Judge: Yes

Production of a Prenylated Stilbenoid in Muscadine Grape Hairy Roots Expressing a Prenyltransferase Gene from Peanut

Stilbenoids are phenolic compounds found in a small number of plant species including muscadine grape and peanut. These compounds have shown biological activities including anticancer, cardioprotective, anti-inflammatory and neuroprotective properties in vitro. However, several stilbenoids have exhibited poor bioavailability limiting their application in vivo. Recently, our group identified prenyltransferases in peanut which can produce more bioavailable stilbenoids. Therefore, the goal of this project is to express the peanut stilbenoid renyltransferase in muscadine grape to ultimately increase its health benefits. In this study, hairy roots of muscadine grape were developed via transformation with an engineered *Agrobacterium rhizogenes* harboring a peanut stilbenoid prenyltransferase. Four muscadine grape hairy root lines showed the presence of the peanut prenyltransferase gene along with *aux1* and *rolC* genes from *A. rhizogenes*. Furthermore, prenyltransferase activity and production of arachidin-2 – a prenylated stilbenoid - were confirmed by enzymatic assays and HPLC-mass spectrometry analyses, respectively. The effect of different growth stages (17, 21 and 25 days) on the production of stilbenoids was also evaluated. Our results demonstrated the successful production of arachidin-2 in muscadine grape hairy roots and the potential to leverage this metabolic engineering strategy to develop muscadine grape fruits with enhanced health benefits.

MOL/CELL BIO – 04 – Neha Verma

Arkansas State University, Graduate Student

Judge: Yes

Genetic modification of Switchgrass cell wall for improved biomass processability

(Co-Author: Jianfeng Xu)

Switchgrass (*Panicum virgatum*) is a perennial C4 grasses that have been most extensively studied as dedicated bioenergy crops. However, efficient conversion of switchgrass biomass to biofuels has been hampered by biomass recalcitrance. Genetic modification of the plant cell wall represents a promising solution to overcoming this problem. The goal of this project is to leverage an innovative strategy, hydroxyproline (Hyp)-O-glycosylation “code”, for de novo design and engineering in switchgrass of novel designer biopolymers (DBPs) to facilitate cell wall reconstruction. The engineered DBPs presumably work in the following ways: 1) intercalate among cell wall biopolymers to create soluble channels in the cell wall matrix; 2) function as a molecular carrier for in planta-expressed cell wall-depolymerizing enzymes to facilitate their deposition and stabilization in the cell wall matrix. The DBPs are derived from the Hyp-O-glycosylated plant cell wall glycoproteins whose glycosylation code and application in DBPs engineering were originally established in dicot plants-tobacco and *Arabidopsis*. The objective of this study was to determine how DBP peptide backbones would be Hyp-O-glycosylated in monocot plants, including switchgrass and rice whose cell wall composition and structure are different from dicot plants; and how effectively the engineered DBPs function to reconstruct the cell wall structure of switchgrass. DBPs comprised of two major types of cell wall glycoproteins: an extensin module consisting of 18 tandem repeats of “Ser-Hyp-Hyp-Hyp-Hyp” motif or (SP4)18, and an arabinogalactan protein module consisting of 32 tandem repeats of “Ser-Hyp” motif or (SP)32, was each expressed in switchgrass and rice as fusion to a green fluorescence protein via both transient and stable transformation. The Hyp-O-glycosylation and subcellular localization of the engineered DBPs were characterized. The phenotype of transgenic witchgrass and biomass saccharification will be determined in the future.

MOL/CELL BIO – 05 – Newton Hilliard

Arkansas Tech University, Faculty Researcher

Judge: No

Using Proteomics to Investigate Microbial Acid Tolerance Response

(Co-Authors: Alan J. Tackett, Kirk L. West)

Stomach acidity is generally one of the first host defense mechanisms encountered by ingested microorganisms. Targeting of microbial acid tolerance response (ATR) mechanisms therefore opens avenues for creation of new and novel antimicrobial therapies. While previous investigators have chosen to emphasize the role of chaperone proteins or acid neutralization mechanisms in ATR, we have proposed to investigate the role of changes in extracellular pH in regulating expression of proteins involved in cytoplasmic and extracytoplasmic pathways for production of metabolic energy. Using the non-pathogenic gammaproteobacteria *Halothiobacillus neapolitanus* as a model species, the GeLCMS/MS technique of Bynum, et. al. was used to evaluate proteomewide pH dependent changes in protein expression levels. Using the published *Ht. neapolitanus* genome sequence as reference, proteins representing approximately >75% of the known non-rna gene sequences were correctly identified. A heat map indicates that >400 proteins show at least Log2 fold change in expression level between pH 5.3 and 7.4. These changes include substantial changes in cellular levels of proteins such as *sor* or *sqrF* that are involved in extracellular oxidation of substrates, *nuoA* NADH oxidoreductase and cytochrome *c* oxidase. Interestingly, little or no change in cellular concentrations of the chaperone proteins *dnaJ/K*, *groL/S*, or *ompH* was detected. The results support utilization of the GeLCMS/MS technique in investigation of proteome wide acid tolerance response.

MOL/CELL BIO – 06 – David McClellan

University of Arkansas - Fort Smith – Faculty Researcher

Judge: No

Molecular Adaptation of Myoglobin Proteins in Deep-diving Cetaceans

That some cetaceans, whales and dolphins, can survive submerged for relatively long periods is indisputable. Sperm whales (Physeteridae), for example, hunt at depths below 2000 meters for over an hour at a time and are known to sleep at similar extreme depths. Beaked whales (Ziphiidae) are known to dive even deeper. These air-breathing mammals are the evolutionary recipients of extreme respiratory adaptations. Several studies have suggested that at least some of these adaptations are molecular in nature. Myoglobin, the protein that stores oxygen in muscle tissues, is one these adapted molecules. This presentation summarizes efforts to identify myoglobin amino acid variants and their physicochemical properties that contribute to the extreme respiratory adaptation of Physeteridae and Ziphiidae, as well as generally in all cetaceans.

Terrestrial and Wildlife Biology Session (Friday, Session 2) Room: White River Room

TERR/WILDL BIO – 01 – John Veon

Hendrix College, Undergraduate Student

Judge: Yes

Disturbance of wintering waterfowl by traffic noise

Wetlands are highly impacted by land-use changes associated with threats like agriculture and urbanization, however one threat that receives less attention is that of anthropogenic noise. Recently, there has been an increase in the number of studies linking anthropogenic noise to impacts on wildlife. Waterfowl could be at risk for disturbance by automobile noise due to the spread of transit networks into rural areas that waterfowl commonly use as wintering habitat. We tested the response of wintering waterfowl to playback traffic noise at 75 dB in wetland habitats in southwest Arkansas from January through March 2018. Each trial of the experiment consisted of three 20 minute phases designated as before, during, or after the traffic playback. During each minute of a trial, we recorded the number of birds of each species and the distance of each bird from the noise source. We found that the mean proportion of all birds detected decreased from 0.30 to 0.15 at distances closer to the noise during the playback, but this change did not persist after the playback stopped. Although mean closest approach of birds to the speaker did not differ significantly between phases of the trial (F=1.62, df=2, 14, p=0.23), our results suggest that there could be a trend for the closest approach to the speaker to increase during traffic noise (X=40 m, SE=10.7) compared to no traffic noise (X=18, SE=9.5). Thus, our study did not conclusively find that waterfowl completely avoid simulated traffic noise, but it does indicate that such noise could change the specific area of habitat that these birds choose to utilize. If birds avoid areas that are resource-rich because of noise, managers could be overestimating the amount of habitat available for use by these birds.

TERR/WILDL BIO – 02 – Heather May

Henderson State University, Undergraduate Student

Judge: No

New records of distribution of *Dracunculus* sp. infecting River Otters (*Lontra canadensis*) in Arkansas

(Co-Author: Renn Tumilson)

The Guinea worm (*Dracunculus* sp.) is a nematode whose maturing females migrate to the extremities of host mammals to deposit their larvae into the water when available. The large females, reaching lengths of 300 mm, create a hole in the skin as they lie in the subcutaneous layers. We searched for specimens of *Dracunculus* sp. in skinned carcasses of river otters (*Lontra canadensis*) provided by trappers and fur buyers during the harvest seasons of 2013-2014. We found the parasite in 29 of 184 otters (15.8%), and document 9 new counties of occurrence, mostly in western Arkansas. This parasite is now known to occur in otters from the Arkansas, Ouachita, Red, and White River drainages.

TERR/WILDL BIO – 03 – Nathan Taylor

Hendrix College, Undergraduate Student

Judge: Yes

Wild game harvest and effects on diet-related CO2 emissions in the U.S.

(Co-Author: Jamie Johnson)

Food production accounts for about one-third of United States greenhouse gas emissions. The diet of the U.S. also has relatively large amounts of meat, the food category associated with highest emission rates. However, some segment of the population acquires much of their meat from the hunting of wild game. In this study, we measured the amount wild game meat harvested from mammals and birds in the U.S. each year and calculated the carbon emission reductions caused by that activity. Over 400 billion kcal worth of wild meat is harvested each year, which accounts for over 2% of the total meat consumption. If this meat were replaced with farmed meat, the added CO2 emissions from the U.S. would rise by over 1 billion kg, equivalent to adding about 220,000 cars to the road. Our analysis indicates that an American diet with the typical proportions of major food groups, but containing only wild game meat, is similar in carbon emissions to a vegetarian diet. Wild game numbers are currently at very high levels (e.g., white-tailed deer) and harvest rates could probably be increased without going beyond sustainable levels. Increasing current consumption patterns of wild game could therefore have a meaningful effect on U.S. carbon emissions.

TERR/WILDL BIO – 04 – James Gore

Arkansas State University, Graduate Student

Judge: Yes

Indiana Bat Occupancy Estimates of Buffalo National River Using a Multi-state Occupancy Model

The importance of proper management for bats has become paramount in recent years because of the introduction and spread of WNS throughout the eastern United States and Canada. Occupancy modeling is one research/management tool that is widely used among biologists. Occupancy is based on the presence/absence of a species, making it a natural fit with acoustic data recorders, which are unable to address abundance, but do well at producing presence/absence data. Thus it seems that the combination of acoustic data and occupancy modeling is ideal for managing a small, highly mobile species whose population size may be difficult to estimate using traditional techniques (e.g. bats). However, disagreement among automated bat identification programs can make accurate occupancy estimates based upon acoustic recordings difficult to achieve. We performed acoustic bat surveys at 96 sites throughout the Buffalo National River, and then used two USFWS approved auto-i.d. programs (BCID and Kaleidoscope) to independently identify the calls. We then estimated occupancy using a multi-state occupancy model in which call sequences identified as an Indiana bat by both auto-i.d. programs are considered “certain detections”, and call sequences identified as Indiana bat by one program are considered “uncertain detection”. We also performed occupancy estimates based on visual identification of bat call sequences and compared the results. Occupancy estimates derived from the multi-state occupancy model were similar to estimates derived from visual identification. As auto-i.d. programs continue to improve their accuracy, an alternative 2-state occupancy model may be the best way to obtain accurate occupancy estimates.

TERR/WILDL BIO – 05 – Renn Tumilson

Henderson State University, Faculty Researcher

Judge: No

New Records of the American Badger (*Taxidea taxus*) in Arkansas, with an updated distribution map

(Co-Author: Blake Sasse)

The first American badger (*Taxidea taxus*) reported from Arkansas was collected in 1964 from Washington County in northwestern Arkansas. Only occasional observations were documented for the next 40 years. Since 2003, several new observations revealed a reproductive population in northeastern Arkansas. Additional observations of badgers have accumulated in eastern and western Arkansas, permitting further documentation of an apparently expanding range into the state. We report a few new observations and county records, and consolidate the literature to provide a map of the current known distribution within the state. It appears that the range of the badger is expanding and establishing eastward from Oklahoma into the Arkansas River Valley, and southward from Missouri into the Arkansas Ozarks and the Mississippi Alluvial Plain.

TERR/WILDL BIO – 06 – David Sasse

Arkansas Game & Fish Commission, Faculty Researcher

Judge: No

Incidental Captures of Plains Spotted Skunks (*Spilogale putorius interrupta*) By Arkansas Trappers, 2012-2017

Arkansas trappers were surveyed following the 2012 and four subsequent trapping seasons regarding accidental captures of spotted skunks while attempting to trap other species. A total of 132 trappers reported capturing spotted skunks although further investigation confirmed the validity of only 42 reports from trappers that caught a total of 60 spotted skunks. Incidental captures were rare; only 0.35-1.29% of trappers each year caught spotted skunks and came primarily from the Ozark and Ouachita regions of the state.

Math, Physics & Computer Science Session (Friday, Session 2) ***Room: Arkansas River Room***

MATH/PHY/COMP SCI – 01 – Zach Rail

Arkansas State University, Undergraduate Student

Judge: Yes

Mathematical Modeling of a rod-beam system

(Co-Author: Jeongho Ahn)

In this work, we consider mathematical and numerical approaches to modeling a rod-beam system. The rod-beam system is motivated by microelectromechanical systems (MEMS). The beam moves transversely and the rod moves longitudinally. When the top of the rod touches a rigid obstacle, Signorini's contact conditions and Barber's heat exchange condition are applied. The beam model combines a Kirchhoff type equation with the Timoshenko beam theory. The motion of the jointed rod and beam is described by four partial differential equations (PDEs) and several boundary conditions and complementarity conditions (CCs). We employ time-discretizations on a time interval and finite element methods (FEMs) over the spatial domain to propose the fully discrete numerical schemes. We use the Newton-Raphson method to compute each time step's numerical approximation satisfying a nonlinear system in the discrete case.

MATH/PHY/COMP SCI – 02 – Baylee Landers

Arkansas Tech University, Undergraduate Student

Judge: Yes

Wave Profile for Current Bearing Lightning Return Strokes

(Co-Author: Ali Alzhrani)

For analytical solution of breakdown waves with a significant current behind the wave front, we use a one-dimensional, steady-state, three-component (electrons, ions, and neutral particles) fluid model. Waves propagating in the opposite direction of the electric field force on electrons (anti-force waves - lightning return stroke) are considered only; and the wave front is considered to be a shock front. The electron gas partial pressure is assumed to be large enough to provide the driving force for the propagation of the wave. The basic set of equations consists of the equation of conservation of mass, momentum and energy, coupled with the Poisson's equation. In this study, the emphasis will be on the waves propagating into a neutral medium only. Inclusion of current behind the shock front alters the equation of conservation of energy and Poisson's equation. Therefore, the boundary condition on electron temperature at the shock front needs to be modified as well. For a range of experimentally

measured current values and a range of possible wave speeds, we will present the method of integration of the set of electron fluid dynamical equations through the dynamical transition region and wave. We will also present the wave profile for electric field as a function of electron velocity for the above mentioned ranges of current values and wave speeds.

MATH/PHY/COMP SCI – 03 – Yosuke Kitakaze

Arkansas Tech University, Undergraduate Student

Judge: Yes

An Interacting Model between Dark Energy and Dark Matter

(Co-Author: Jesse Griffiths)

Dark energy is one of the mysterious constituents of the cosmic inventory and although its existence is confirmed by observations, its nature is completely unknown to physicists. There are several different ways dark energy is described. In each theory, dark energy has its own unique properties. The most common candidate for dark energy is the cosmological constant, although there are other candidates as well. Traditionally it is also assumed that dark energy evolves independently from other constituents. To address some of the issues of modern cosmology, like Cosmic Coincidence Problem, we introduce an interaction between dark energy and matter. In our previous studies we always considered interacting models where dark energy was considered to be holographic. In this work, considering a sign-changeable interaction, we also assume that dark energy is proportional to the Hubble Parameter. The sign-changing interaction is proportional to the deceleration parameter, so its sign changes when we go from decelerating universe into an accelerating one. The differential equations for this interacting models will be derived and the numerical solution will be studied.

MATH/PHY/COMP SCI – 04 – Tulin Kaman

University of Arkansas, Faculty Researcher

Judge: No

Verification and Validation for Turbulent Mixing Simulations

We present the validation studies for acceleration driven turbulent mixing flows, comparison of simulations to experiments. The studies show simulation agreement with Rayleigh-Taylor experiments using the algorithms based on front tracking, large eddy simulation with sub-grid scale.

MATH/PHY/COMP SCI – 05 – David Peterson

University of Central Arkansas, Faculty Researcher

Judge: No

Nutrient Concentrations in Big Creek Correlate to CAFO Presence

Nutrient concentrations in Big Creek, a major tributary of the Buffalo National River, are expected to be an issue in the current contentious battle over the continuing permit of a concentrated animal feeding operation (CAFO, 2012). This paper examines both spatial and temporal changes in nitrate and total phosphorous (TP) using data from the Big Creek Research and Extension Team (BCRET), the Arkansas Department of Environmental Quality (ADEQ), and the U. S. Geological Survey (USGS). In the CAFO stretch of Big Creek, from upstream to downstream, the mean nitrate concentration increases by 124% and the flow weighted TP mean increases 125%. In low flow regimes there is evidence of stream nitrate contamination from ground water sources, and at the “house well”, adjacent to the waste lagoons, ground water nitrate levels have increased 50% (5/01/2014-8/31/2017). The importance of these and other increases will be put in context by comparisons with other Buffalo River tributaries.

MATH/PHY/COMP SCI – 06 – Puskar Chapagain

Southern Arkansas University, Faculty Researcher

Judge: No

Efficacy of Supplemental Instruction on Algebra and Calculus-Based Physics Teaching-Learning Processes

(Co-Authors: Lavana J. Kindle, Dipak Rimal)

Supplemental instruction (SI) is a group based teaching/learning method designed for students to succeed and retain material taught in historically difficult subjects. In this method, each group is assigned an SI leader who has already completed the course. The SI leader attends lecture classes, takes notes, and solves problems with students. The students meet in SI sessions twice a week outside of the lecture where they review matter covered in the class, discuss among themselves, and work as a group to solve problems under the facilitation of the SI leader. Reports from supplemental instruction in physics and other classes at Southern Arkansas University (SAU) dated since the fall semester of 2002 were reviewed. To assess the efficacy of the SI program,

we analyzed data collected as post completion of the students enrolled in both algebra and calculus-based physics at the end of each semester until the fall of 2017. We studied the impact of SI sessions on students’ GPA, letter grades, numbers of withdrawal/incompletion, and compared students who attended SI sessions versus those who did not attend. Further, we discuss the influence on overall retention of students enrolled in physics classes at the end of each semester.

General Biology Session (Saturday Session) Room: Mockingbird Room

BIO – 01 – Brian Wagner

Arkansas Game & Fish Commission, Faculty Researcher

Gene flow and genetic structure of two of Arkansas’s rarest darter species (Teleostei: Percidae), the Arkansas darter, Etheostoma cragini, and the least darter, E. microperca

(Co-Authors: Robert Wood, Justin Baker)

Distinguishing the effects of historical fragmentation from those of contemporary landscape modification is important to understanding human influences on gene flow and population dynamics. We examined the effects of fragmentation operating over separate timescales on two darter species, Etheostoma cragini and E. microperca, from the Ozark Highlands. These species now occur within this region only in highly isolated habitats. We separated fragmentation effects at distinct spatial and temporal scales by using several molecular loci (mtDNA/nuclear DNA/nuclear microsatellite DNA). Sequence divergence among Ozark and northern populations of E. microperca indicate long-standing isolation. Both species were further isolated in unique ‘island’ habitats, sometimes at fine spatial scales, as shown by sequence divergence among Ozark Highland populations of E. cragini. Microsatellite data also revealed additional subdivision among Arkansas populations with E. cragini divided into three distinct populations and E. microperca into two. Overall, migration rates were similar among contemporary and historical time periods although patterns of asymmetric migration were inverted for E. cragini. Estimates of contemporary effective population size (N_e) were substantially lower for both species than past population sizes. Overall, historical processes involving natural fragmentation have had long-lasting effects on these species, potentially making them more susceptible to current anthropogenic impacts.

BIO – 02 – Renn Tumilson

Henderson State University , Faculty Researcher

Distribution of Campostoma spadiceum in southern Arkansas

(Co-Author: Henry Robison)

The Highland stoneroller (Campostoma spadiceum) was recently resurrected as a species distinct from the Central stoneroller (Campostoma anomalum). The map provided in the redescription of the form showed little overlap of distribution between the species, and showed most specimen localities to be in the Ouachita Mountains, but it did not document the identity of specimens in southern Arkansas below the fall line of the Ouachitas. We examined specimens of stonerollers from near and below the fall line in southern Arkansas to determine their identity and better understand the distribution of this fish.

BIO – 03 – David Jamieson

Crowder College, Faculty Researcher

Notes on Tarantula (Aphonopelma hentzi) Reproduction in Missouri

(Co-Author: Austin Jones)

Recent survey work by the Arkansas Department of Natural Heritage suggests only one species of tarantula, Aphonopelma hentzi, occurs in the state of Arkansas and that its population is primarily found within the uplands of the western portion of the state. In the Ozark Mountains and Ouachita Mountains Physiographic Regions it is dependent on the xeric conditions found in the glade habitat. We recently published an article comparing the fecundity of this species from the Ozarks and Ouachitas of Arkansas. The other significant published work concerning reproduction in this species within Arkansas is by William J. Baerg, who studied a tarantula colony located in a glade just south of Fayetteville (Washington County) in the early 20th century. We are unaware of any ecological data published from other physiographic regions of the state. We have spent the last three years (2015-2017) in Hercules Glade located just east of Branson, Missouri with the purpose of providing additional information on reproduction from that state. The results are presented and compared to the data from Arkansas.

BIO – 04 – Stan Trauth

Arkansas State University, Faculty Researcher

Distal Urogenital Anatomy in Male Southern Coal Skinks, *Plestiodon anthracinus pluvialis* (Reptilia: Scincidae)

(Co-Author: Kevin Gribbins)

I investigated the morphology and histology of the distal urogenital anatomy of male Southern Coal Skinks (*Plestiodon anthracinus pluvialis*) from reproductively active individuals collected in Arkansas in order to provide comparative information with recent studies on squamate urogenital anatomy. Specifically, I focused on the basic anatomy and positioning of posterior ducts in this skink, which included portions of the ductus deferens, the ampulla ductus deferentis, the sexual segment of the kidney, the ureter and collecting ducts, as well as aspects of the urodaeal chamber and urogenital papillae. I found a much reduced ampulla ductus deferentis comprising only 0.7 mm in length in the caudal region of the ductus deferens. The sexual segment of the kidney was well developed, being located in collecting ducts of the kidney proper, in walls of collecting ducts leading away from the kidney as well as within anterior portions of the ureter. The anterior dorsal recess of the urodaeum possessed epithelial crypts within a highly folded epithelium. Finally, a ductal triad (ductus deferens, ureter, and a single collecting duct) terminates at each orifice of the paired urogenital papillae. The distal urogenital anatomy of this scincid lizard revealed anatomical features similar to other species within the genus *Plestiodon*.

BIO – 05 – David Sasse

Arkansas Game & Fish Commission, Faculty Researcher

Early Seasons Primeness in Arkansas Raccoon Pelts

Trapping seasons in the United States are generally set around the time of the year when pelts are in “prime” condition and are in their most valuable state. In order to assess whether the start of the Arkansas trapping season is at an appropriate date 122 raccoons were captured during the month of November in 2014 and 2015. Based on the evaluation of experienced fur dealers, the percentage of pelts in prime condition was then assessed on weekly and half-monthly basis.

BIO – 06 – Jack Jackson

University of Arkansas - Fort Smith, Faculty Researcher

Avian Frugivory in a Fruiting Mulberry Tree (*Morus spp.*) in Arkansas

(Co-Author: Ragupathy Kannan)

A fruiting Mulberry tree (*Morus spp.*) was observed for 67 hours in the spring of 2016 and 2017 in Fort Smith, Arkansas. A total of 172 five-minute scans were performed, during which the following parameters were recorded: species visited, number of individuals of each species, time of visitations, and foraging tier. Between each scan, the foraging rate (number of fruits consumed/min), inter- and intra- specific associations, and aggressive interactions were recorded. A total of 3465 observations of individual birds from 31 species were recorded. Species diversity index was higher in the upper half of the tree, and was higher in the morning. The mean foraging rates for the 9 most commonly observed species ranged from 1.17-2.39 fruits/min. A total of 346 aggressive interactions were observed of which 68% were intraspecific.

BIO – 07 – Renn Tumilson

Henderson State University, Faculty Researcher

Vertebrate Natural History Notes from Arkansas, 2018

(Co-Authors: Blake Sasse, Henry Robison, Matt Connior, Chris McAllister, Kelly Jobe, Matthew Anderson)

Many important details of vertebrate biology are unknown to the scientific community because the observations are not part of a larger specific study. Knowledge of such details not only fills gaps in understanding but also creates a framework for hypothesis building. Although vertebrates are a commonly studied group of animals, the distribution and natural history of many species within Arkansas remains undocumented. We continue to augment current literature with new observations and provide notes on the natural history of selected vertebrates from Arkansas. Herein we include previously unreported records of distribution, reproduction, and other aspects of natural history of the vertebrates of Arkansas. We report new records of bats based on submissions to the Arkansas Dept. of Health for rabies testing.

BIO – 08 – Heather May

Henderson State University, Undergraduate Student

New records of distribution of *Dracunculus sp.* Infecting River Otters (*Lontra Canadensis*) in Arkansas

(Co-Authors: Allison Surf, Renn Tumilson)

The Guinea worm (*Dracunculus sp.*) is a nematode whose maturing females migrate to the extremities of host mammals to deposit their larvae into the water when available. The large females, reaching lengths of 300 mm, create a hole in the skin as they lie in the subcutaneous layers. We searched for specimens of *Dracunculus sp.* in skinned carcasses of river otters (*Lontra canadensis*) provided by trappers and fur buyers during the harvest seasons of 2013-2014. We found the parasite in 29 of 184 otters (15.8%), and document 9 new counties of occurrence, mostly in western Arkansas. This parasite is now known to occur in otters from the Arkansas, Ouachita, Red, and White River drainages.

Chemistry and Geosciences Session (Saturday Session) Room: White River Room

CHEM/GEO – 01– Franklin Hardcastle

Arkansas Tech University, Faculty Researcher

Bond Valence - Length Relationships and Orbital Exponents for Hydrogen through Fluorine

Bond valence-length empirical relations provide a way of calculating bond valences, or bond orders (numbers), directly from bond lengths. Linus Pauling (1947) was the first to suggest the “empirical” logarithmic dependence of bond order or valence, s , to bond length, R , as $s = \exp[(R_0 - R)/b]$, where R_0 is the bond length of unit valence, and “ b ” is an empirical fitting parameter. A theoretical expression has previously been derived for the “ b ” parameter in terms of atomic orbital exponents. Published crystallographic bond length data is used along with conservation of valence to establish bond length-valence relationships as well as R_0 (bond length of unit valence) for selected bonds. These relationships are applicable regardless of physical state or oxidation number.

CHEM/GEO – 02 – Mariusz Gajewski

Arkansas Tech University, Faculty Researcher

Inhibition of Cystine Transport Leads to Human Glioma Growth Retardation

Gliomas, or tumors with origins in glial cells make up approximately 80% of all malignant brain cancers. These tumors are associated with significantly low survival rates. Astrocytes express an obligate exchange transport protein, Xc-, which among numerous functions, is responsible for providing the cells with cystine (cysteine dimer), a precursor in glutathione synthesis. Glutathione performs a function of an antioxidant. Cancerous astrocytes overexpress Xc- protein to ensure abundant supply of glutathione, which is necessary for their rapid metabolism, growth and division. It was hypothesized that inhibition of the protein would result in impaired supply of glutathione to the cancerous cells, causing their oxidative stress, eventually leading to apoptosis. This hypothesis was tested by assays of human cancerous cell lines treated by a panel of six new molecules developed in the PI's lab. This presentation will focus on these novel inhibitors of the Xcprotein and their influence on glioma cell metabolism. The inhibitors' design, synthesis and results of biological assays will be discussed.

CHEM/GEO – 03 – Rajib Choudhury

Arkansas Tech University, Faculty Researcher

Understanding the Complexation of Small Molecules with a Macromolecule

(Co-Author: Vaidhyanathan Ramamurthy)

Octa acid (OA), a synthetic macrocycle with eight carboxylic acid groups at the portals, is a container molecule that is used to encapsulate, confine, and control the excited state behavior of organic guest molecules. In this study, inclusion of several small molecules (guests) with different structural and electronic properties, within octa acid (OA) was probed by isothermal calorimetry, ¹H nuclear magnetic resonance spectroscopy, and molecular dynamic (md) simulations. Under the condition of the experiments (pH ~ 9), the guests were included as carboxylate anions with the polar anionic head group facing water and hydrophobic carbon skeleton buried within the OA, forming 1:1 host to guest complexes. Importance of weak interactions between the guest and the OA interior is reflected in the measured negative ΔH values. Although ΔH was negative for all guests, ΔS was positive for adamantyl guests and negative for naphthyl guests. Quite likely the difference in hydrophobicity between the two sets of molecules and the strength of interaction between the guest and the OA are responsible for the sign difference in ΔS between the two series. The importance of steric factor during inclusion of naphthyl carboxylic acids within OA cavity is brought out by the difference in

thermodynamic parameters between the 1- and 2- substituted naphthyl carboxylic acids; 2-naphthyl carboxylic acids that can penetrate deeply have larger $-\Delta H$ and 1-naphthyl carboxylic acids that can only enter the cavity in an angle have smaller $-\Delta H$. As expected, based on the well-known concept of “enthalpy-entropy compensation,” the molecules that have large $-\Delta H$ are accompanied by large $-\Delta S$.

CHEM/GEO – 04 – Michael Davis

Arkansas Tech University, Faculty Researcher

Optimum Magnetometer Transect Spacing to Locate Legacy Oil and Gas Wells

(Co-Authors: Jason Patton, Kenyon Gowing, Hunter Vickers)

The purpose of this study is to determine the optimum transect spacing to locate legacy oil and gas wells using an Overhauser magnetometer. Widely known to be a potential environmental hazard, legacy oil and gas wells may act as a conduit for methane and/or deeper subsurface fluids (naturally occurring brines, injected waste fluids, or injected CO₂) to the surface or shallow subsurface. Many plugged wells have all surface equipment removed leaving no visible trace at the surface and thus making the environmental assessment of these wells difficult. Using a magnetometer along a set of predefined transects, magnetic anomalies from the metal casing can be detected. In order to assess large numbers of wells, knowledge of the typical anomaly size is critical to maximize the transect spacing and therefore minimize magnetometer field work time. Here we show the results of five wells with an initial survey grid at two meter spacing. Although there is significant variation in the anomaly size (X, Y, and Z), analysis of the data shows that transect spacing of 20 m is sufficient to identify these buried wells. The anomalies associated with four of the wells ranged from approximately 700-1200 nanoteslas (nT), with one well anomaly more than 6000 nT above background.

CHEM/GEO – 05 – Kristin Dooley

University of Central Arkansas, Faculty Researcher

Comparison of effective optical properties of two-component internally mixed aerosols using various mixing rules

(Co-Author: Jessica DeYoung)

Accurately modelling the effect of internally mixed aerosols on the global radiation energy budget hinges on the correct computation of the particle's associated scattering and absorbing optical properties. While it is possible to compute the optical properties of internally mixed particles using exact Mie single-scattering calculations, atmospheric aerosols containing randomly spaced inclusions are computationally difficult and expensive to model. As a result, climate models commonly employ various computational mixing rules to approximate the refractive index of more complex types of internally mixed particles. This effective refractive index is then used to compute the scattering and absorbing parameters in a much simpler computational routine. In the current work, several types of mixing rules have been applied to two-component internally mixed particles of various mixing ratios. Differences in the calculated computed effective index of refraction are compared in order to discuss the merits and limitations of the mixing rules themselves.

Engineering and Computer Science Session (Saturday Session) Room: Arkansas River Room

ENG/COMP SCI – 01 – Richard Segall

Arkansas State University, Faculty Researcher

Steps Toward Measuring World Space Exploration Activity

(Co-Authors: Ronithkumareddy Duggirala, Venkat Kodali, Daniel Berleant, Hyacinthe Aboudja)

This presentation discusses the continuation and extension of previous research performed by the research group on modeling of data pertaining to space missions to astronomical bodies beyond earth [1]. This presentation discusses the modeling of the following. (1) Trends and summarizing facts mined from data about the missions launched by all countries that go to planets, comets, and asteroids, and representation of the data in graphs based on those missions. (2) Trends and summarizing facts mined from data about Earth satellites obtained from a Union of Concerned Scientists (UCS) Dataset and Wiki Satellite Data. The presentation provides an overview of our current research and visual representations, including the following. I. Mission data and statistical analysis performed using Excel charts, Tableau software, and Qlik, to produce graphs focusing on trends over time. Comparisons are made between one planet and other planets to observe differences. Graphs are provided that indicate if trend lines exist in the missions to individual planets, from one planet compared with other planets and overall. Moving averages are used to smooth the graphs and to understand if there are trend lines for missions over time. II. Earth satellite data and discussion of graphs created to show summarizing facts about satellite purpose, launch sites, orbital distance, successful vs. failed launches over time, and launches by country. This presentation concludes with a summary of the above current research topics and future

directions of the research. Reference: 1.Hall, C.; Berleant, D.; Segall, R. S.; Lu, S.. “Steps toward Quantifying Advancement in Space Exploration,” Proceedings of 20th World Multi-Conference on Systemics, Cybernetics and Informatics, Volume II, WMSCI 2016, Orlando, FL, July 8-11, 2017, pp. 106-112.

ENG/COMP SCI – 02 – Xin Yang

Southern Arkansas University, Faculty Researcher

Deep Learning-based framework for fMRI Autism Image classification

(Co-Authors: Ning Zhang, Saman Sarraf)

Neuroimaging has become the most commonly used imaging technique for the study of human brain, which has given us insights about the complex neural characteristics of the human brain and also provided helpful information for the diagnosis of various disease. The purpose of this paper is to provide accurate and efficient machine learning models for functional brain image classification of Autism spectrum disorder. Autism spectrum disorder (ASD) is a neurally based psychiatric disorder, which is characterized by the impaired development of social interaction and communication skills. Although strong genetic factors are suspected, ASD continues to be diagnosed using symptom-based clinical criteria and its etiology remains unestablished. Recent epidemiological studies have shown that the incidence of autism is increasing. Further study in this area could provide helpful information in gaining a better understanding of the neuronal pathology of autism in children. In this paper, we build a deep learning framework based on NVIDIA GPU platform. By using the Convolutional Neural Network(CNN) and the LeNet-5 architecture, we successfully classified functional MRI image of Autism spectrum disorder from normal controls.

ENG/COMP SCI – 03 – Ashokkumar Sharma

University of Arkansas at Little Rock, Faculty Researcher

RAM pump, an energy independent solution to improve water accessibility to underdeveloped inhabitants in the world – A performance improvement study

(Co-Authors: Srikanth Pidugu, Shashank Khaire, Swaminadham Midturi)

Water is undeniably a vital need for our survival and its availability has always played a key role in human existence. Access to quality water is an essential factor for our lives. The facts are many inhabitants in the world do not have drinking water due to water shortages especially in remote and/or hilly locations. This is because to convey water to higher altitudes required pumping infrastructure and in the absence of such facilities, the communities that reside on isolated areas seriously encounter water scarcity; affecting the drinking, sanitation, farming and other water based needs. These issues can positively be solved by employing a RAM pump, which works on the principle of energy conservation and operates without any power source resulting in a zero or negligible running cost. A team of senior design students has recently built a hydraulic RAM pump and successfully demonstrated its operation. However, many parameters that considerably influence the pump performance (such as delivery head, suction head, diameter of drive pipe, pipe length, pipe material, type of poppet valve etc.) are yet to be optimized. The goals of the proposed study is to improve the performance of an existing RAM pump by optimizing the suction and delivery heads. Based on the previous results, three levels of suction head below 5 ft and three levels of delivery head below 20 ft will be investigated. Data measurement will include quantity of water pumped and quantity of wastewater collected during each experiment. Results will predict the effect of suction and delivery heads on the pumping rate and pump efficiency.

ENG/COMP SCI – 04 – Brandon Kemp

Arkansas State University, Faculty Researcher

Applications of theoretical advances in the optical energymomentum debate: invisibility cloaks, tractor beams, and reversed radiation pressure

(Co-Author: Cheyenne Sheppard)

The momentum of light in matter have been debated in physics for more than a century. The Abraham-Minkowski debate is often discussed in terms of the correct form of optical momentum in media, but, actually arose out of relativistic considerations for the stress-energy-momentum (SEM) tensor in electrodynamics. [1] Recently, we have proved and demonstrated that momentum, energy and stress are important to understand the electrodynamics of field-matter coupled systems. It is the field-kinetic subsystem of light which represents the electromagnetic portion of the SEM tensor and is responsible for center-of-mass translations of matter, while the canonical subsystem represents the coupled system of material and field. [2, 3] We revisit some recent advances in the understanding and interpretation of the electrodynamics of moving media including the field-kinetic subsystem and the coupling of electromagnetic stress, energy, and momentum with material media. We then show how anomalous interactions may occur in or at the surface of materials producing anomalous interactions such as negative refraction in a metamaterial, invisibility cloaking, the tractor beam on a chip, and reversal of radiation pressure in nanoparticles. 1. B. A. Kemp, Prog. Opt. Vol. 60, Chapter 5 (2015). 2. C. J. Sheppard and B. A. Kemp, Physical Review A, 93, 013855 (2016). 3. C. J. Sheppard and B. A. Kemp, Physical Review A 93, 053832 (2016).

ENG/COMP SCI – 05 – Cheyenne Sheppard

Arkansas State University, Faculty Researcher

The Electrodynamics of Kinetic, Canonical, and Hidden Systems Under Relativistic Motion

(Co-Author: Brandon Kemp)

For the past century, the optical momentum debate, commonly referred to as the Abraham-Minkowski controversy, has been studied. This debate concerns itself with the understanding of kinetic and canonical electromagnetic momentum phenomena inside matter. Closely related to this is the topic of electromagnetic hidden momentum, which studies the concept of center of mass translations and linear momentum exchange between the fields and a given medium. In reviewing literature on this topic, it is clear that there lacks an accurate understanding of the hidden momentum and the material contributions within electromagnetic wave phenomena. Thus, we utilize the relativistic principle of virtual power to derive the leading formulations of electrodynamics. These formulations are invariant from one inertial reference frame to another and satisfy global conservation laws. Using standard electromagnetic field and material definitions, as well as the derived formulations, we formulate the hidden subsystem, which contains the hidden momentum. To demonstrate our analysis, we analytically model the electromagnetic wave phenomena using the derived formulations and their field-matter interactions within moving time varying and time averaged thought experiments. The results show that when adding the derived hidden momentum to the Amperian formulation, one must utilize the total hidden subsystem to account for relativistic energy-momentum conservation laws within the electromagnetic system. Additionally, we find that the Chu and Minkowski formulations are responsible for the kinetic and canonical formulations, respectively.

ENG/COMP SCI – 06 – Muhammad Safeer Khan

Arkansas Tech University, Faculty Researcher

Investigation of Acoustic-Based Crack Detection in PVC Pipes

The closed circuit television camera (CCTV) inspection is current industry standard for structural health monitoring and blockage detection in underground sewer pipes. For pipeline inspection, the CCTV camera is mounted on a self-propelled robotic crawler which passes through the pipe and relays video to an operator. These systems are contained in special vehicles and require a monitoring station with proprietary software to enable the operator to annotate the videos with notes. This makes these systems cost and labor intensive. There is a need to investigate and develop a system that can be easily deployable and cost-effective. Recent developments in acoustic based pipeline inspection technologies have highlighted that acoustic signals can be effectively used to detect blockages in pipes. The present acoustic systems, however, are not capable of detecting cracks in underground sewer pipes. This paper examines the use of acoustic signals to detect cracks in polyvinyl chloride (PVC) pipes which are industry standard for use in sewer installations. Extensive lab testing was done on pipe samples with and without cracks and pipes with laterals to develop a method to distinguish the change in pipe's acoustic response based on presence of a crack and a side branch. The results of analysis will be presented and the future directions of this research will be laid out.

ENG/COMP SCI – 07 – Ismaeel Al-Baidhany

Al-Mustansaryah University, Faculty Researcher

A study of M and M_{dyn} masses at the different of the dynamical parameters of the spiral host galaxies

(Co-Authors: Sami Salman Chiad, Nadir Fadhil Habubi, Khalid Haneen Abass, Ehssan S. Hassan, Mohamed Odda Dawod, Wasmaa Jabbar)

Several techniques are used to derive dynamical masses. The most accurate methods are based on one of two approaches: the solution of Poisson and Jeans equations or the description of the system using an orbit-superposition method. These methods are expensive in terms of observing time. A cheaper alternative is to use a simple mass estimate or based on the virial theorem. We have studied the stellar and dynamical masses for the spiral galaxies using the virial relation and mass to light ratio (M/L) to find M_{dyn} and M masses respectively. We found the dynamical mass using the virial relation $M_{dyn} = K \sigma^2 re/G$ with the virial coefficient $K = 5.0$. We obtained a stellar velocity dispersion from the literature. We obtained the bulge effective radius (re) using 2D bulge-disc decomposition of Spitzer/IRAC 3.6 μm images. The stellar mass M of each galaxy has been estimated by using the bulge 3.6 μm luminosity with the stellar mass or light ratio (M/L). In this work, we have characterized of M and M_{dyn} at the different of the dynamical parameters of the spiral host galaxies.

ENG/COMP SCI – 08 – Sami Chiad

Al-Mustansaryah University, Faculty Researcher

Optical Properties and Dispersion Parameters of PMMA-MnCl₂

(Co-Authors: Nadir Fadhil Habubi, Khalid Haneen Abass, Ismaeel Al-Baidhany, Ehssan S. Hassan, Mohamed Odda Dawod, Wasmaa Jabbar)

Casting method was used to prepare PMMA films with various content of MnCl₂. The absorption spectra were recorded by UV-Visible spectrophotometer, and the optical properties and dispersion parameters were investigated. The absorbance increased with the increasing of MnCl₂ additive, while the transmittance decreased. The Urbach energy decreased and the energy gap increased with the increase of MnCl₂. The dispersion parameters E₀, E_d were increased with the increasing of MnCl₂ additive in the PMMA films.

Parasitology Session (Saturday Session) Room: Black River Room

PARA – 01 – Chris McAllister

Eastern Oklahoma State College-Idabel, Faculty Researcher

Parasites of the Spotted Sucker, *Minytrema melanops* (Cypriniformes: Catostomidae) from Arkansas and Oklahoma

(Co-Authors: D.W. Cloutman, A. Choudhury, T. Scholz, S.E. Trauth, T.J. Fayton, and H.W. Robison)

During October 2015, March and April 2016 and again between March and April 2017, 15 adult Spotted Suckers (*Minytrema melanops*) were collected from sites in the Ouachita (n = 5), Red (n = 1), and St. Francis (n = 5) river drainages, Arkansas, and the Arkansas River drainage, Oklahoma (n = 4), and examined for protozoan and metazoan parasites. Found were *Calyptospora* sp., *Myxobolus* sp., *Pseudomurraytrema alabarrum*, a caryophyllidean tapeworm, and *Acanthocephalus* sp. New host and distributional records are documented for these helminths.

PARA – 02 – James Daly Sr.

University of Arkansas for Medical Sciences, Faculty Researcher (Retired)

Prevalence as a Predictor of Other Helminth Population Descriptors (Mean, Standard Deviation, Maximum Number) is Relatively Inaccurate at High Parasite Densities in the Host)

Descriptors of parasitic helminth populations, such as mean abundance (standard deviation), maximum number, mean intensity (standard deviation) and dispersion indices have been shown to have significant correlations between each other. Based on regression studies on these descriptors (J. J. Daly Sr., 2014: J. Ark. Acad. Sci.; 68:57) from *Clinostomum marginatum* metacercaria in black bass (*Micropterus*) these correlations are good enough that if one has the value of one descriptor then by using previously obtained regression coefficients a reasonable estimate can be made of the other descriptors. An exception is prevalence (% of hosts infected) which, based on the literature, may be highly correlated with other descriptors in one infection, poorly in another and not at all in another. In this study using population data from three different helminth parasites a definite parasite density effect is seen in that the heavier the parasite burden the less correlative prevalence is.

PARA – 03 – Chris McAllister

Eastern Oklahoma State College-Idabel, Faculty Researcher

Additional Records of Acanthocephalan Parasites from Arkansas Fishes, with New Records from Missouri Fishes

(Co-Authors: M.A. Barger, and H.W. Robison)

Over the last decade, our research consortium has provided information on acanthocephalan parasites of Arkansas vertebrates, including those from the state's fishes. Here, we continue to provide data on new geographic and new host records of acanthocephalans from Arkansas fishes. In addition, for the first time, we report records of acanthocephalans from some Missouri fishes. We document several new state records as well as 13 new host records for some fish acanthocephalans.

PARA – 04 – James Daly Sr.

University of Arkansas for Medical Sciences, Faculty Researcher (Retired)

Proportionality of Statistical Parameters for Helminth Parasite Populations in Smallmouth Bass (*Micropterus dolomeiu*) from the Buffalo National River in Arkansas

Previous studies have shown that the population descriptors of mean, standard deviation and maximum number of *Clinostomum* sp. infections in stream smallmouth bass from Arkansas were highly correlative with each other with percent infection much less so. These populations also showed standard deviation (SD) to mean ratios larger than 1 indicating aggregation rather than infections obtained randomly. A study by Kilambi and Becker in 1977 on the helminth parasites of smallmouth bass from the Buffalo National River offered the opportunity to analyze their data to see if such correlations also occurs in other helminth populations of smallmouth bass. Mean, standard deviation, maximum number and percent infection were available for hosts from three locales (upper, middle, and lower sections) for four seasons. Combined calculations of locales and seasons for 24 monogenean, digenean, cestode, acanthocephalan and nematode populations were used to determine descriptor correlations. All 24 showed SD/mean ratio of greater than one (aggregation) averaging 3.6 ± 1.7 . Correlations between means, SDs, and maximum numbers were all highly significant with each other with percent infection correlations being not significant with each of the other descriptors. This data agrees with *Clinostomum* infections in smallmouth bass previously reported. The SD/mean ratios were in line with other helminth data in the literature in which most have aggregated structured populations rather than random infections.

Poster Presentation Abstracts

Poster Session, Centennial Hall Biology - Medicine, Molecular & Cellular Biology

P: 01 – Jasleen Saini

University of Arkansas, Graduate Student

Judge: Yes

Generation and Analysis of chromosomal gene deletion mutants of two putative thiosulfate sulfurtransferases in *Mycobacterium smegmatis*

(Co-Author: Ravi D. Barabote)

Mycobacterium smegmatis is the most widely used non-pathogenic model organism for elucidating the unique physiology of Mycobacteria, which include immensely important human pathogens. While sulfur metabolism has been recognized as a key target against pathogenic mycobacteria, the mycobacterial sulfur metabolism pathways are not fully understood. Mycobacterial genomes encode multiple homologs of putative thiosulfate sulfurtransferases (TSTs) whose functions remain to be defined. We are interested in studying the function of putative mycobacterial TSTs using *M. smegmatis* as the model. The *M. smegmatis* genome encodes two sequence homologs of putative TSTs, encoded by *sseA* and *cysA2* genes. Currently, we have generated a chromosomal gene deletion mutant of *sseA* using dif-flanked Hygromycin-resistance cassette recombination system. Gene deletion of *cysA2* (along with its adjacent gene, *sseC*) is in progress. Using the genetic mutants, the role of the two putative TSTs in sulfur metabolism and stress resistance is being investigated. Generation, confirmation, and preliminary analysis of the mutants will be presented.

P: 02 – Saroj Mahato

University of Arkansas, Graduate Student

Judge: Yes

Investigation of the function of a putative cysteine synthase homolog in *Mycobacterium smegmatis* using unmarked gene deletion mutation

(Co-Author: Ravi D. Barabote)

Mycobacteria include highly successful human pathogens that pose a global health crisis. Cysteine synthesis pathways offer unique and strategic targets for developing new and effective antimycobacterial drugs, since these pathways are lacking in humans. Mycobacterial genomes encode multiple homologs of cysteine synthases, at least three of which have been characterized in vitro. However, the in vivo pathways for cysteine synthesis and the significance of the multiple cysteine synthases paralogs in mycobacteria are unknown. Our laboratory is interested in investigating the in vivo routes to cysteine synthesis in mycobacteria. We use *Mycobacterium smegmatis*, the most widely used non-pathogenic mycobacterial model. To study the physiological role of the cysteine synthase paralogs, we are generating chromosomal gene deletion mutants in *M. smegmatis*. Specifically, we have initially targeted the deletion of the complete operon encoding the *cysM*, *cysO* and *mec+* genes. To generate mutants, we used a linear DNA construct generated by fusing a hygromycin-resistance gene flanked by dif-sites between nucleotide sequences upstream and downstream of the operon. Development, confirmation, and analysis of the mutants will be presented.

P: 03 – Kelsey Martin

Harding University, Graduate Student

Judge: Yes

The Effect of SLCO Transporter Polymorphisms on Prostaglandin Levels in Healthy Postmenopausal Volunteers

(Co-Authors: Nimmy E. Isaac, Landry K. Kamdem)

There has been a link established with increased prostaglandin levels, specifically PGE2, and an increased risk for breast cancer1. Previous studies from Clark et al. found variable urine PGE2 levels after healthy volunteers took exemestane, an aromatase inhibitor used to treat breast cancer2. It is theorized that the varying prostaglandin induction is due to genetic variability in single nucleotide polymorphisms (SNPs) in the inflammatory pathway and in transporter genes2. This experiment wanted to identify

if any SLCO transporter SNPs, a family of organic anion transporters that are involved with drug uptake, are associated with increased PGE2 levels³. In this study, we genotyped SLCO1B1 (rs4149056), SLCO2B1 (rs12422149, rs2306168) and SLCO1B3 (rs4149117, rs11045585) in 82 healthy postmenopausal women using an endpoint genotyping technique that was performed on the LightCycler 480. We then performed genotype-phenotype analyses from previously collected PGE2 levels from Clark et al. to see if there was any significant association. From the 5 SLCO transporters genotyped, there were no significant associations found from the SLCO polymorphisms and the varying prostaglandin levels after comparing wild type homozygous, heterozygous, and wild type variant. More genotyping of different transporters and inflammatory pathway genes needs to be conducted to explain varying prostaglandin levels after taking exemestane. [1] Kraus, S. Impact of genetic polymorphisms on adenoma recurrence and toxicity in a COX2 inhibitor (celecoxib) trial: results from a pilot study. [2] Clark, B. COX2 induction: a mechanism of endocrine breast cancer resistance? [3] Bruno Hagenbuch. SLCO family of organic anion transporting polypeptides. Accessed on 03/09/2018. IUPHAR/BPS Guide to PHARMACOLOGY, <http://www.guidetopharmacology.org/GRAC/FamilyDisplayForward?familyId=238>.

P: 04 – Mason Rostollan

University of Central Arkansas, Graduate Student
Judge: Yes

Characterization of Biomass Smoke Particles via Scanning Electron Microscopy and Energy-Dispersive X-Ray Spectroscopy

The burning of biofuels for cooking and heating is particularly common in regions with low socioeconomic status and can lead to detrimental respiratory illness or mortality. This problem is worsened by lack of affordable healthcare and poor environmental health conditions. Previous work in Kanembwe, Rwanda has identified smoke production as an area of concern with respect to health. The World Health Organization (WHO) recognizes particles with an aerodynamic diameter of 10 µm (PM10) or less is considered inhalable, and below 2.5 µm (PM2.5) is considered a fine particle and has a more devastating effect on respiratory health. However, the use of rocket stoves may be able to lower the negative health impacts by reducing smoke production. Verbal accords suggest a reduction of irritation to both eyes and lungs. In this study, we will first use a Sioutas personal cascade impactor sampler (PCIS) to collect suspended particulates from both a traditional 3-stone fire and an implemented rocket stove. Once the particulates are collected, we will characterize the size, shape, and elemental composition of smoke particles via scanning electron microscopy (SEM) and energy-dispersive x-ray spectroscopy (EDS). Preliminary data was collected using a rocket stove at the university before field tests in Rwanda. These preliminary tests show large numbers of fine particles being released into the air and collected with the PCIS, with slightly varying compositions consisting of C, O, Mg, Mn, Ca, Nb, and F. Future work will include field tests in Kanembwe, comparisons between the two cooking methods, and daily personal exposure experiments. The identification of these characteristics are essential to understanding the potential health risks of biomass fuel burning.

P: 05 – Nirman Nepal

Arkansas State University, Graduate Student
Judge: Yes

Molecular Mechanisms Underlying the Higher Biomass and Abiotic Stress Tolerance Phenotype of Arabidopsis MIOX Overexpressers

(Co-Authors: Jessica P. Yactayo Chang, Lucia M. Acosta-Gamboa, Karina Medina-Jimenez, Mario A. Arteaga-Vazquez, Argelia Lorence)

Myo-Inositol oxygenase (MIOX) is first enzyme in the inositol route to vitamin-C (L-ascorbate, AsA). MIOX Arabidopsis over-expressers have elevated AsA and display enhanced biomass and increased tolerance to abiotic stresses. The molecular mechanisms underlying this phenotype are not well understood. In this work RNA-Seq analysis, RT-qPCR, LC/MS, microscopy, and physiological measurements were used to study gene expression profiles and to find biological significance of the differentially expressed transcripts in the high AsA line compared to controls. In silico and RT-qPCR analysis indicate increased expression of transcripts involved in auxin biosynthesis, hydrolysis, transport, and metabolism, which are supported by elevated auxin levels and their effect on epidermal cell elongation in the MIOX over-expressers. Additionally we detected upregulation of transcripts involved in photosynthesis. In support of this finding we measured increased efficiency of the photosystem II and lower non-photochemical quenching in the transgenics. These changes in auxin metabolism and efficient photosynthesis are likely explanations for the enhanced biomass accumulation and growth rate of the MIOX line. Multiple gene families conferring plants tolerance to cold, drought, and heat stresses were found to be elevated in the MIOX overexpressers. Increased expression of amylase and increased glucose levels in the high AsA line possibly confer tolerance to cold stress and act as signal molecules to initiate biotic defense responses. Interestingly, we detected upregulation of transcripts involved in defense hormones biosynthesis (e.g. jasmonates), defense proteins (e.g. defensin), secondary metabolites (e.g. glucosinolates), and transcription factors that are known to be important for biotic stress tolerance in the high AsA line. Negative effects of downregulation of transcripts in pathogen defense response seems to be compensated by elevated salicylic levels in the MIOX line. Further quantification of glucosinolates using HPLC, in vivo auxin quantification and sensitivity analysis, and bioassays challenging the MIOX line with nematodes will be carried out in follow up studies.

P: 06 – Brenna Walters

Harding University, Undergraduate Student
Judge: Yes

Exposure to carbon black nanoparticles during larval development affects adult physiological stress tolerance in wild type isolates of Caenorhabditis elegans

(Co-Authors: Gavin Traber, Riley Jones, Kasey Boatwright, Jared Cooper, Emme Copeland, Coleman Dennis, Brandon Gates, Shelby Hamilton, Jon Aaron Howell, Caroline Minton, Joe Tolar, Jo Goy)

The Earth is currently undergoing rapid and detectable environmental fluctuations, some natural and some man-induced. Levels of pollutant particles are at highest levels recorded for many global locations, including numerous large cities that serve as home to a large portion of the Earth's human population. The effects of air pollutants on human health is of interest as we enter into a period of larger human population and higher levels of environmental pollution than has been known in recorded history. However, determining the impact of pollution on human health is inherently difficult. To investigate the effects of pollution on health, we exposed hermaphrodite nematodes (*Caenorhabditis elegans*), a model genetic organism, to carbon black nanoparticles (CB, average particle size of 0.042 microns, 0.1mg/ml final concentration), a common component of air-borne and ground pollution. To maximize the likelihood of detecting an affect, parental populations were grown in the presence of bacterial food containing CB and subsequent F1 generation larvae were split into two groups; either continued exposure to CB as developing F1 larvae (+/+), or not exposed to CB during F1 development (+/-). F1 hermaphrodites were evaluated by a spectrum of assays to detect changes in health-related factors including reproductive effort, metabolism, and ability to tolerate oxidative stress compared to unexposed controls (-/-). Initial data suggest that exposure to CB shifts embryo production to earlier in adulthood without changing brood size. N2 hermaphrodites grown in the presence of CB showed a reduced tolerance to paraquat-induced reactive oxygen species (ROS) compared to unexposed hermaphrodites. Furthermore, hermaphrodites of the wild type strain CB4856 (isolated in Hawaii) showed lower overall survival rates when exposed to paraquat compared to N2 (isolated in England) for both control (no CB exposure) and treated (exposed to CB). Preliminary data suggest that CB exposure during development affects a range of physiological parameters for adult *C. elegans*.

P: 07 – Spencer Long

University of Central Arkansas, Undergraduate Student
Judge: Yes

A Retrospective Multistate Analysis of Influenza Pandemic Deaths

(Co-Author: Ashton Purtle)

The 1918-1919 H1N1 influenza pandemic was one of the deadliest in modern history. Estimates of 600,000 US deaths and as many as 50-100 million deaths globally are common. The pandemic raged in the US from September 1918 through April 1919. While a variety of studies have examined death trends for the pandemic at the large city (e.g. New York City) or national level, far fewer studies have been performed on individual states without large urban centers. This project examines the pandemic in New Hampshire, Arkansas, and Arizona. Each of these states represents a very different part of the country – long-established New England, rural-agricultural mid-South, and Southwest deserts and mountains. Age and gender demographics in the pandemic mortalities are collected from death record archives and tested against expected values obtained from federal census information. A full breakdown of age of death information in each state's population is included. This work represents new information regarding the 1918 pandemic in as-yet unexamined geographic areas.

P: 08 – Ryan Williams

Arkansas Tech University, Undergraduate Student
Judge: No

Transient Receptor Potential Channel 3 and Its Effects on Systemic Blood Pressure Regulation in Diseased Versus Healthy Mesenteric Arteries

Hypertension is one of the leading causes of death in the United States leading to nearly 360,000 deaths per year and costing nearly \$46 billion per year. In the United States, one out of three individuals have hypertension, and of those only 54 percent adequately regulate their hypertension. This study focuses on the molecular regulation of systemic blood pressure via the Transient Receptor Potential Channel 3 (TRPC3) transmembrane protein in rat mesenteric arteries. Previous studies have shown TRPC3 to be present in the membrane of both the endothelium and the smooth muscle of the mesenteric arteries. The activation of TRPC3 in the endothelium of mesenteric arteries has been shown to cause hyperpolarization of smooth muscle, leading to smooth muscle relaxation, dilation of the arterial lumen, and subsequent decrease in systemic blood pressure. The focus of this study is to test the effects of TRPC3 activation on mesenteric arteries with denuded endothelium as is seen in patients who have vascular disease as well as high blood pressure. Denuded mesenteric endothelium is hypothesized to cause decreased activation of TRPC3 in the endothelium, as well as increased activation of TRPC3 on the exposed receptors in the smooth muscle. Decreased activation of TRPC3 in the endothelium is hypothesized to cause a lowered hyperpolarization, and increased systemic blood pressure, while activation of TRPC3 in smooth muscle is hypothesized to cause smooth muscle contraction and further increased hypertension. This

study uses wire myography to study the relaxation and contraction of rat mesenteric arteries with intact and denuded endothelium in the presence of TRPC3 agonists and antagonists, in hopes to illuminate the effects of TRPC3 activation in denuded and intact mesenteric arteries. The study design, mechanism of action, methodology, and experimental results are discussed.

P: 09 – Spencer Sanson

University of Arkansas for Medical Sciences, Graduate Student
Judge: Yes

Detection of Ten Antineoplastic Drugs in a clinical setting by Wipe Test and LC-MS/MS analysis

(Co-Author: Howard Hendrickson)

The potential for inadvertent exposure to chemotherapeutic drugs in hospital clinic settings has been studied in a few cases. These few studies demonstrate the need to determine if accidental spillage of drug solutions might put health care staff, patients, and visitors at risk to exposure to these potent drugs with potential adverse health consequences to those exposed. This study was designed to determine if ten frequently used cancer drugs (vincristine, cyclophosphamide, ifosamide, methotrexate, doxorubin, epirubicine, cytarabine, gemcitabine, etoposide, and irinotecan) could be detected using a wipe test paired with LC-MS/MS analysis. Surface samples were taken from heavily used working surfaces in the University of Arkansas for Medical Sciences Infusion 4 Clinic, which is located in the Winthrop Rockefeller Cancer Center. Four rooms and twenty-two surfaces were screened for the 10 compounds on a Sunday morning with little patient activity. Sampling was accomplished using Whatman 903 protein saver cards. There was no significant detection of any of the compounds tested. Therefore, at the time of testing the four rooms and twenty-two surfaces were determined to be free of the ten common antineoplastic drugs that were screened. Future studies should exam these same surfaces when there is more patient activity in the clinic.

P: 10 – Malynn McKay

Arkansas Tech University, Undergraduate Student
Judge: No

A comparison of Japanese and American children’s diets, and a literature review of diet and disease.

The popular belief is that Japanese have a healthier diet than Americans. My goal was to determine if this belief is scientifically founded. The diets of Japanese and American children (ages 6-10) of similar socio-economic backgrounds, and living in similar rural environments were compared. A survey was conducted in Ofunato, Japan, as well as in Vilonia, Arkansas. This survey asked children what they ate for dinner the previous night, including the number of servings that the children had. Each student’s meal was organized by what percentage of each biomolecule (saturated fat, unsaturated fat, high fructose corn syrup, cane sugar, protein, fiber) was in the meal. The results were analyzed using ANOVA statistical analysis to determine if any significant differences exists between the two group’s diets, and a Tukey Post-Hoc to determine between which biomolecules the differences exists. Next, a literature review of previous research was done to analyze the health benefits or detriments of each biomolecule. The top five death-causing chronic illnesses were identified for each country, and the aspects of the diet that are believed to influence the probability of developing each illness were discussed.

P: 11 – Antoinette Davis

Southern Arkansas University, Undergraduate Student
Judge: Yes

The effect of green tea extract on Daphnia magna

We investigated the effect of commercial green tea extract (GTE) on Daphnia magna by means of acute and reproductive toxicity tests. We found that GTE significantly reduces the reproductive output of D. magna over a 21-day test period.

P: 12 – Jeremy Brown

Southern Arkansas University, Undergraduate Student
Judge: Yes

Genetic engineering of the Mad locus using CRISPR/Cas-9 and Phi-C31 recombination

Mothers against Decapentaplegic (Mad) is the effector of the canonical Bone Morphogenic Protein (BMP) signaling pathway in Drosophila. Mad and other BMP pathway components are highly conserved in vertebrates where they control and regulate myriads of physiological processes. Furthermore, abnormal BMP signaling is implicated in the pathologies of developmental and genetic disorders. Studies on Mad are currently limited by the lack of effective antibodies against Mad. The current project focuses on using CRISPR/Cas9 to scarlessly insert a phage docking site into the Drosophila’s mad locus. The mad docking site can then be targeted for transgenesis using Phi-C31 recombination. We will first use this docking site to insert a fluorescent protein (FP) into

the mad locus. This biomarker will allow us to visualize the location and intensity of endogenous Mad-FP in the neuromuscular synapse or anywhere else in the organism. Mad-FP will also facilitate biochemical assays. Moreover, the Mad-FP can be targeted by deGradFP for loss-of-function experiments. Finally, the docking site will enable the generation of any number of future structure/function mutations in mad, which will be used to elucidate the role of this critical pathway effector.

P: 13 – Jeremy Brown

Southern Arkansas University, Undergraduate Student
Judge: Yes

Identify Microbes in Drinking Water using PCR

In the U.S., the Safe Drinking Water Act allows the EPA to regulate water quality. One of the primary concerns of the EPA is the number of recoverable coliforms in drinking water. Coliform recovery is a potential indicator of the presence of harmful bacteria. To combat coliforms and other bacteria, chlorination is commonly used as a chemical sanitization technique to lower and hopefully eliminate recoverable coliforms from local water systems. However, recent studies have found evidence that suggests coliforms are actively adapting to survive the levels of chlorine which are present in some drinking water systems. This project is aimed at using both microbiological and genetic techniques to detect the presence of E. coli O157:H7 a potentially harmful coliform. The coliforms are recovered from a rural water supply in the southern United States. The bacteria are initially recovered using selective media and identified using microbiological techniques such as indole and oxidase tests. Then PCR is used to identify the bacteria with primers targeting strain specific genes. Finally, the primers are tested for their efficacy to detect that same strain of bacteria. This project was started in October of 2017 and if successful then this technique could be used in the future as a costeffective approach to rapidly detect potentially harmful bacteria in water supplies.

Biology - General Biology & Ecology

P: 14 –Kimberly Smith

University of Arkansas, Faculty Researcher
Judge: No

House Finch (Haemorhous mexicanus) nesting in December in Arkansas

During December of 2017, a pair of House Finches attempted to nest in a Christmas wreath in Maumelle (Pulaski County), Arkansas. The wreath was hung on 28 November and birds were investigating the wreath by 12 December. When the wreath was removed on 29 December, a House Finch nest with 4 eggs was discovered.

P: 15 – Kimberly Smith

University of Arkansas, Faculty Researcher
Judge: No

Observations of Townsend’s Solitaires (Myadestes townsendi) on Mount Magazine in Logan County, Arkansas

(Co-Author: Don Simons)

Townsend’s Solitaires (Myadestes townsendi) normally range throughout the Rocky Mountains. In winter months they are known to occur eastward into the Midwest primarily associated with cedar thickets. Range maps in most bird field guides do not indicate that they visit Arkansas. Beginning in 2005, multiple reports have been made from Mount Magazine in Logan County, which are summarized in this report. Since 2005, Simons has been able to confirm the occurrence of solitaires on Mount Magazine 6 out of 13 winters and has found at least 14 birds. This shows that Townsend’s Solitaires are more common during winter in Arkansas than previously thought.

P: 16 – Kimberly Smith

University of Arkansas, Faculty Researcher
Judge: No

Second record of the Gray-headed Junco (Junco hyemalis caniceps) in Arkansas

(Co-Author: Karen Garrett)

On 1 March 2018, a Gray-headed Junco was discovered at the Visitor Center at Hobbs State Park - Conservation Area in Benton County. The only other record for Arkansas was a bird in Little Rock at the end of February in 1963. These 2 records are the farthest eastern records for this western subspecies.

P: 17 –Amanda Trusty

Arkansas State University, Undergraduate Student

Judge: Yes

Does frequently visiting a Bluebird nest increase predation risk?

(Co-Author: Virginie Rolland)

A review showed that frequently monitoring nests may impact predation risk, but manmade nest cavities were not considered. Thus, our objective was to determine the effect of visit frequency on nest predation of birds nesting in artificial cavities. Between March and September 2017, we monitored 115 nest boxes occupied by Eastern Bluebirds (*Sialia sialis*), about 10 km north of Jonesboro, Arkansas. We recorded the nest status every 1-6 days from the first egg to fledging or nest failure. Fifteen days after hatching, chicks may fledge prematurely if disturbed. We randomly divided nests with 15-day-old chicks in two groups: checked daily or at the estimated fledging date. We excluded nests of unknown fate, and of the remaining 195 nesting attempts, 44 were depredated. Specifically, we found that frequent visits did not impact risk of predation but increased risk of abandonment. However, all chicks successfully fledged from nests checked daily after day 15, indicating that nests may be most vulnerable at a younger stage. We recommend that bluebird monitors record nest status at a 3-day or longer interval during early nest stages. With caution, monitors may visit nests daily after day 15 to accurately determine nest fate without jeopardizing nest success.

P: 18 – Michael Trusty

Arkansas State University, Undergraduate Student

Judge: Yes

Does axle grease effectively protect bluebird nests from predators?

(Co-Author: Virginie Rolland)

Bird conservation organizations have long promoted the use of predator guards, such as the Kingston stovepipe baffle, to protect nest boxes and increase nest success of birds nesting in cavities. A recent large-scale study showed that predator guards effectively reduce nest predation. However, the effectiveness of axle grease as a common predator deterrent was not tested. Therefore, our objective was to determine the effectiveness of axle grease at increasing nest success. From March to September 2017, we monitored 148 nest boxes at a site 10 km north of Jonesboro, Arkansas, but we focused our study on the 115 nest boxes used by Eastern Bluebirds (*Sialia sialis*). We divided these nest boxes evenly among three groups: baffle, grease, and no guard. Bluebirds made 238 nesting attempts, 44 of which were depredated, primarily by snakes (48%) followed by raccoons/cats (28%), squirrels (13%), and unidentified predators (11%). Our models indicate that grease and baffles equally improved bluebird nest success by about 40%. Though not significantly, grease tended to yield a higher nest success than baffles. To conclude, axle grease is a cheap and effective alternative to baffles that owners of bluebird boxes in Arkansas and elsewhere can use to further bluebird conservation.

P: 19 – Edgar Sanchez

Arkansas Tech University, Undergraduate Student

Judge: Yes

Developing Microsatellite Markers for Genetic Identification of Songbirds

(Co-Author: Douglas Barron)

Microsatellites are short tandem repeats (e.g. AGAGAGAG) of base pairs in a species’ genome. High mutation rates in these regions produce variation in the number of repeats across individuals that can be utilized to determine parentage genetically. In our present research, we are interested in determining traits of individual birds that influence their reproductive success. Because females regularly mate outside of their social pair bond, however, we cannot assume all offspring belong to the female’s mate but instead must utilize genetic paternity analyses to determine a male’s reproductive success. In this project our objective was to develop useful microsatellites for our two main focal species, the House Finch (*Haemorhous mexicanus*) and House Sparrow (*Passer domesticus*). We used mist nets to capture birds on the Arkansas Tech University campus and collected blood samples for use in developing microsatellite markers at The Field Museum’s Pritzker DNA Laboratory in Chicago, IL. In short, we fragmented genomic DNA and isolated only those fragments that contained microsatellites using specially designed probes. DNA fragments were then transformed into competent *E. coli* cells, PCR-amplified, and Sanger sequenced. The resulting DNA sequences were then used to design primers to amplify specific microsatellite loci from genomic DNA. After sequencing approximately 500 *E. coli* colonies, we successfully designed 15 primer pairs for each species that are suitable to determine parentage genetically. This finalized set of microsatellites will be used to genotype all captured individuals in our study so we may evaluate the relationship between adult characteristics and reproductive success.

P: 20 – Gary Graves

Smithsonian Institution, Faculty Researcher

Judge: No

Winter surveys of *Cotinus obovatus* (American smoketree) in the Ozark Mountains

Cotinus obovatus (American smoketree) is a rare deciduous tree with a relictual distribution in southeastern North America. Efforts to map its fine-scale geographic distribution in the Ozark Mountains have been limited to the growing season when the distinctive blooming panicles and foliage facilitate detection in hardwood-cedar woodlands. Here I describe the physiognomic traits of leafless *C. obovatus* that permit effective population mapping in winter landscapes. Clumped growth and diagonally leaning stems facilitate detection at a distance and bark texture, twig morphology, and sap odor confirm the identity of the tree at close range.

P: 21 – Zac Campbell

Arkansas State University, Faculty Researcher

Judge: No

High-throughput Plant Phenotyping at the A-State Phenomics

Facility (Co-Author: Nirmal Nepal)

The A-State Phenomics Facility offers a variety of high-throughput plant phenotyping assay capabilities, including multi-well plates for seed phenotyping; petri dishes to assess in vitro cultures, seed germination, and seedling growth and vigor; tray configurations for small plants such as *Arabidopsis* and tobacco; and pot configurations for larger, faster growing plants, such as rice, maize, soybean, and tomato. We routinely test plants growing in both soil and hydroponics, and a number of stress tolerance protocols have been optimized, including those to assess water limitation, heat, nutrients, light, and salinity. We continue to update our technology and protocols in order to achieve the highest level of excellence during each experiment. Utilizing visible, fluorescence, near and far infrared sensors, and proprietary and open source algorithms, we can obtain a wealth of readouts to quantify plant size, color, architecture, and overall health to empower plant biology research.

P: 22 – Leila Henning

University of Arkansas at Monticello, Undergraduate Student

Judge: No

Novel nuclear and plastid loci and their utility for inferring relationships among species of the genus *Streptanthus* (Brassicaceae) found in Arkansas and adjoining states.

(Co-Authors: Freddie Rivera, Brent Baker, Karen Fawley, Marvin Fawley)

One of the main challenges of species level taxonomy in vascular plants is finding regions of DNA that are variable enough to provide adequate characters for phylogenetic inference. Often, plant species that are easily distinguished by morphological features have few or no differences in the DNA sequences of traditionally used loci such as the ribosomal DNA ITS regions, *rbcL*, *matK*, or *COI*. We have been interested in the taxonomic status of the Arkansas twistflower, *Streptanthus maculatus* subsp. *obtusifolius*, which is an Arkansas endemic plant. We are trying to determine if this subspecies should be maintained, merged with *Streptanthus maculatus* subsp. *maculatus* (found in Oklahoma and Texas), or elevated to species status. Preliminary studies using nuclear ribosomal ITS sequence data provided some indication of relationships, but with very few character differences. Here we describe preliminary results with the novel nuclear loci, G34 and G56, as well as the plastid *trnH-psbA* spacer and a plastid region that comprises the *trnL-ccsA* spacer and most of the *ccsA* gene. Together these nuclear and plastid regions provide variability that should be useful for approaching our research question.

P: 23 –Jennifer Bryant

Arkansas State University, Undergraduate Student

Judge: Yes

The Hunt for Bigleaf

(Co-Author: Travis Marsico)

Rare trees are invaluable for the ecological niches they fill, supporting ecosystems and having potential economic and medicinal values. The bigleaf magnolia is no exception. This aptly named magnolia is a spectacular understory tree that has leaves up to 1 m long and .5 m wide, unlike anything else found Arkansas! With only one wild population documented west of the Mississippi River, this population is in danger of being lost. Although vouchered specimens exist, the location of this tree remains a mystery. The specimen labels contain errors in counties and coordinates that make it unclear if all known Arkansas specimens have come from a single population or multiple populations in Northeast Arkansas. The mission of this research project is to identify these locations, conduct a thorough search of last-known possible locations to determine if there are living trees in these populations, and to categorize habitat metrics to aid in searching for unknown populations. Located trees will be documented and records shared with the Arkansas Natural Heritage Commission for further study and preservation of the native genotypes. Failure to locate any trees of this species in Arkansas could result in an ecological restoration project for this species.

P: 24 – Emma Martin

Arkansas State University, Graduate Student

Judge: Yes

Assessing Mitigative Properties of Vegetation in Northeast Arkansas Agricultural Ditches using Biotic and Abiotic Measures

Agricultural ditches are important tools for managing water quality because of their ability to settle sediment and sequester nutrients from field runoff. Aquatic vegetation is an important characteristic of these ditches that influences sediment and nutrient values. This study investigated the effectiveness of aquatic vegetation at filtering contaminants from surrounding agricultural landscape. Ten sites within two separate ditch systems in northeast Arkansas were measured weekly for three years to determine upstream and downstream sediment and nutrient loading. Bed and bank vegetation cover was assessed at each site and plants were identified. Water chemistry, turbidity, chlorophyll a, animal surveys, and Whole Effluent Toxicity (WET) tests were performed to evaluate the vitality of each site. Differences in measured variables will be compared between upstream and downstream sites in each system using analysis of variance (ANOVA) tests. Agricultural ditches are established to move water away from fields and discharge into larger streams in the Mississippi River Delta. This movement is part of the larger drainage basin that feeds into the Gulf of Mexico and contributes the nutrients that exacerbate hypoxic conditions. The results of this study will help understand the in-stream processes that have the potential to improve downstream water quality.

P: 25 – Chris McAllister

Eastern Oklahoma State College-Idabel, Faculty Researcher

Judge: No

A Preliminary Checklist of the Stoneflies (Arthropoda: Insecta: Plecoptera) of Arkansas

(Co-Author: H.W. Robison)

Seventy-seven species of stoneflies representing eight families and 24 genera are herein reported from Arkansas. The most diverse families of state stoneflies were Perlidae (26 species), Capniidae (14 species), and Perlodidae (12 species) while Pteronarcyidae had only a single species. Additional species will surely be added to the list with future taxonomic studies involving molecular analyses.

P: 26 – Chris McAllister

Eastern Oklahoma State College-Idabel, Faculty Researcher

Judge: No

Additional County Records of Invertebrates from Arkansas

(Co-Authors: C.T. McAllister, H.W. Robison, and R. Tumlison)

Arkansas is home to a great variety of invertebrate fauna. Recently, natural history observations on various invertebrates of the state were reported by our community collaborative efforts. Here, we document additional noteworthy natural history and ecological observations for selected invertebrates from Arkansas.

P: 27 – Brain Staley

University of Central Arkansas, Undergraduate Student

Judge: No

Biological and ecosystem-level changes from the addition of reservoirs to headwater streams

(Co-Author: Maureen McClung)

Dams result in reservoirs for agriculture, resource extraction and recreation. Dams change the hydrology, chemistry and habitat connectivity of streams that also change macroinvertebrate communities and associated functions. We hypothesize that macroinvertebrate diversity will be greatest in streams with reservoirs from more days with flowing water and that leaf litter decomposition will be faster in streams with reservoirs from greater macroinvertebrate detritivore processing. We sampled macroinvertebrates, water chemistry data (temperature, dissolved oxygen, specific conductivity, discharge), and leaf decomposition over 3.5 months downstream of three dammed and three undammed small sites. We will present results on the physical conditions that could alter macroinvertebrate detritivore communities and the carbon cycle.

P: 28 –Sierra Hubbard

Hendrix College, Undergraduate Student

Judge: Yes

Biodiversity of Hymenoptera across sky islands of Arkansas

(Co-Authors: Reynol Rodruiguez, Allison F. Monroe, Maureen R. McClung, Matthew D. Moran, Oliver J. Kuhns, Michael W. Gates)

Sky islands are areas of higher elevation isolated from surrounding lowland habitats that often support unique biological communities. Arkansas houses several sky island habitats in the mountainous regions of the state (Ozark and Ouachita Mountains). While several unique insect species have been found in these areas, broad community comparisons are lacking. The objective of our study was to measure the community structure of Hymenoptera in sky islands of Arkansas and determine their similarity. We collected Hymenoptera using ground and canopy Townes-Malaise traps on Rich Mountain, Mount Magazine, and Petit Jean Mountain once a month from June through October 2017. Traps were positioned in areas of post oak (*Quercus stellata*) savanna habitat, the predominant habitat in these sky islands. Specimens were identified to the superfamily level and then morphotyped. We then calculated diversity metrics and compared the number of common morphospecies across sites. Each site showed more than 100 species of hymenoptera, with high levels of evenness (J' > 0.85) at all sites. Each site exhibited many unique species (i.e., species found at only one sky island), in particular, Mount Magazine. Each site had few species in common, with no pair of sites having more than 16% morphospecies overlap. Low morphospecies overlap suggests that each sky island has a unique community assemblage of parasitic Hymenoptera. These sky islands are rich in hymenopteran diversity. The high degree of evenness is indicative of a community with many uncommon species and few dominant ones. Because these results suggest that sky island habitats in Arkansas each contain different communities, they may be worthy of enhanced conservation efforts.

P: 29 – Brianna Trejo

University of Central Arkansas, Graduate Student

Judge: Yes

Energetic cost of girdling in the notodontid caterpillar, Oedemasia Leptinoides

(Co-Author: 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 (Ganong et al., 2012). After girdling, *O. leptinoides* larvae bathe the girdle in saliva. Girdling may expose vascular tissues so salivary components can enter the plant, or sever the flow of plant secondary metabolites to the area in which the caterpillar is feeding. The energetic costs of cutting girdles in tough plant tissues have not been explored. Using *O. leptinoides* and *L. manteo* as model notodontids, I will combine behavioral observations and respirometry data to produce overall energy allocation budgets for each species. I will then test for significant differences in energy allocation between the girdling and nongirdling species. Understanding more about the costs and benefits of girdling and about the co-evolutionary dynamic between girdling caterpillars and their host plants may have widespread significance for tree-feeding caterpillars, including some important pests.

P: 30 – John Hunt

University of Arkansas at Monticello, Faculty Researcher

Judge: No

Organochloride Pesticides Present in Animal Fur, Soil, and Streambed in an Agricultural Region of Southeastern Arkansas

(Co-Author: Christopher Sims)

Animals in agricultural settings may be subject to bioaccumulation of toxins. For the last several years, we have been collecting hair samples from bats and rodents in an agricultural area near Bayou Bartholomew in Drew County, Arkansas. Samples were submitted to the Center of Environmental Sciences and Engineering at the University of Connecticut for wide-screen toxin analysis. Several of these samples contained measurable amounts of organochloride pesticides or their metabolites, including some that have been banned for decades, such as dichlorodiphenyltrichloroethane (DDT) and chlordane. In addition, we collected several samples of soil from within an agricultural field, from adjacent edge habitat, from alongside the bank of the Bayou, and from the bed of the Bayou itself. Although none of these samples tested positive for DDT or chlordane, all of the samples except one contained measurable amounts of metabolites from these pesticides. This study raises questions about environmental persistence of DDT/DDE and other organochlorides. There may be risk to wildlife populations, warranting further investigation into effects of long-term exposure to these toxins.

P: 31 – Stacy Scherman

Arkansas State University, Graduate Student
Judge: Yes

Southeastern Myotis and Rafinesque’s Big Eared Bats Switch Their Roosting Habits Seasonally in Arkansas Bottomlands
(*Co-Authors: Tom Risch, Virginie Rolland*)

Tree roosts in bottomland forests are an important resource for Rafinesque’s Big-eared (*Corynorhinus rafinesquii*; CORA) and Southeastern (*Myotis auroriparius*; MYAU) bats. Both bat species are considered rare across their range and little is known about their roost requirements as seasons change from fall to winter. The objective was to characterize roost trees in both seasons in the Cache River National Wildlife Refuge, Arkansas, one of few remaining tracts of unaltered bottomland hardwoods. In October-December of 2016 and 2017, we radio-tracked 38 bats (21 CORAs and 17 MYAUs) and found 78 confirmed roost trees. Tree species and cavity type (e.g., basal cavity) were recorded for each confirmed roost tree. Both species switched their roosting habits as environmental conditions changed. Various tree cavity types were used for roosting by CORAs until they discontinued using basal cavities entirely late in the season. MYAUs showed no strong preference for cavity types early in the season but progressed to favor upper cavity openings later in the season. This suggests that both CORAs and MYAUs anticipated seasonal flooding that could potentially trap them inside the cavity. Additionally, CORA used Water Tupelo (*Nyssa aquatica*; NYAQ) exclusively, but MYAU shifted from using mainly NYAQ initially to using a variety of tree species as environmental conditions changed. Changing behaviors may coincide with changing priorities from foraging to avoiding seasonally rising flood waters and maintaining homeostatic balance in an increasingly cold time of year.

P: 32 – Andrew Feltmann

University of Central Arkansas, Graduate Student
Judge: No

Serial founder effects in *Crotaphytus collaris*: the influence of genetic drift on phenotypic diversification
(*Co-Author: Matthew Gifford*)

Founder effects have been proposed as an important mechanism driving evolutionary divergence among populations and may result in speciation events (Mayr 1954; Templeton 1980). These founder effects result from colonization of new habitat patches by a small number of individuals that cause a change in the genetic and phenotypic constitution of a population. This project will test for phenotypic differentiation as a consequence of repeated founder events in populations of Eastern Collared Lizards (*Crotaphytus collaris*) located on Stegall, Thorny and Mill Mountains in southcentral Missouri. Qualitatively, male *C. collaris* on Thorny Mountain are different phenotypically than their Stegall Mountain counterparts (A. Templeton, pers. comm.). Neuwald and Templeton (2013) identified distinct genetic groups within a single mountain’s glade complex. This suggests limits to gene flow among different glade clusters, potentially leading to an environment favoring phenotypic differentiation. I will examine the relative role of genetic drift in contributing to phenotypic variation. I will use the known colonization history of individual glades within and between mountains to test whether lizards inhabiting glades on the same mountain are more similar to one another than they are to lizards inhabiting glades on other mountains. The data generated in this project will permit a better understanding of how genetic drift influences phenotypic differentiation within a metapopulation where dispersal is common between patches (glades) but rare between populations (among mountains).

P: 33 – Hilary Canada

Arkansas State University, Undergraduate Student
Judge: Yes

Phylogeographic analyses suggest cryptic diversity within the Bluntnose Darter, *Etheostoma chlorosoma*

Previous morphological studies of the Bluntnose Darter (*Etheostoma chlorosoma*) revealed little variation among populations across the Gulf Coastal Plain. While some western populations (e.g. Colorado River, Texas) showed significant divergence from other populations, there was little support for taxonomic recognition of these populations. As a part of a larger study to evaluate phylogeographic patterns of Gulf Coastal Plain fishes, we sequenced mtDNA and multiple nuclear loci for *E. chlorosoma* to evaluate the Mississippi and Tombigbee river discontinuity hypotheses. Preliminary analyses reveal a deep phylogeographic break (TMRCA approx. 8 mya) among members east and west of the Mississippi River for *E. chlorosoma*. The deep divergence among eastern and western clades of *E. chlorosoma* suggests previously unrecognized cryptic diversity within the species. However, individuals from the Sabine River fall within the eastern clade. Ongoing work with additional nuclear DNA markers and increased sampling will be incorporated into this framework, shedding light on this unique phylogeographic pattern in the Gulf Coastal Plain.

Chemistry**P: 34 – Ben Quattlebaum**

Arkansas Tech University, Undergraduate Student
Judge: Yes

Effects of NIR Fluorophores in Selective Biological Scenarios
(*Co-Author: Hope Parker*)

Fluorophores constructed to emit near infrared (NIR) light pertain substantial advantages over conventional fluorophores, which emit blue and/or green light when excited. Utilized NIR for fluorescent analysis in biological systems is minimally disturbed by endogenous chromophores and disables possible photodamage to living organisms. Recently synthesized fluorophores have limitations as well: minimal water solubility and molecular aggregation. To synthesize any efficient NIR fluorophore, these limitations must be overcome. Within the research project, two NIR fluorophores were synthesized and analyzed. The team conducting the research has studied the fluorophores’ photophysical properties in ten differing solvents. Their efficiency in aqueous and nonpolar environments has been qualitatively and quantitatively analyzed. The partially water soluble NIR fluorophore forms a supramolecular complex with an albumin protein (HSA). HSA acts as the concentric macromolecule that the partially water-soluble fluorophore targets and probes. The other, insoluble fluorophore aggregates in water and acts inert to HSA.

P: 35 – Gary Orman

University of Arkansas, Undergraduate Student
Judge: Yes

The Purification of Sodium Channel Toxin from *Centruroides vittatus*

(*Co-Authors: Srinivas Jayanthi, Ravi Kumar Gundampati, Tsunami Yamashita, T.K.S. Kumar*)

Much is known about sodium channels and their function; however, there is still much unknown regarding the disruptive functioning of scorpion toxins on these channels. The focus of this project is to develop insight by effectively purifying a toxin from the Striped Bark Scorpion, *Centruroides vittatus*, and exploring its characteristics for potential medicinal purposes, such as in heart or pain medication. This purification process was performed by an over-expression of the toxin in *Escherichia coli* cells with an IPTG inducer, purification on a Glutathione Sepharose column followed by concentration/desalting, proteolytic cleavage using thrombin, and gel filtration followed by concentration/desalting to ensure the gathering of pure protein. SDS-PAGE assays were performed after each experiment to assess proper results and aid in planning. Future characterization experiments will hopefully be performed (from March 11 - April 7) on the toxin, such as circular dichroism, differential scanning calorimetry, isothermal titration calorimetry, NMR spectroscopy, thermal denaturation and proteolytic digestion. These experiments will provide a greater insight into the functions of the protein.

P: 36 – Ryan Coleman

University of Arkansas, Undergraduate Student
Judge: Yes

Testing the re-usability of defined medium for an effective incorporation of unused 15N label into recombinant proteins

Protein labeling is an integral part of biological and biochemistry research. While the different types of labels vary, a common type is the isotope label. Isotope labeling involves the addition of a specific isotope into a reaction that can then allow the reaction to be monitored. A more specific type of isotope labeling called stable isotope labeling uses isotopes such as C13 and N15 that can easily be identified through nuclear magnetic resonance (NMR) and mass spectrometry (MS). The only issue with this method is the price. This research aims to test a potential solution to this problem. The viability of reusing the same media repeatedly was tested to ascertain how effective the incorporation of the isotope label was. This was done by making a simple media with the sole source of nitrogen being the N15 isotope. A modified strain of *E. Coli*, BL21(DE3), containing the wtFGF1 plasmid was then expressed five times using the labeled simple media. These pellets were then purified and ran through a sodium dodecyl sulfate-polyacrylamide (SDS-PAGE) to determine whether wtFGF1 was being produced in the later rounds of growth. Once confirmed, the media samples were analyzed with NMR to determine the levels of N15 remaining after each subsequent round of growth. Once complete, this research will potentially provide a new cost-effective alternative to growing labeled proteins.

P: 37 – Harper Grimsley

University of Arkansas, Undergraduate Student

Judge: No

Application of ROMP Catalysts to Homo-Coupling

(Co-Author: Stefan M. Kilyanek)

William Forrest and Co. developed a tungsten-oxo alkylidene in 2014 which they determined to be a successful catalyst for ringopening metathesis polymerization (ROMP). The Kilyanek lab is interested in using the alkylidene catalyst to synthesize novel large, chelating ligands. These ligands will in turn be attached to cobalt to generate a di-nuclear cobalt catalyst for oxygen reduction in fuel cells, the advantages of which would include reduced cost and reduced formation of destructive by-products such as peroxides. The proposed synthetic route however, demands that the alkylidene catalyst perform homo-coupling, which is an entirely different olefin metathesis from ROMP. Additionally, the alkylidene catalyst must be Z-selective to yield the preferred spatial orientation of the cobalt atoms in the oxygen reduction catalyst. I synthesized the same alkylidene and evaluated its effectiveness for the homocoupling of terminal olefins, especially 1-hexene. Proton NMR studies revealed that not only did the alkylidene catalyst couple the 1-hexene into 5-decene, but that the reaction was highly regioselective, favoring Z-5-decene formation. This established clear precedent for use of the alkylidene catalyst in the synthesis of the ligands of interest.

P: 38 – Sydney Shuttleworth

Harding University, Undergraduate Student

Judge: No

Isolating a Fat Mobilizing Substance from a Fasting Individual

(Co-Author: Dennis Province)

Previous research has shown that a fasting individual produces a fat mobilizing substance (FMS), which is excreted from the body through the individual's urine. This substance was isolated but never identified. FMS is also believed to be present in the urine of those who suffer from congenital lipodystrophy. After extracting the proteins from the urine by co-precipitating with saturated benzoic acid and alcohol, the proteins are separated into fractions by size exclusion chromatography (HPLC). The column used separated the proteins by size. These fractions will be tested for fat mobilizing activity using a Lipolysis Assay. This colorimetric assay uses 3T3-L1 Adipocytes to test for the presence of glycerol release. Fractions that show activity will be sent to the UAMS Proteomics Core Facility for identification and sequencing. Two different female's urine samples (one fasting and one well-fed) are being evaluated.

P: 39 – Conner Breen

Hendrix College, Undergraduate Student

Judge: Yes

Iron reduces mitochondrial DNA damage induced by mitochondrial reactive oxygen species n HepG2 cells

(Co-Author: Andres Caro)

In iron overload disorders, iron and mitochondrial reactive oxygen species (superoxide anion, hydrogen peroxide) interact through the Haber-Weiss cycle to produce the highly reactive oxidant hydroxyl radical. Mitochondrial DNA is a sensitive target for hydroxyl radical-mediated oxidation. On the other hand, iron also induces the expression of antioxidant genes through the activation of redoxsensitive transcription factors. Therefore, it is expected that the level of mitochondrial DNA damage induced by iron and mitochondrial reactive oxygen species will depend on the balance between its pro-oxidant and anti-oxidant nature. The objectives of this work were to evaluate the effect of iron on antioxidant expression and oxidative mitochondrial DNA damage in hepatocytes. Hepatocyte-like HepG2 cells incubated with ironnitritotriacetic acid (Fe-NTA) increased the concentration of free iron in a dose-dependent manner. Cellular reactive oxygen species evaluated as dichlorofluorescein oxidation decreased after Fe-NTA administration, an effect associated with induction of the antioxidant enzyme gamma-glutamylcysteine ligase. An inhibitor of mitochondrial complex I (rotenone) increased the levels of mitochondrial reactive oxygen species and increased oxidative mitochondrial DNA damage. Pre-incubation with Fe-NTA inhibited the oxidative mitochondrial DNA damage induced by rotenone. These results suggest that iron induces antioxidant genes related with glutathione synthesis, which limit the oxidation of mitochondrial DNA produced by hydroxyl radical.

P: 40 – Eliza Hanson

John Brown University, Undergraduate Student

Judge: Yes

Novel Peptoids as Antimicrobial Agents

(Co-Author: Francis Umesiri)

Increasing incidence of drug-resistant strains of Mycobacterium tuberculosis means that there is a continuing need for discovery of new anti-tuberculosis (TB) drugs, which operate by a different mechanism of action from current drugs in the market. Although studies suggest that synthetic peptides have shown promise as antimicrobial agents, they are readily degraded in vivo and have low bioavailability. To overcome these limitations, peptoids (poly-N-substituted glycines) are utilized as peptide mimetics since they are resistant to protease degradation. We hereby report the design, synthesis and initial biological screening of a number of new peptoids as anti-microbial agents. The result shows that some synthetic peptoids involved in the study exhibited some inhibitory activity against Mycobacterium smegmatis (ATCC 14468), Staphylococcus aureus, and E. coli, using Kirby-Bauer disk assay. Future direction includes modification of leads and screening for improved activity. Synthetic peptoids were characterized by ESIMS, 1H and 13C NMR spectroscopy.

P: 41 – Emily Joy Seminara

Hendrix College, Undergraduate Student

Judge: Yes

Extraction and Quantitation of Heterocyclic Aromatic Amines from Cooked Bacon using Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry

(Co-Authors: Lora J. Rogers, Susan Kadlubar, Howard Hendrickson)

Diabetes affects 11.7% of inhabitants within the “diabetes belt” of the southern United States, and type 2 diabetes (T2D) makes up around 90-95% of all of these cases of diabetes. T2D can be managed by healthy eating, physical activity, and medications. However, though we are aware that diet plays a part in greater risk of T2D, there is not yet a mechanistic explanation as to why this occurs beyond controlling the intake of carbohydrates which are converted to glucose. One source of this increased risk may be in the trademark southern diet, rich with fried meats and gravy. Heterocyclic aromatic amines (HCAs) are compounds found in meats cooked at high temperatures, such as those characteristic of the southern diet. HCAs are known as carcinogens, but recently 2-Amino-1-methyl-6-phenylimiazo[4,5-b]pyridine (PhIP), one of the most abundant HCAs, was found to upregulate 20 genes involved in heightened risk of T2D, notably Collagen VIII alpha-1 polypeptide (COL8A1) and Insulin-like growth factor binding protein 7 (IGFBP7). To observe the effects of HCAs extracted from meats typical of the southern diet on these genes, HCAs were extracted from cooked bacon using solid phase extraction (SPE). The HCAs PhIP, MeIQx, and AαC were analyzed using liquid chromatography/tandem mass spectrometry (LC-MS/MS). While other HCAs are likely present, the current work detected predominately PhIP and MeIQx in the cooked bacon. Human mesenchymal stem cell (hMSC)-derived adipocytes are being exposed to dilutions of the HCA extracts and expression of genes associated with T2D will be determined.

P: 42 – Kylie Cleavenger

University of Arkansas, Undergraduate Student

Judge: Yes

The Isolation and Characterization of a Recombinant Fibroblast Growth Factor-1

(Co-Authors: Thallapuram Krishnaswamy Suresh Kamar, Ravi Kumar Gundampati)

Fibroblast growth factor-1 (FGF-1) is a cytokine protein found in the human body that is known to play an important role in a variety of crucial biological processes such as cell proliferation, angiogenesis, and wound healing. Many studies have been conducted on the potential use of FGF-1 in human therapies, such as in the treatment of diseases caused by ischemia; however, FGF-1 is characterized by a low thermal stability, thereby limiting its potential use in pharmaceuticals. Mutations have shown to be a common method for altering a protein's properties to overcome these barriers, and thus present a potential method to increase the stability and functionality of FGF-1. The purpose of this project has been to over-express, purify, and characterize a mutant fibroblast growth factor-1 in Escherichia coli for comparison with the wellcharacterized wild-type protein FGF-1. Biophysical and biochemical techniques were used in determining the recombinant protein folding structure and function, providing insights on both this particular mutant and the effect of this novel type of mutation on proteins.

P: 43 – Peyton Munch

Harding University, Undergraduate Student

Judge: Yes

Analyzing composition of plaster from Tel Beth-Shemesh archaeological site

A plaster sample from Tel Beth-Shemesh, an archaeological site in Israel, was tested to determine its hydraulicity. This sample was obtained from a strata that is from ~ 900 BC. Hydraulic lime plaster was a technological construction advancement in the ancient world. Non-hydraulic plaster is primarily CaCO₃, whereas hydraulic plaster is made by the addition of pozzolans, Si and Al containing materials, which give the hydraulic plaster added strength and reduced setting time. Therefore, carbonate and silica content were utilized as measures of how hydraulic the plaster is. Initially, concentrated acid was added to plaster samples to convert CaCO₃ to CO₂. This gas was then directed into an inverted graduated cylinder, where the CO₂ displaces water in direct proportions to the carbonate content. Further, plaster samples were dissolved in dilute acid, followed by a reaction with acidified ammonium molybdate which forms a heteropoly acid, silico-12-molybdic acid. This was reduced to form the so-called molybdenum blue complex, which can be measured spectrophotometrically at $\lambda_{\text{max}} = 810 \text{ nm}$. For both experiments, the unknown plaster sample was compared to known hydraulic plasters. The plaster sample appears to have some slight hydraulic character; however, it is unknown if this was purposeful or accidental.

P: 44 –Pooja Lukhi

University of Arkansas, Undergraduate Student

Judge: Yes

A New and Simple Method for the Purification of Recombinant Proteins from Inclusion Bodies*(Co-Author: Musaab Al-Ameer)*

Recombinant DNA technology and the production of recombinant proteins has become a major focus in recent years within the biopharmaceutical industry. Proteins, with their high biological activity, high specificity and penetration, and low production costs in comparison to other biological molecules, have become the targets for drug-design and production for treatment of various pathologies such as diabetes mellitus type 1, rheumatoid arthritis, hepatitis, and is currently undergoing research for treatment of neurodegenerative diseases such as Alzheimer's, Parkinson's, Huntington's and ALS. However, despite the growth of biopharmaceuticals and biotechnology, the conventional methods for protein purification through column chromatography are laborintensive, costly, and are inefficient in the purification of proteins from inclusion bodies. This study has successfully designed a new protocol to optimize the purification and biological activity of recombinant proteins in a simple and cost effective process that can someday eliminate the need for column purification. The Three-Phase Partitioning (TPP) method is a versatile new approach in the refolding and purification of proteins. Through TPP, we have successfully purified, without the use of column chromatography, several recombinant proteins and recombinant fusion proteins while maintaining their biological activity. TPP is scaleable and has applications in the recovery of biologically active proteins from inclusion bodies and the purification of various fusion proteins that have historically been difficult to purify using conventional purification methods. Through the utilization of the Three-Phase Partitioning method, mass protein purification is possible with reduced labor, in a more timely manner, and at a lower cost and can possibly be used within the pharmaceutical industry to mass produce protein-based drugs at an economical price.

P: 45 – Trevor Loew

Hendrix College, Undergraduate Student

Judge: Yes

Mitochondrial CYP2E1 activates antioxidant and mitochondrial biogenesis signaling in hepatocytes.*(Co-Author: Andres Caro)*

Mitochondrial CYP2E1 is an enzyme induced by chronic alcoholism in the liver, which produces mitochondrial reactive oxygen species as a metabolic side-product. Mitochondrial DNA is a sensitive target for oxidation by mitochondrial reactive oxygen species. On the other hand, mitochondrial reactive oxygen species induce the expression of antioxidant genes through the activation of redox-sensitive transcription factors. Therefore, it is expected that the level of mitochondrial DNA damage induced by mitochondrial reactive oxygen species produced by mitochondrial CYP2E1 will depend on the balance between its pro-oxidant and anti-oxidant nature. The objectives of this work were to evaluate the effect of mitochondrial CYP2E1-related reactive oxygen species on mitochondrial DNA damage in hepatocytes. Mitochondrial CYP2E1 overexpression in hepatocyte-like HepG2 cells increased the levels of cellular and mitochondrial reactive oxygen species evaluated by dichlorofluorescein and mito-sox red staining, respectively. Mitochondrial DNA integrity was conserved in cells overexpressing mitochondrial CYP2E1 in spite of the increased oxidative stress. Mitochondrial biogenesis markers (mitochondrial DNA content, PGC-1 alpha expression) and antioxidant genes (catalase, gamma glutamylcyteine ligase) were induced in mitochondrial CYP2E1-overexpressing cells. These results suggest that mitochondrial CYP2E1 produces both oxidative stress and activation of antioxidant and mitochondrial biogenesis signaling in hepatocytes. This activation might limit the mitochondrial DNA damage observed in chronic alcoholism.

P: 46 – Kaleb Reid

Harding University, Undergraduate Student

Judge: Yes

Preparation of 3-Phenyl-2-Propynoic Acid Using Undergraduate Organic Chemistry Lab Techniques

This experiment explores the multistep synthetic methods used to create 3-phenyl-2-propynoic acid from trans-cinnamic acid with two goals in mind: to create a laboratory procedure that teaches undergraduate organic chemistry students multistep synthesis involving alkynes and to determine if it is possible to create 3-phenyl-2-propynoic acid in sufficient yields while using techniques that can be performed by undergraduate chemistry students. Bromine in dichloromethane solution and trans-cinnamic acid were used to create the intermediate product, 2, 3-dibromo-3-phenylpropanoic acid or cinnamic acid dibromide. This intermediate product was tested with three different bases in large excesses: potassium hydroxide, potassium carbonate, and pyridine. Based on the experimental trials, potassium hydroxide is the only base that produced desired product, and this reaction is fairly low yielding with the most pure products having an average percent yield of 45 percent based on the stoichiometric calculations from trans-cinnamic acid. Infrared and HNMR both determined that the product created was by far in the majority due to a lack of excess peaks in either spectrum. The melting points also were measured lower than expected, leading to the conclusion that some impurity is present due to potential side reactions or unreacted intermediate product. The lab procedure devised by these experiments gives students both a multistep synthetic lab that can be run over multiple weeks and demonstrates alkyne chemistry. However, it is clear that further research is necessary to understand the kinetics and the side reactions involved and to improve the percent yield of this reaction.

P: 47 – Ayesha Siddiqua

Arkansas State University, Graduate Student

Judge: Yes

Morphological Investigation of Mammalian Cancer Cells

The atomic force microscopy (AFM)-based techniques have gained popularity in biomedical applications in recent years. Different scanning techniques such as contact, no-contact, and nanoindentation of an AFM can be very useful to understand nanoscale phenomena of cancerous cells. In particular, morphological and phase contrast images, and mechanical data obtained from an AFM can provide a better understanding on the nature, strength and progression these cells, and thereby treatment measures can be adopted based on the diagnoses results. This paper provides an overview of different AFM-based scanning modes and its prospects in biomedical applications based on an extensive review of existing literature available in public domain. Also, morphological images of some mammalian cancerous cells will be presented in this study. Outcomes of this study are expected to be beneficial for researchers and medical professionals in getting familiarized with the AFM technologies and their applications as novel diagnostic tools.

P: 48 – Alexander Rothenberger

University of Arkansas for Medical Sciences, Graduate Student

Judge: Yes

Characterization of Goldenseal Product Quality by Dissolution Studies*(Co-Author: Howard Hendrickson)*

Goldenseal has been used as a natural supplement and as a remedy for many different ailments including gastrointestinal upset and hyperlipidemia. Since goldenseal is marketed as a natural product, it is regulated differently than medications by the Food and Drug Administration (FDA). Through the Dietary Supplement Health and Education Act (DSHEA), manufacturers of natural products do not need the FDA's approval to market their product. They must simply keep their product free of adulterants, properly labeled, and the product itself must qualify as a natural supplement. It is important that products are consistent with their labels and especially between batches from the same manufacturer so that consumers can be certain that the product will work the same way each and every time they use it. Unfortunately, many manufacturers do not standardize their supplement products to the suspected active pharmaceutical ingredients. One method of testing for consistency is to perform dissolution studies with a device such as the USP dissolution apparatus. For our experiments we used a verified USP apparatus type 2 to obtain the dissolution profile of four different sets of goldenseal capsules. We tested each capsule for the amount of berberine, hydrastine, and canadine released which was determined by liquid chromatography and quadrupole mass spectrometry. These three compounds are considered the most active and are thought to be responsible for goldenseal's effects. The media we used for this study included surfactants produced by biorelevant.com which are designed to produce a more accurate model of the human gut in dissolution testing. The simulated dissolution condition that tested is fasting gastric fluid. This allowed us to determine the consistency of dissolution among the four sets of goldenseal capsules (n=6). At thirty minutes the average amount of berberine as a percent of total capsule mass was $2.24 \pm 0.26\%$, $1.45 \pm 0.57\%$, $2.03 \pm 0.25\%$, and $2.61 \pm 0.20\%$ for GS-04, GS-08, GS-16, and GS-19 respectively. For hydrastine the percentages were: $2.22 \pm 0.10\%$, $1.63 \pm 0.43\%$, $2.52 \pm 0.31\%$, and $3.55 \pm 0.20\%$ for GS-04, GS-08, GS-16, and GS-19 respectively. Lastly, canadine was present in small concentrations and its percentages were $0.058 \pm 0.0037\%$, $0.030 \pm 0.0098\%$, $0.035 \pm 0.0050\%$, and $0.055 \pm 0.0042\%$ for GS-04, GS-08, GS-16, and GS-19 respectively. These results will be used to determine the most consistent and efficient capsule which will then be bought in bulk and used in further clinical studies.

P: 49 – Sarah Phillips

University of Arkansas for Medical Sciences

Graduate Student

Judge: No

Development and Validation of an LC-MS/MS based Method to Quantitate Octreotide in Mouse Plasma*(Co-Authors: Qiang Fu, John Seng, Martin Hauer – Jensen, Howard P. Hendrickson)*

A new analytical method has been developed for the analysis of octreotide in mouse plasma using liquid chromatography tandem mass spectrometry. Octreotide is a 1018 Da octapeptide that mimics somatostatin and has been shown to be useful in reducing radiation induced intestinal damage. This method involves simple sample preparation using weak cation exchange solid phase extraction followed by evaporation and reconstitution in 20% acetonitrile. Analytical separation was performed on a YMC-Pack-ODS-AQ analytical column (150 x 3.0 mm (i.d.) with a chromatographic run time of 5.00 minutes. In developing this method two different internal standards, leuprolide, and Octreotide-D5, were evaluated for matrix ion effects, and extraction recovery. Using leuprolide as an internal standard showed significant matrix ion enhancement of 119±59.9% and an extraction recovery of 70±10.5%. By using the stable isotope octreotide-D5 as an internal standard, matrix ion effects were negligible at -5.0±6.5% and extraction recovery was 88±8.3%, this lead to an overall process recovery of 84±7.8%. The lower limit of quantitation (LLOQ) was determined to be 10 ng/mL based on a signal to noise ratio of 5, and the lowest concentration that maintained acceptable accuracy and precision defined by the FDA's Guidance for Industry for Bioanalytical Method Validation. Accuracy for 5 calibration standard sets were between 87% and 114% based on a 1/x weighted linear regression. Intraday precision was =17% at the LLOQ, and =10% at non-LLOQ concentrations and interday precision was =19% at LLOQ and =11% at non-LLOQ concentrations. Freeze-thaw stability was tested at concentrations of 10 ng/mL, 100 ng/mL, and 300 ng/mL and were shown to be stable for three freeze-thaw cycles. Also three sets of calibrations standards were analyzed and shown to be stable at 4°C for at least 24 hours. Octreotide was quantitated in 5 authentic mouse plasma pharmacokinetic samples to further validate this method.

P: 50 – Divya Kandanoor

Arkansas State University

Graduate Student

Judge: Yes

Structure, composition, and oligosaccharide profiles for hemicellulosic polysaccharides isolated from rice bran fiber*(Co-Author: Brett Savary)*

Rice bran represents a reservoir of largely underutilized functional biopolymers that may be mobilized for improved food, feed, and nutraceutical uses. Soluble arabinoxylan and oligosaccharide fragments isolated from rice bran fiber have been implicated to function as biological response modifiers, providing healthful benefit to consumers. Arabinoxylan is largely immobilized within the insoluble fiber matrix through dehydrodiferulate and ligniniferulate cross-links. Ferulate moieties are ester-linked at the O-5 position of arabinofuranoside side-branches (linked O-2 and/or O-3) along the (1β→4) xylopyranose backbone. To support investigation of putative immunomodulatory activities in the colon by rice bran arabinoxylan, we have isolated gram quantities of soluble polysaccharide fractions from rice bran fiber following sequential alkali extraction. We have similarly isolated these fractions through a separate extraction with dilute alkaline hydrogen peroxide, providing conditions to retain ferulate esters. We will present our results obtained for preparing polysaccharide fractions from rice bran, for determining their linkage structure and compositions, and for comparing oligosaccharide profiles (enzyme “fingerprints”) generated from them following treatment with a monocomponent GH11 xylanase. Our results demonstrate the means to produce and analyze defined materials to investigate innate immune response activity in in vitro cell bioassays.

P: 51 – Kan Takahashi

Arkansas State University, Graduate Student

Judge: Yes

Identification of a novel glucan crosslink to feruloylated arabinoxylan in rice bran fiber*(Co-Author: Brett Savary)*

We have produced feruloylated oligosaccharides (FAXOs) from rice bran fiber by acid hydrolysis to investigate their prebiotic and innate immune response activity by the gut epithelium. Such products in the diet may promote healthful gastro-intestinal functioning beyond traditional benefit as inert dietary fiber. We recently reported prebiotic properties for this FAXO preparation, finding anaerobic fermentation profiles with human fecal bacteria are comparable to fructo-oligosaccharides (Pham et al., *Nutrients* 2017, doi:10.3390/nu9111237). We also described preliminary evidence for activity in modifying epithelial barrier function with T84 colon epithelial cells (Savary et al., AGFD #4, 252nd ACS National Meeting, 2017). We will present details for compositional and structural profiles for our rice bran fiber FAXO preparation. Primary analysis of the FAXO preparations by MALDI-TOF MS (oligosaccharide mass profiles) and GC-FID (for monosaccharide composition) supported a structural model for a crosslink site between arabinoxylan and mixed linkage glucan. While this crosslink was proposed over thirty years ago, our results support the first direct evidence for this. Further analyses to characterize the linkage structure (partially methylated alditol

acetates and anomerspecific glucosidase treatment) showed amylose-like oligosaccharides are covalently bound to our FAXO preparations. This suggests a transglycosylation occurred during enzymatic starch digestion during fiber preparation. Further studies will test this hypothesis by characterizing conditions for this novel catalytic reaction.

Engineering**P: 52 – Kaushik Luthra**

University of Arkansas, Graduate Student

Judge: Yes

Maintaining Quality of Rough Rice Dried in a Fluidized Bed by adding Hold-up periods*(Co-Author: Sammy Sadaka)*

Fluidized bed drying of rice reduced the moisture content of freshly harvested rough rice to 13% (w.b.) in less time but with lower head rice yield as compared to the conventional drying. Rice kernels developed fissures and ultimately cracked due to the high thermal gradient being developed in fluidized-bed drying. The hypothesis that adding hold-up periods can reduce the thermal gradient is tested in the experiment. The objective thus is to compare the quality of rice with and without the period of ambient air application i.e. hold-up period in a fluidized-bed dryer. A lab-scale fluidized bed dryer was developed and the effects of drying duration of 10, 20 and 30 minutes and the hold-up duration of 0, 15, 30, 40 and 60 minutes on rough rice moisture content, head rice yield, milled rice yield, and whiteness were investigated. The results showed that the hold-up periods reduced the moisture content considerably without additional heating. The head rice yields were comparable to the conventional drying methods and increased with the addition of hold-up periods as compared to without the hold-up period in a fluidized-bed drying. The hold-up period provided time for stabilization of the high induced thermal stress due to the high thermal gradient during the drying period. Thus, in conclusion, hold-up periods has the potential to solve the problem of low head rice yield associated with fluidized-bed drying of rice.

P: 53 – Kazi Tamzidul Islam

Arkansas State University, Graduate Student

Judge: Yes

Scaling Resistance of Industry Waste Modified Concrete Exposed to Deicing Chemicals*(Co-Author: Zahid Hossain)*

Damaging effects of deicing chemicals on industry wastes such as Rice Husk Ash (RHA) modified and unmodified (Control) concrete mortar bars have investigated in this study. Different Supplementary Cementitious Materials (SCM), namely, three types RHA (RHA-1, RHA-2, and RHA-3 with corresponding nominal maximum sizes of 600µm, 150 µm, 44 µm, respectively), Class C fly ash (CFA), and silica fume (SF) were used as a partial replacement (10% by the weight of cement) of Type-I Ordinary Portland Cement (OPC) to prepare mortar bars. The prepared samples were then submerged in a solution containing 40g of anhydrous calcium chloride per liter of water. Afterward, Freezing-Thawing (F-T) condition was maintained to evaluate the scaling resistance of mortar bars. Due to the penetration of deicing chemicals during the F-T cycle, the crystallization pressure increased, which eventually caused frost damage on the surface of mortar bars. Experiment results showed that RHA-1 resulted in a severe surface deterioration due to the deicing chemical and had the highest scaling rating. Compare to RHA-1, RHA-2-modified mortar bars showed less damage. On the other hand, RHA-3, CFA, and SF showed the minimum surface damage compare to the control mortar bars (no substitution of OPC). From this investigation, it can be concluded that finer SCM materials are less prone to the deicing chemical in the freezing weather, and RHA-3 is a viable construction material in controlling concrete surface scaling.

P: 54 – Md Saber Nazim

Arkansas State University, Graduate Student

Judge: Yes

Rayleigh Scattering in Multiple Nanoparticle Systems: A Study of the Scattered Magnetic Fields*(Co-Author: Zahid Hossain)*

The electromagnetic waves and nanoparticle interaction always involve some scattering. If the size of the particle(s) is much smaller than the incident electromagnetic wavelength, then such a scattering phenomenon is called Rayleigh scattering. These types of scattering phenomenon have been well investigated and quite a good number of publications are present in the literature. However, much of the research effort has been dedicated to the study of the scattered electric field. In this work, we have investigated the scattered magnetic fields from scratch. Starting from the case of the scattered magnetic field from a single dielectric Rayleigh particle we have expanded our fiefdom to different types of Rayleigh single particles (i.e. metallic, active, dielectric) and multiple particle systems comprised of these particles. In addition, the impact of the presence of different kinds of substrates on the scattered magnetic fields has also been studied.

P: 55 – Sumon Roy

Arkansas State University, Graduate Student

Judge: Yes

Quantification of Moisture Effects on Adhesion and Modulus Properties of Paving Asphalts*(Co-Author: Zahid Hossain)*

In this study, the effects of moisture in asphalt binders are examined by using adhesion force and modulus values obtained from an Atomic Force Microscope (AFM). Four different types of asphalt binder samples, collected from two different sources (Source 1 and Source 2), were used to estimate their modulus and adhesion values at the nanoscale level. The AFM test samples were prepared on thin glass plates and conditioned under dry and wet conditions. Afterward, they were examined by using the PeakForce Quantitative Nanomechanical Mapping™ (PFQNM) mode of the AFM. Test results show that adhesion and modulus values under the wet condition are substantially different from those of under the dry condition. It is apparent that wet conditioned binder samples from Source 1 exhibit noticeably lower adhesion values compared to the dry samples. A similar decreasing trend is observed for binder sample from Source 2 except that the binders modified with polyphosphoric acid (PPA) and styrene-butadiene-styrene (SBS) showed a slight increase in adhesion values. It is evident that the modulus values of Source 1 binders were reduced in a similar way of the adhesion values. However, a smaller increase in modulus values was noticed in both SBS-modified and PPA+SBS-modified binders from Source 2, providing sufficient moisture resistance. On the other hand, the base binder from each source is the most susceptible to moisture damage among all binders, and the PPA-modified binder also provides the least resistance to water action. Findings of this study will provide a better understanding for selecting the most effective asphalt binders against moisture damage.

P: 56 – Tamal Sarkar

Arkansas State University, Graduate Student

Judge: Yes

Anomalous electrostatic nature of charged particles: An approach towards stable equilibrium in inverted systems

Non-uniform distribution of likely charged particles turns down the fundamental tenet of Coulomb's law due to their nonlinear behavior towards a stable non-touching equilibrium. A balance between electrostatic attraction and repulsion is created with the intervention of van der Waals attraction. Three likely charged particles were put in an inverted system in terms of electrical permittivity of background medium and charged particles as an experimental setup. The magnitude and orientation of the forces demonstrate a specific stable equilibrium zone for the assembly. The results open up the scope for developing novel mesoscale non-touching crystal lattices with tunable optical properties.

P: 57 – Obande Ikwuyum

Arkansas Tech University, Undergraduate Student

Judge: Yes

Development of a PEDOT:PSS Buffer Film for Anorganic Solar Cell*(Co-Author: Matthew Young)*

An organic film made from Poly(3,4-ethylenedioxythiophene): Poly-styrene sulfonate (PEDOT:PSS) was fabricated using a dynamic spin coating technique. Before the film was fabricated, it was necessary to install and test various pieces of research equipment. The PEDOT:PSS film was fabricated on a borosilicate glass substrate at a temperature of 150°C. To measure film conductivity a commercial silver paste was used to paint on contacts. A two point probe method was used to measure the thin film conductivity which was found to be between 5×10^{-8} and 5×10^{-9} S. Work continues to optimize the PEDOT:PSS film and characterize its electrical and optical properties.

Geosciences**P: 58 – Haylee Campbell**

Arkansas State University, Undergraduate Student

Judge: Yes

Variation in Soil Moisture Levels in No-till, Cover Crop, and Conventional Tillage Systems in NE Arkansas Cotton*(Co-Authors: Kyle Wilson, Amanda Mann, Michele Reba, Tina Gray Teague)*

Cotton performance and yield stability may be affected by different environments and production practices including tillage systems and irrigation. These practices could impact plant resilience to stress including water deficits tolerance. This field experiment was conducted in association with a long term tillage study established Fall 2007 at the Judd Hill Foundation Research Farm in Northeast Arkansas to assess agronomic and environmental impacts of conservation tillage systems. Studies in 2016 monitored soil environments of three tillage systems: no-till, cover crop/low till, and conventional, with and without supplemental irrigation; 2017 evaluated the three tillage systems without supplemental irrigation. In 2016 and 2017, sensors in the no-till and cover crop systems were more reactive and slower to dry after rain and irrigation events. Use of no-till and cover crop treatments has potential to be more efficient with water use suggesting that less irrigation could be used in fields under these management practices. These results indicate rain fed fields would benefit more from no-till systems emphasizing the importance of treatment specific irrigation recommendations.

P: 59 – Megan Cassingham

Hendrix College, Undergraduate Student

Judge: Yes

Qualitative Analysis of PM2.5 Organic Compounds in Conway, Arkansas*(Co-Author: Dana Henry)*

Aerosols in the atmosphere have a tendency to travel extraordinary distances by wind currents. By using a TISCH high volume air sampler, particulate matter smaller than 2.5 μm (PM2.5) in diameter can be collected from the lower atmosphere and deposited on a quartz filter. The organic molecules are then extracted using methanol and isooctane as polar and nonpolar solvents, respectively. The organic extract is then analyzed using gas chromatography/mass spectrometry (GC/MS). NIST library matches were used to identify organic compounds present in the samples. Aerosol concentrations in Conway, Arkansas, identities of polar and nonpolar organic aerosol components, and potential emission sources will be reported.

P: 60 – Ryan Tumminello

Hendrix College, Undergraduate Student

Judge: Yes

Quantification of Soluble Ions in Atmospheric Particulate Matter Using Ion Chromatography*(Co-Author: Courtney Hatch)*

Atmospheric particulate matter (PM2.5 and PM10) have been shown to have significant impacts on regional air quality, climate change, and human and are abundant in our atmosphere. Particulate matter samples were collected over one week intervals using a high-volume aerosol sampler located on Hendrix Campus in Conway, Arkansas. Water-soluble anions, including sulfate, nitrate, and phosphate, in the particulate matter samples were analyzed using ion chromatography (IC). Optimization of the IC flow rate was conducted by measuring the resolution between sulfate and phosphate peaks and the number of theoretical plates for all anions measured as a function of flow rate (0.5-1.5 ml/min). Aerosol concentrations and results from IC analysis of common anions will be reported.

P: 61 – Sonja Wagner

University of Central Arkansas, Undergraduate Student
Judge: Yes

Gamma-Gamma Angular Correlation

(Co-Author: *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. The result of this annihilation is two identical gamma rays (each with 511 keV of energy), which are ejected from the sample. Because momentum has to be conserved, these gamma rays are theoretically ejected in polar opposite directions. Our experiment was designed to test this theory by employing two identical radiation detectors equidistant from the Na-22 sample, and recording each instance of a simultaneous 511 keV gamma reading of the two detectors at varying angles (164-196 degrees). The results of our experiment was precisely as predicted: when the detectors were at 180 degrees with respect to one another, we gathered the greatest number of gamma-gamma detections, and the further we deviated from 180 degrees, the fewer detections were read, with almost no detections read at 164 and 196 degrees. We would like to acknowledge Dr. Duncan Weathers from the University of North Texas for his assistance with this experiment.

P: 62 – Timothy Brown

University of Central Arkansas, Undergraduate Student
Judge: Yes

X-Ray Fluorescence

(Co-Author: *Rahul Mehta*)

X-ray fluorescence 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 identified 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-fit line was used to find the composition of unknown samples. *Credit to University of North Texas, Dr. Duncan Weathers, Mr. Jordan Watkins.

P: 63 – Trae Stagers

Arkansas State University, Undergraduate Student
Judge: Yes

Development and Testing of a Scientific Payload and Ground-Based Tracking System for High-Altitude Balloons.

(Co-Author: *Jackson Mixon*)

This project involves the development and testing of a scientific payload and ground-based tracking system for high-altitude ballooning research at Arkansas State University. The payload consists primarily of two Geiger counters, data logger, and longrange wireless transceiver controlled by a Raspberry Pi single board computer. Ground-station tracking system provides connectivity to the payload via 5.8 GHz point-to-point connection to give livestreaming video and data from stratospheric balloon flights. We discuss the progression and testing of this system from the August 21, 2017 total solar eclipse to date.

P: 64 – Jackson Mixon, Arkansas State University, Undergraduate Student

Judge: Yes

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P: 65 – Jake Bass

University of Central Arkansas, Undergraduate Student
Judge: Yes

Gamma-Gamma Angular Correlation

(Co-Author: *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. The result of this annihilation is two identical gamma rays (each with 511 keV of energy), which are ejected from the sample. Because momentum has to be conserved, these gamma rays are theoretically ejected in polar opposite directions. Our experiment was designed to test this theory by employing two identical radiation detectors equidistant from the Na-22 sample, and recording each instance of a simultaneous 511 keV gamma reading of the two detectors at varying angles (164-196 degrees). The results of our experiment was precisely as predicted: when the detectors were at 180 degrees with respect to one another, we gathered the greatest number of gamma-gamma detections, and the further we deviated from 180 degrees, the fewer detections were read, with almost no detections read at 164 and 196 degrees. *We'd like to acknowledge Dr. Duncan Weathers at the University of North Texas for his assistance with this experiment.

P: 66 – Nicholas Scoles

University of Central Arkansas, Undergraduate Student
Judge: Yes

Development of an Acoustic Scanner

Hardware and software are being developed to create a system that can be used scan a 2-dimensional acoustic wave field. The system consists of two linear actuators aligned perpendicular to each other. Mounted on the scanner is a 1/4" 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 fields.

P: 67 – Samantha Dix

Arkansas Tech University, Undergraduate Student
Judge: Yes

Generation of Generalized Gaussian Beams Via a Spatial Light Modulator

(Co-Author: *Jessica Young*)

A Spatial Light Modulator (SLM) is a device that can alter the phase, amplitude, or polarization of a wavefront. Passing a laser beam through an SLM encoded with a specific computer generated hologram can shape a simple spot into a more complicated pattern. Our primary goal for this project is to create Generalized Gaussian (GG) laser beams using an SLM. This goal was accomplished by programming the SLM with MatLab to display the required holograms. The holograms are created by calculating the interference pattern of the desired beam shapes and the input beam (a fundamental Gaussian beam) and encoding the resulting pattern onto the SLM. Commercially available SLMs can cost up to thirtyfive thousand dollars. To avoid spending thousands of dollars, we constructed one from a liquid crystal display (LCD) and motherboard removed from a surplus overhead projector. To achieve our goal, we created a program that would work correctly for our experiment's laser and LCD. We present the holograms used to shape the GG laser beams, the resulting beam profiles, and compare the experimentally generated profiles to the theoretically expected profiles. The quality of the laser beam profiles are lower than expected from a commercially available research-grade SLM; however, we show that the homemade SLM shapes the laser beam into the desired intensity patterns with reasonable quality.

P: 68 – Yassamine Ghazzali

Southern Arkansas University, Undergraduate Student
Judge: Yes

Effect of simulated microgravity on radiation-induced endothelial dysfunction markers

(Co-Authors: *Abdel Bachri, Rupak Pathak, Marjan Boerman, Martin Hauer – Jensen*)

The effect of outer space radiation exposure and near-zero space gravity environment on DNA damage is not well documented, and is a primary concern to NASA in furthering its goal for deep space exploration. We illustrate technics of subjecting the cells to microgravity and discuss our preliminary findings on the role of microgravity. We irradiate Human Umbilical Vein Endothelial Cells (HUVECs), and subject them to ground-based simulated microgravity. HUVECs are used because cardiovascular diseases have been linked to genomic instability in endothelial cells. We use the High Aspect Ratio Vessel (HARV) bioreactor to seed the

cells onto Cytodex-3 microcarrier beads and cause them to undergo free suspension, a condition similar to near zero gravity in the outer space. A key component for this experiment is to standardize the microcarrier bead concentration, cells attachment and the HARV rotation speed to achieve free suspension. This standardization is required in order to prevent damage to the cells during the long microgravity treatment and optimize cell recovery. We discuss standardization techniques to improve cell attachment and microgravity treatment. We share preliminary result that suggest microgravity. Simulated microgravity causes morphological alteration and enhances radiation-induced cell killing. Finally simulated microgravity alters the expression of radiation-induced endothelial dysfunction markers.

P: 69 – Patrick Tribbett

Arkansas State University, Undergraduate Student
Judge: Yes

Stratospheric Ballooning RGB System for LiDAR Measurements
(Co-Author: Ross Carroll)

Academic stratospheric ballooning is an inexpensive alternative for near space and upper atmospheric probing. As part of Arkansas BalloonSAT, this research aims to design and implement a ground and aerial based spectral measurement system to observe atmospheric absorption and attenuation through changes in altitude. This technique and system consists of RGB laser pulses fiber coupled through a 127 mm telescope, which are then reflected off a balloon payload and back through the atmosphere to the telescope. These gated pulses are then filtered through a spectrometer for analysis. In addition to atmospheric attenuation measurements, bench testing of the intermediate system has enabled speed of light measurements and an inexpensive LiDAR system via the reflection of gated pulses. Preliminary results of this intermediate system demonstrate accurate speed of light measurements, a robust LiDAR system, and laser fluences that may be capable of reflection from a balloon payload at a distance of 25 km line of sight. Future work will include ballooning field tests and atmospheric attenuation data acquisition.

P: 70 – Paul Niyonkuru

University of Central Arkansas, Undergraduate Student
Judge: Yes

Rutherford Backscattering Spectrometry

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 target atom and the scattering angle. This theory predicts that one could determine the mass, hence, the nature of the target atom by only knowing the energy ratio and mass of the particle, and its scattering angle. In this project we test this theory against the experimental observations by using a source particle beam of Helium +1 ions, with known energy, incident on a foreknown sample target thin film composed of bismuth, silver, and copper deposited onto a silicon substrate. The scattering angle is measured as well as the energy of the scattered particle beam.

P: 71 – Paul Niyonkuru

University of Central Arkansas, Undergraduate Student
Judge: Yes

Analyzing the Changeover from a Macroscopic System to a Nanosystem by Investigating the Moving Boundary Between Two Phases.

In macroscopic thermodynamics, the variables that we deal with are either extensive or intensive. When we explore nano materials some properties that are extensive on the macro scale are no longer extensive, and as systems get smaller some of the intensive properties become less well defined. We will present the results to date of our investigations of the moving boundary between two phases in both a nano system and a macroscopic system of the same material. This is known as the Stefan problem. We analyze this problem for both a macroscopic system and a nano-systems with the method of lines adapted to a MatLab code. The goal of the research is to gain a better understanding of the changeover from a macroscopic system to a nano system. Initial calculations are being made for radially symmetric systems that are gold as there is an extensive literature devoted to the measurement of the properties of gold particle nano systems.

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