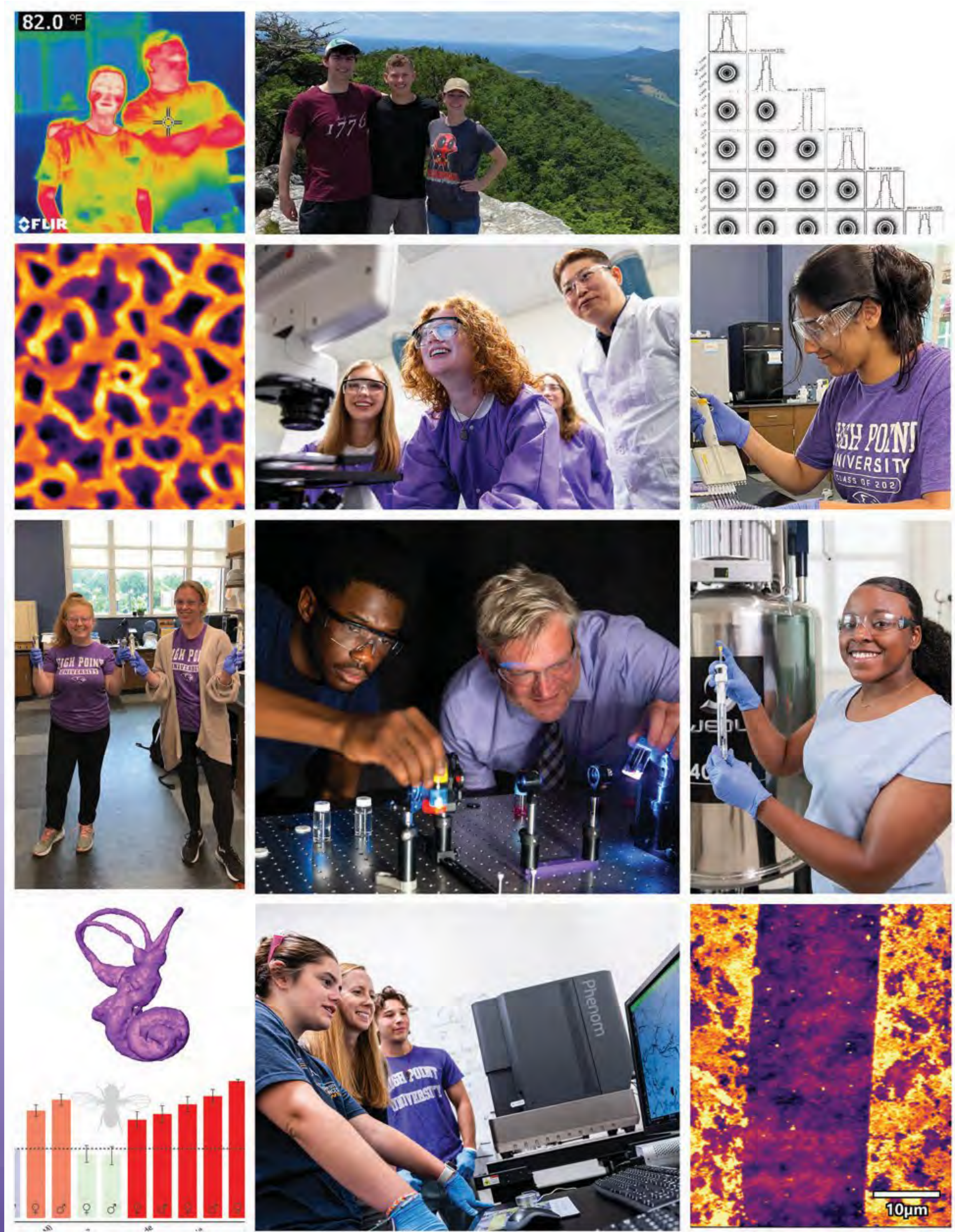
2022

High Point University
Summer Research Program in the Sciences
(SuRPS) Final Research Symposium



Wanek School of Natural Sciences

Thursday, July 28 & Friday, July 29

Scenes from SuRPS...

2022 SuRPS KEYNOTE SPEAKER

"Planting Seeds: A Perspective on Alternative Paths"

Elizabeth Reardon
(Department of Biology Class of 2017)

Clinical Study Manager
The Emmes Company, LLC, Rockville, MD

ABSTRACT

Throughout my undergraduate education, I had several opportunities to participate in research, including the inaugural summer for SuRPS. Following graduation, I was employed with the United States Peace Corps as a Peace Corps Volunteer in the Dominican Republic. Though I was not working in traditional scientific research settings, I found my interest in public health to come to the forefront of my mind, and decided to focus on this interest. With mentors who encouraged me to pursue this field, I worked as a Contact Tracer during the COVID-19 pandemic and am now employed as a Clinical Study Manager for a clinical research organization. In retrospect, I've come to recognize that experiences of all kinds can shape your path years down the line, and I will share with SuRPS participants how planting these seeds, maintaining connections, and asking questions will only enhance your experiences in the future.

BIO

Elizabeth received a B.S. degree in Biology from High Point University in 2017. During her time at HPU, she participated in the first SuRPS program where she worked with Dr. Sandra Cooke in a freshwater ecology laboratory. Following the completion of her undergraduate degree, she served as a United States Peace Corps Volunteer in the Dominican Republic from February of 2018 through March of 2020. Elizabeth has since transitioned to the American workforce, where she worked as a COVID-19 Contact Tracer for a bi-lingual project based out of San Antonio, Texas for a healthcare startup called Emocha, and for the past two years she has been employed as a Clinical Study Manager at the Emmes Company, LLC, where she works on clinical trials in infectious disease for a private biopharmaceutical company, and maternal and child health for the Eunice Kennedy Shriver National Institute of Child Health and Human Development. This fall, she will continue to work while attending George Washington University to begin an MPH in Global Health Epidemiology and Disease Control.

SuRPS Final Symposium

(Thursday, July 28, 2022, Culp Planetarium, Wanek School of Natural Sciences)

Session I: Oral Presentations: Dr. Pamela Lundin, Department of Chemistry, Presiding

	8:30 – 9:00		*COFFEE, TEA RECEPTION (WSNS Lobby)*
	9:00 - 9:05	Dr. Brian Augustine	Opening Remarks and Announcements
	9:05 – 9:20		Poster Session Part A Elevator Pitch
Th.1	9:20 - 9:40	Hannah Pickett	*Evaluation of Self-Assembled Monolayers on Polydimethylsiloxane to Inhibit Methicillin-resistant Staphylococcus aureus (MRSA) Biofilm Formation*
Th.2	9:40 – 10:00	Katie Craun	*Digital Reconstruction of the Bony Labyrinth of Dipsalidictis krausei: Anatomy and Functional Morphology*
Th.3	10:00 - 10:20	Jalen Dixon	*Optimization of Single-Molecule Fluorescence Correlation Spectroscopy: Characterization of Novel Fluorophores*
Th.4	10:20 - 10:40	Bryce Smith	*A Three-Day Companion to the Hybrid Hot Subdwarf B Pulsator BPM 36430 Detected with TESS Pulse Timings and Confirmed with Radial Velocities*
	10:40 – 11:00		*BREAK*

Session II: Keynote Address: (Introduction by Dr. Jackson Sparks, Department of Biology)

11:00 - 12:00	**Ms. Elizabeth Reardon** (HPU Class of 2017) Clinical Study Manager Emmes Company, LLC	**Planting Seeds: A Perspective on Alternative Paths**

12:00 – 1:30	*LUNCH BREAK*

SuRPS Final Symposium
(Thursday, July 28, 2022, Wanek School of Natural Sciences)

Session III: Poster Presentations Part A 1:30 – 3:00 p.m.

Posters will be set up in the hall and lobby of the Wanek School of Natural Sciences. All posters should be set up by 1 pm on Thursday for both poster sessions.

3:00 – 3:15	*BREAK*

Session IV: Oral Presentations: Dr. Briana Fiser, Department of Physics, Presiding

Th.5	3:15 - 3:35	Zoe Brown Samantha Mitchell	*Total Chemical Synthesis of Novel Antibacterial Peptides from Capsicum chinense*
Th.6	3:35 - 4:00	Sadie Flagg	*Examining the Impact of the Interaction Between BHT Inhibitor and Water on the Microstructure of Spun-cast Nanoporous Films of PMMA*
Th.7	4:00 – 4:20	Raegan Koon Gracie Lefever Taylor Galavotti	*A Plant-derived Isothiocyanate Erucin Induces Apoptotic Cell Death Through Suppression of mTOR and Akt Signaling Pathways in Cervical Cancer Cells*
Th.8	4:20 – 4:45	Joshua Ekanem Zane Sobejana Morgen Story	*Anthocyanins Serve as Non-visual Cues for Insects*

SuRPS Final Symposium

(Friday, July 29, 2022, Culp Planetarium, Wanek School of Natural Sciences)

Session V: Oral Presentations: Dr. Kelsey Kean, Department of Chemistry

	8:30 – 9:00		*COFFEE, TEA RECEPTION (WSNS Lobby)*
	9:00 - 9:20		Poster Session Part B Elevator Pitch
Fr.1	9:20 - 9:40	Angelina Pierre	*Synthesizing and Characterizing a Library of Rhodamine B Amide Dimers with Varying Covalent Linkers*
Fr.2	9:40 – 10:00	Rachel Spera	*Analyzing the Fluorescent Behavior of Rhodamine B Regarding pH Changes*
Fr.3	10:00 - 10:20	Chloe Cox	*Optimizing a C. elegans Infection Model to Evaluate Antibiotic Adjuvants Against MRSA*
Fr.4	10:20 - 10:40	Jenny Aguirre	*Designing, Constructing, and Testing a Custom Lab Apparatus to Demonstrate Angular Momentum*
Fr.5	10:40 – 11:00	John Guglielmetti Owen Hunter	*An Extension of the Fire History of Pilot Mountain as Recorded by Fire Scars in Southeastern Pines*
	11:00 - 11:15		*BREAK*

Session VI: Poster Presentations Part B 11:15 – 12:45 p.m.

Posters will be set up in the hall and lobby of the Wanek School of Natural Sciences. All posters should be set up by 1 pm on Thursday for both poster sessions.

Lunch at Café

Special Thanks:

Dr. Joanne Altman, Director HPU Undergraduate Research and Creative Works Program
Rebecca Smoak, Biology, Chemistry and Physics Administrative Assistant extraordinare
Betsy Warner, WSNS Administrative Assistant
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Luke Dixon, Biology Department Lab Manager
Erin Brady, Physics Department Lab Manager
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STUDENT ABSTRACTS ORAL PRESENTATIONS:
{Note: presenting author is underlined, * denotes faculty advisor(s)}

(Fr.4) Designing, Constructing, and Testing a Custom Lab Apparatus to Demonstrate Angular Momentum

Jenny Aguirre[1], Matt Eaton[2], Aiden Kelley[2], Levi Wenger[2], and Aaron Titus[*,1]
[1]Department of Physics, High Point University
[2]School of Engineering, High Point University

Our goal is to design, construct, and test a lab apparatus to demonstrate angular momentum. The apparatus contains a motor-controlled disk at each end of a beam that spins freely on a cam follower. An ESP32 microcontroller runs a web application which we use to control the motors. Each disk can spin either clockwise or counterclockwise at varying speeds. A change in angular momentum of the disks causes the beam to rotate. We improved the previous design by designing and building a printed circuit board (PCB), incorporating rechargeable lithium-ion batteries, improving the bearing used for the beam, adding rotary encoders to measure the rotation of the disks, and integrating a gyroscope to measure rotation of the beam. The web application now displays the angular velocity of the disks and beam in real-time. Using the apparatus, we can demonstrate rotational angular momentum, translational angular momentum, and conservation of angular momentum.

(Th.5) Total Chemical Synthesis of Novel Antibacterial Peptides from *Capsicum chinense*

Zoe Brown[1], Samantha Mitchell[1], Keven Culver[2], Jessie Allen[2], Lindsey Shaw[2], Leslie Hicks[2] and Andrew Wommack[*,1]
[1]Department of Chemistry, High Point University
[2]Department of Chemistry, University of North Carolina at Chapel Hill

Four novel cysteine-rich peptides, CC-AMP1 and three truncated derivatives, that possess anti-inflammatory, antioxidant, and antimicrobial activities were identified in the ghost pepper plant, *Capsicum chinense*, using a blend of *in silico* antimicrobial peptide (AMP) predictions and peptidomic techniques. The 32-amino acid sequence of CC-AMP1 contains three disulfide bonds with a connectivity pattern of 1-6, 2-5, 3-4, a pyroglutamic acid post-translational modification, and an overall cationic charge (+2) at neutral pH. Three truncated versions of CC-AMP1 also form three disulfide bonds with the same connectivity pattern possess +4 or +5 charges at neutral pH. These sequences have low homology with known AMPs and display low µM antimicrobial activity against Gram-negative bacteria. To further study the antimicrobial mechanisms, Fmoc-based solid-phase peptide synthesis was performed to produce the reduced forms of CC-AMP1 and its derivatives after native chemical ligation of two peptide fragments. Conditions to obtain regioselective oxidative folding to form the desired disulfide bonding pattern of CC-AMP1 and its derivatives were achieved.

(Fr.3) Optimizing a *C. elegans* Infection Model to Evaluate Antibiotic Adjuvants Against MRSA

Chloe Cox, Heather Miller, and Meghan Blackledge*
Department of Chemistry, High Point University

Methicillin-resistant *Staphylococcus aureus* (MRSA) infections kill roughly 23,000 Americans yearly and are becoming increasingly common in both healthcare and community settings. As such, the demand for novel treatments that combat antibiotic-resistant pathogens is increasing just as rapidly; one way to treat these infections is by utilizing adjuvants in combination with antibiotics. Antibiotic adjuvants are nontoxic molecules that enhance the efficacy of antibiotics. Based on previous work in our lab, loratadine, the active ingredient in Claritin, has been identified as an effective adjuvant against MRSA. In our lab, loratadine has proven successful *in vitro* but has not been tested *in vivo*, until now. *Caenorhabditis elegans* (*C. elegans*) is a nematode roundworm that is significantly similar molecularly to humans, making it a useful model organism. Using *C. elegans* as an infection model, we have tested the efficacy of adjuvants, including loratadine and novel compounds, alone and in combination with the antibiotic oxacillin. Assay optimization parameters, along with results, will be discussed.

(Th.2) Digital Reconstruction of the Bony Labyrinth of *Dipsalidictis krausei*: Anatomy and Functional Morphology

Katie Craun, Heather Ahrens*
Department of Biology, High Point University

Oxyaenidae was a family of archaic mammals that appeared during the major radiation of eutherian mammals in the Paleocene and Eocene epochs. The late Paleocene oxyaenid, *Dipsalidictis krausei*, is known from a well-preserved specimen, which allowed us to reconstruct the bony labyrinth (inner ear) of this species. Using Avizo Lite 9.4, we constructed the first digital model of the bony labyrinth of *D. krausei*. Measurements of the bony labyrinth can be used to calculate locomotor agility and the range of hearing frequencies of *D. krausei*, which may elucidate why oxyaenids became extinct. First, we described the morphology of the inner ear. Second, we determined the agility scores and hearing frequency range of *D. krausei* from measurements on the surface model of the semicircular canals, cochlea and basilar membrane. The agility scores were lower than expected given the postcranial anatomy of *D. krausei*. This indicates that either the agility scores were underestimated for *D. krausei* based on the mammalian regression or that methods used to measure body mass in oxyaenids should be reevaluated. The hearing frequency ranges indicated that *D. krausei* was similar to the contemporaneous *Chriacus pelvidens*, as well as the extant aardvark. This information provides important first observations of the inner ear of oxyaenids.

(Th.3) Optimization of Single-Molecule Fluorescence Correlation Spectroscopy: Characterization of Novel Fluorophores

Jalen Dixon, Angelina Pierre, Pamela Lundin*, and Keir Fogarty*
Department of Chemistry, High Point University

Fluorescence Correlation Spectroscopy (FCS) is a specialized method for the analysis of incredibly low concentrations of fluorophores. FCS can determine all physical variables related to any spontaneous change in fluorescence by measuring the number of photons emitted by the molecules in a solution over time. Therefore, FCS can be employed to determine local & equilibrium concentrations, the average speed of molecules in solution, and the rate constants of molecular interactions. This wide array of measurable parameters makes FCS an ideal method for the characterization for novel fluorophores. Over 8 weeks we optimized our FCS setup using Avalanche Photon Diodes and fifty micrometer pinholes to prepare for the analysis of novel Rhodamine B dimers that we developed. We are interested in expanding the range of Rhodamine B's applications by modifying the dye's basic structure. Dimerization has led to the emergence of unique fluorescence properties when compared to the monomer. By using FCS, it is possible to characterize RB2 and gain insight into what physical parameters allow for our dimer's novel fluorescent properties, opening the door for future applications.

(Th.8) Anthocyanins Serve as Non-Visual Cues for Insects

Joshua Ekanem[1], Zane Sobejana[1], Morgen Story[1], Niky Hughes[*,1], Isabella Allar[2], Claire Welp[2], Cecil Saunders[2], Jackson Sparks[*,1]
[1]Department of Biology, High Point University
[2]Department of Biology, Wake Forest University, Winston-Salem, NC

Color is perhaps the most conspicuous of plant characteristics, yet we are only just beginning to understand how plants fully utilize anthocyanin pigments to acclimate and adapt to their environments. Several studies have demonstrated that aphids and caterpillars preferentially feed on green over red leaves, but it remains largely unknown how different anthocyanins taste or smell to insects, how these pigments impact growth and development, and whether these effects vary between insects using different feeding strategies (e.g., frugivores or herbivores). Here we present results from behavioral trials using *Drosophila melanogaster*. We show that multiple pure anthocyanins modulate adult proboscis extension reflex and larval substrate preference. We are sequencing all transcripts from larvae reared on anthocyanin-enriched diets to identify key genetic pathways mediating behavioral and physiological responses.

(Th.6) Examining the Impact of the Interaction Between BHT Inhibitor and Water on the Microstructure of Spun-cast Nanoporous Films of PMMA

Sadie Flagg[1], Erik Peterson[1], Aaron Titus[2], and Brian Augustine[*,1]
[1]Department of Chemistry, High Point University
[2]Department of Physics, High Point University

Tetrahydrofuran (THF), a common organic solvent for polymers, is often stabilized with butylated hydroxytoluene (BHT), to prevent the formation of peroxide compounds. In prior work we had shown that solutions of 996 kg/mol poly(methyl methacrylate) (PMMA) dissolved at a concentration of 15.0 mg/mL in THF and spun-cast onto Si substrates produce thin nanoporous films unlike smooth films prepared from solvents such as toluene and chloroform. Prior literature has suggested this is due to the Lewis acid-base properties of the various solvents and the PMMA polymer. Previously we had reported the effect of BHT on these THF/PMMA solutions to influence the resulting film morphology. It had appeared that the concentration of BHT directly affected the porosity of the films, dependent on the age of the THF, and its contamination from exposure to air. In this study, we examined the effect of the interaction of ambient water present in the THF with the BHT and its influence on the PMMA films' nanoporosity by systematically controlling H2O concentration from 0 – 2000 ppm. Additionally, the effect of humidity on the films from the scintillation vials and silicon substrates used was examined. The moisture and humidity appear to have a significant effect on the resulting film morphology. Currently we are using pandas and Jupyter notebook to create a database to analyze the porosity variation within the films and will report on quantitative trends in nanoporosity by analyzing atomic force microscopy data.

(Fr.5) An Extension of the Fire History of Pilot Mountain as Recorded by Fire Scars in Southeastern Pines

John Guglielmetti, Owen Hunter, Erin Davenport, and Dane Kuppinger*
Department of Biology, High Point University

Fire impacts the biodiversity, structure, and function of ecosystems across the Southeastern United States. While large scale fires are uncommon in the Piedmont region, fire plays a significant role in dry-forest communities as is evident by the fire-dependent species present. However, the Piedmont's fire history has not been extensively studied due to the limited presence of species that retain fire scars. The adoption of national fire suppression policies from 1930-1980 resulted in a decrease in fire frequency. Understanding the impact of this policy is important as land managers have begun to reintroduce fire using prescribed fires. This research builds upon previous work, allowing us to expand on the following questions: How often did Pilot Mountain experience fire? How did fire frequency differ between pre-suppression, suppression, and post-suppression periods? The newly collected samples increased the geographical range of the combined data set by introducing additional samples on the north and south aspects of Pilot Mountain. Each sample's rings were measured and dated; enabling fire scars to also be dated. 48 samples were collected in 2022. Of these, 26 were sanded and 22 contained fire scars. Across both projects 36 fires were recorded; 17 fires occurred pre-suppression (1826-1929), 11 occurred during suppression (1930-1980), and 8 occurred post-suppression (1980-2022). The Mean Fire Interval (MFI) increased from 3.25 to 4.80 during the suppression period and declined to 4.29 for the post suppression period. These findings add to our understanding of management policy impacts and can inform future management actions.

(Th.7) A Plant-derived Isothiocyanate Erucin Induces Apoptotic Cell Death Through Suppression of mTOR and Akt Signaling Pathways in Cervical Cancer Cells

Raegan Koon, Taylor Galavotti, Gracie Lefever, and Kevin Suh*
Department of Biology, High Point University

Consumption of cruciferous vegetables in the Brassicaceae family is associated with reduced risk of various types of cancer. Isothiocyanates such as sulforaphane and erucin are believed to be responsible for such anticancer effect. The mammalian target of rapamycin (mTOR) signaling pathway promotes tumor progression and regulates autophagy while the Akt plays very important roles in cell proliferation and survival. Therefore, studies suggest that targeting these pathways could be an effective strategy for the treatment of cancer. In the current study, we investigated the anti-cancer effect of erucin in HeLa cervical cancer cells. Erucin treatment resulted in significant inhibition of cell viability as measured by MTS assay and promoted apoptotic cell death. In cells treated with erucin, we observed decreased expression of phosphorylated mTOR and mTOR signaling complex constituents such as Raptor, Rictor, and GbL. The inhibition of mTOR resulted in the inactivation of its target proteins such as ribosomal protein S6. Erucin treatment also decreased the expression and activation of Akt. Taken together, these results indicate that erucin could be a potent inhibitor of mTOR and Akt signaling in HeLa cells and suggest its potential use as chemotherapeutic agent against cervical cancer.

(Th.1) Evaluation of Self-Assembled Monolayers on Polydimethylsiloxane to Inhibit Methicillin-resistant *Staphylococcus aureus* (MRSA) Biofilm Formation

Hannah Pickett, Abby Copeland, Courtney Linden, Margaret Mauer, Sophie Spalding, Meghan Blackledge* and Pamela Lundin*
Department of Chemistry, High Point University

Infections caused by bacterial biofilms can be long-lasting and difficult to treat, requiring multiple rounds of antibiotics. This perpetuates in a cycle as it can lead to the development of antibiotic resistant bacteria in biofilms, with more deadly outcomes to the patient. Prophylactic chemical surface modification of medical devices prior to implantation would prevent bacterial adhesion in early stages, reducing subsequent formation of biofilm and suppressing infection risk. We are investigating how self-assembled monolayers of ω-aminoalkyltriethoxysilanes on polydimethylsiloxane, a common medical implant material, can inhibit development of mature biofilms of methicillin resistant *Staphylococcus aureus* (MRSA). These nanoscale treatments could provide a biocompatible and efficient route for reducing biofilm potential without contributing to progression of antibiotic resistance. We will present our results that evaluate biofilm inhibition quantitatively and qualitatively by crystal violet staining, scanning electron microscopy, and other techniques.

(Fr.1) Synthesizing and Characterizing a Library of Rhodamine B Amide Dimers with Varying Covalent Linkers

Angelina Pierre, Rachel Spera, Brandy-Fey Stratton, Keir Fogarty and Pamela Lundin*
Department of Chemistry, High Point University

Rhodamine B is a commercially available fluorescent dye based on a xanthene core that can be used as a staining reagent. Amide derivatives of rhodamine B have found applications in fluorescent sensors for metal ions and as a method to conjugate the dye to biomolecules for use as bio markers. We are interested how forming dimers of rhodamine B amides may impact the subsequent optical properties. A library of rhodamine B covalent dimers have been synthesized using different diamine linkers, including aryl and alkyl diamines that vary in flexibility. These dimers have been characterized using nuclear magnetic resonance (NMR), liquid chromatography-mass spectroscopy (LCMS), ultraviolet-visible spectroscopy (UV-vis) and fluorescence spectroscopy. In this presentation, specific aspects of the synthetic procedure will be discussed, as well as the primary differences of the dimers in the library.

(Th.4) A Three-Day Companion to the Hybrid Hot Subdwarf B Pulsator BPM 36430 Detected with TESS Pulse Timings and Confirmed with Radial Velocities

Bryce Smith[1], J.J. Hermes[2], Ben Rosenthal[2], and Brad Barlow[*,1]
[1]Department of Physics, High Point University
[2]Department of Astronomy, Boston University, MA

The pulsations of compact stars like white dwarfs and hot subdwarfs are stable enough to be used as precise clocks to look for small changes in the pulse arrival times due to secular evolution, orbital reflex motion, or other effects. Using photometry from TESS, we have discovered the hot subdwarf B star BPM 36430 to be a hybrid sdBV pulsator exhibiting several low–amplitude g–modes and a strong radial-mode pulsation. The latter shows a clear, periodic variation in its pulse arrival times. Fits to this phase oscillation, when interpreted as reflex motion, imply BPM 36430 orbits a barycenter approximately 10.7 light-seconds away once every 3.1 d. Using the CHIRON echelle spectrograph on the CTIO 1.5-m telescope, we confirm the reflex motion by detecting a radial velocity variation with semi–amplitude, period, and phase in agreement with the pulse timings. We conclude that a white dwarf companion with minimum mass of ~ 0.44Msun orbits BPM 36430. Our study represents only the second time a companion orbiting a pulsating hot subdwarf or white dwarf has been detected from pulse timings and confirmed with radial velocities.

(Fr.2) Investigating pH Sensitivity of Rhodamine B Amide Derivatives

Rachel Spera, Bailey Sobolewski, Angelina Pierre, Pamela Lundin* and Keir Fogarty*
Department of Biology**,** High Point University

Rhodamine amides are versatile derivatives of the xanthene dye rhodamine B that possess the ability to open or close depending on the surrounding environment. Higher levels of protonation that are associated with acidic environments encourage the open form of a rhodamine B dimer, which results in bright orange fluorescence. The basic profile of the dimer corresponds with the closed spirolactam form and does not generate any orange fluorescence, indicating there is a transitional pH range in which the molecular structure changes from open to closed. Samples of rhodamine B dimers synthesized by Dr. Lundin's organic chemistry lab were combined with diluted bases or acids to establish incremental pH levels in a variety of solvents, each of which influenced the observable fluorescence of the solutions. The excitation and emission wavelengths of these substances were collected from 3D fluorescence spectra through the use of fluorometry. Understanding the optimal conditions and trends for fluorescence in different pH and solvent environments will allow inexpensive fluorescent dyes such as rhodamine B to be utilized in sensors as effective visual indicators.

STUDENT ABSTRACTS POSTER PRESENTATIONS:

{Note: presenting author is underlined, * denotes faculty advisor(s)}

THURSDAY, JULY 28 POSTER SESSION A (1:30 – 3:00 pm):

(P.1-Th) Synthesizing Derivatives of Loratadine in the Development of Antibiotic Adjuvants to Target Antibiotic Resistance

Kiara Busby, Sophia Gregory and Meghan Blackledge*
Department of Chemistry, High Point University

As antibiotic resistance continues to increase worldwide, it is getting harder to treat resistant bacteria, such as Methicillin-resistant *Staphylococcus aureus* (MRSA). Rather than developing novel antibiotics, an alternative approach to addressing this issue is using antibiotic adjuvants to increase the efficacy of pre-existing antibiotics. Previous work done in the Blackledge lab identified loratadine as an effective adjuvant in MRSA. That work determined that the carboxy-ethyl tail of loratadine is essential for adjuvant activity. However, this tail is easily severed within the human body, eliminating any adjuvant activity. The goal of this project is to create loratadine analogs that resist degradation in the body while maintaining adjuvant activity. We have synthesized a library of loratadine analogs and are in the process of identifying those with adjuvant antibiotic activity. Synthetic methodologies and preliminary biological data will be discussed.

(P.2-Th) Developing a Fire History of Hanging Rock

Erin Davenport, Owen Hunter, John Guglielmetti and Dane Kuppinger*
Department of Biology, High Point University

Fire plays an important role in ecosystems by removing underbrush, returning nutrients to the soil, and opening the canopy to more sunlight. While landscape scale fires are common in the western U.S and southeastern coastal plain, the Piedmont's fires are more localized burns. Prescribed burns are increasingly important in many ecosystems because roads and property lines inhibit many natural wildfires. Knowledge of the Piedmont's fire history is not extensive due to high numbers of hardwood trees that do not retain fire scars as readily as pines. The study aids in our understanding of fire in the Piedmont bioregion by analyzing fire scars on pines at Hanging Rock State Park, Stokes County, NC. Hanging Rock State Park is home to fire dependent species such as *Pinus pungens*. The study addresses the following questions: Does the park contain fire scarred pines that will provide material to reconstruct the fire history of the park? What is that history? The area was surveyed over 4 days to identify potential samples. 144 potential samples were identified, and 14 of these were subsequently collected in the field. After collection, samples were sanded to increase tree ring clarity. Tree rings were dated in order to place the date of the fire scars in the samples. These scars will then be used to develop a fire history for Hanging Rock. Park management will be able to use this fire history to determine the appropriate frequency, seasonality, and scale of prescribed burns.

(P.3-Th) Synthesis and Structural Expansion of a Novel Antibiotic Adjuvant Scaffold to Improve Aqueous Solubility and Biological Activity

Sophia Gregory, Jessica Emrich and Meghan Blackledge*
Department of Chemistry, High Point University

Antibiotic resistance is growing at an alarming rate and current antibiotics are no longer effective treatments against resistant strains of bacteria. To address this, antibiotic adjuvants are being synthesized to target antibiotic-resistance mechanisms, which potentiates our arsenal of antibiotics. Our lab has identified a novel carbazole-based adjuvant scaffold in MRSA that potentiates the activity of several ß-lactams. To determine a cost effective and simple synthetic route to synthesize the scaffold, different phenylboronic acids in combination with anilines are being explored using the Chan-Evans-Lam coupling reaction to ultimately be cyclized and form the adjuvant scaffold. Preliminary reaction conditions will be discussed. To expand the scaffold and discover more potent adjuvant compounds, N-alkylation of our lead carbazole was explored for further derivatization of the molecule with the ultimate goals of improving adjuvant activity and aqueous solubility. Investigation of several N-alkyl linker strategies led us to attach an epoxide with a short linker to the carbazole nitrogen. Epoxide opening with a variety of nucleophiles afforded several products suitable for biological investigation and creation of a structure-activity relationship. Synthetic methodologies, biological data, and a preliminary structure-activity relationship will be presented.

(P.4-Th) Synthesis of Glutathione Derivatives for Biocompatible Thiol-ene Coupling Reactions

Aaliyah Holloway, and Andrew Wommack*
Department of Chemistry, High Point University

The thiol-ene coupling (TEC) is a widely applied methodology in materials and polymer chemistry to control photoinitiated polymerization. Historically, transferring the methodology of this click reaction to aqueous and functional-group rich environments that are found in biological settings is not straightforward. Building on literature precedent, we have developed protocols that allow efficient TEC in these demanding conditions to generate a new thioether bond as a redox-inert disulfide surrogate. We have successfully synthesized a range of alkene-containing glutathione derivatives to facilitate the study of disulfide bonding during glutathionylation events. In our future work, the biocompatible TEC methodology will help study signaling systems by successfully installing a model thioether bond between the alkene-containing glutathione derivative and a protein thiol without the use of harsh UV light or inorganic photoinitiatiors.

(P.5-Th) Using Self-Assembled Monolayers to Control the Pattern and Morphology of Conjugated Polymer Brushes of Poly(3-hexylthiophene)

Tristan Kaz, Sadie Flagg, Olivia Armendarez, Grace Todd, Evan Silver, Brian Augustine*, and Pamela Lundin*
Department of Chemistry, High Point University

Conjugated polymers are long chains of repeating organic units that create a π electron system that extends across the polymer chain. When conjugated polymers are grown from a surface, this creates a conjugated polymer brush, which can have a variety of applications in photovoltaics, anti-microbial films, thermoelectric, and spintronics. Within our lab, we are interested in how the structure of self-assembled monolayers (SAMs) affects the quality of the conjugated polymer brush films on silicon and gold substrates. We are particularly interested in how the reactive headgroup impacts the growth of poly(3-hexylthiophene) morphology as determined by atomic force microscopy. Our success in this area has led us to experiment with patterning the SAMs and subsequent P3HT formation using microcontact printing.

(P.6-Th) Identification of Lead Compounds to Inhibit Methicillin Resistant Staphylococcus aureus (MRSA) Biofilm Adherence and Growth

Owee Kirpekar, Meghan Blackledge*
Department of Chemistry, High Point University

Infections caused by antibiotic resistant bacteria continue to pose as a health threat both in and out of hospital settings. Those that cause biofilm infections, such as methicillin resistant Staphylococcus aureus (MRSA), are particularly difficult to treat because bacteria in biofilms can be up to 1000 times more resistant to antibiotics, requiring the investigation of novel treatments. Bacterial biofilms are three-dimensional communities of bacteria adhered to a surface and held together with an extracellular matrix. The goal of this research is to identify lead compounds that may inhibit MRSA biofilm adherence and growth in an effort to prevent and treat biofilm infections. We focused on three clinically relevant MRSA strains: ATCC 43300, USA 300, and USA 100. Several compounds at various concentrations were measured for biofilm inhibition using 24- and 48-hour standard static crystal violet biofilm assays. A few lead compounds were identified as the most effective in inhibiting biofilm growth and adherence. Biological results will be presented.

(P.7-Th) Optimizing the Fabrication of Nanotube Arrays for Use in Artificial Cilia

Jenna Mastropolo, Tommy Lotito, and Briana Fiser *
Department of Physics, High Point University

Motile cilia are microscopic hair-like structures on the surface of some cells that can cause flow in the surrounding fluid. By mimicking these cilia, we can create an artificial cilia system to explore applications in fluid flow or in the design of antibacterial surfaces. We fabricated nickel nanotubes of various lengths within polycarbonate membranes that are 10 µm and 25 µm thick. The polycarbonate membranes have cylindrical pores to create the tube-like shapes, and we electrodeposit nickel using a nickel (II) sulfate bath. The deposition time controls tube length. These tubes are filled with polydimethylsiloxane (PDMS), which is a polymer that crosslinks into a soft solid upon heating. We plan to incorporate these artificial cilia into microfluidic channels to study fluid flow. Additionally, we plan to explore the antibacterial nature of these cilia and create the tubes out of iron to be more biocompatible, for potential use as a coating on medical devices that reside in the body.

(P.8-Th) Novel Expression and Characterization of Lactate Monooxygenase from *Thermus thermophilus*

Abigail Nimmo, Makenzie Wiseman, and Kelsey Kean *
Department of Chemistry, High Point University

Lactate monooxygenase (LMO) is an α-hydroxy acid oxidase protein that uses lactate and oxygen to make acetate and carbon dioxide. While all proteins within the α-hydroxy acid oxidase family are flavoenzymes that bind FMN and are yellow, LMO differs from its family members in its catalytic mechanism. Most characterization has been done using the LMO from *Mycobacterium smegmatis* (MsLMO), but based on previous work, we propose that LMO is found in other bacteria as well as in other phylum including archaea and fungi. Here, we report the first expression, purification, and characterization of this protein from *Thermus thermophilus* (TtLMO), confirming it behaves as a lactate monooxygenase. Thermophilic proteins often possess desirable properties, such as increased stability under high heat, which is useful in industrial and medical applications. Optimization of conditions for expression and characterization of TtLMO will also be discussed. Using MsLMO and a lactate oxidase from *Aerococcus viridans* (AvLOX) for comparison, we used colorimetric and HPLC-based assays to characterize activity. In the future, we propose to characterize the stability and activity of TtLMO under higher temperatures.

(P.9-Th) Novel Expression and Characterization of Lactate Monooxygenase from *Thermus thermophilus*

Bailey Sobolewski, Rachel Spera, Meghan Blackledge, and Keir Fogarty*
Department of Chemistry, High Point University

According to the National Institutes of Health (NIH), bacterial infections that feature the formation of biofilms contribute to 80% of chronic and life-threatening infections. Biofilms are communities of bacteria that adhere and grow on surfaces by excreting a slimy, glue-like substance which also acts as a shield to protect these communities and causes them to be antibiotic resistant. These biofilms are typically found on medical devices that are inserted or implanted into the body; with around 70% of all infections coming from them. One way to combat antibiotic resistances is by using adjuvants, or a drug that doesn't kill the biofilm alone but rather makes the biofilm susceptible to antibiotics. Past research performed by the Blackledge lab proved that loratadine was an adjuvant for the antibiotic. In collaboration with the Blackledge lab, my research has focused on taking advantage of the intrinsic fluorescence's of loratadine to develop an assay which measures the inhibition of biofilm formation on a custom-designed flow cell. The flow cell is designed via 3D printing to simulate biofilm formation in physiologically relevant environments. Our flow cell contains a layer of PDMS that is laced with loratadine that slowly leeks out over time in a known concentration, preventing the accumulation of biofilm and therefore the spread of antibiotic resistance. Our flow cell allows for us to view this process in an environment mimicking that of the human body in hopes of implementing this idea into future medical devices.

FRIDAY, JULY 29 POSTER SESSION B (11:15 am – 12:45 pm):

(P.10-Fr) Anthocyanins Modulate Behavior and Development in *Drosophila melanogaster*

Joshua Ekanem[1], Zane Sobejana[1], Morgen Story[1], Niky Hughes[*,1], Isabella Allar[2], Claire Welp[2], Cecil Saunders[2], Jackson Sparks[*,1]
[1]Department of Biology, High Point University
[2]Department of Biology, Wake Forest University, Winston-Salem, NC

Anthocyanins are water-soluble red or purple pigments in plants that act as visual cues to animals, protect against extreme temperatures, and serve as photosynthetic sunblock. Insects interact with anthocyanin-rich plants in many ways: feeding, egg-laying, sheltering, etc. While some studies have shown that anthocyanin-rich plant tissues affect insect feeding behaviors, no comprehensive works exist concerning anthocyanin-insect interactions. We use pure anthocyanins to test adult and larval chemosensory-dependent behaviors in *Drosophila melanogaster*. At least two common anthocyanins elicit robust appetitive responses in these flies. Further, anthocyanin-enriched diets increase the rate of development of multiple strains of flies. Our data suggests anthocyanins are important chemosensory cues affecting physiology in insects. Future experiments extend to genetic responses and non-model species.

(P.11-Fr) Effect of a Plant-derived Compound Erucin on ROS Levels in Mammalian Cells

Taylor Galavotti, Gracie Lefever, Raegan Koon and Kevin Suh*
Department of Biology, High Point University

Increased levels of Reactive Oxygen Species (ROS) as induced by aerobic metabolism are highly toxic to human cells. These highly reactive chemicals, in excess, can break down integral cellular machinery, especially membranes and proteins. Therefore, determining methods by which to decrease intracellular ROS become necessary. While the antioxidant effects of many different vegetables are advertised to the general public as an overall health benefit, this research aims to examine the extent to which certain vegetables actually decrease ROS. In a new wave of alternative therapies, many researchers have turned to nature, isolating phytochemicals derived from some vegetables recommended for consumption, such as broccoli and Brussel sprouts. Erucin, an isothiocyanate derived from cruciferous vegetables, successfully decreased ROS levels in HeLa cells. For the fluorescence-based ROS assay, we seeded 10,000 HeLa cells into a black-walled 96 well plate. We found a marked negative effect on ROS levels across 7 replicates of 0, 5, 10, 20, and 40 µM treatments of erucin to HeLa cells for 24 hours. This suggests that erucin is a viable option for decreasing relative ROS levels.

(P.12-Fr) Examining the Invasiveness of Cervical and Triple Negative Breast Cancer Cells Following Phytochemical Treatment

Gracie Lefever, Raegan Koon, Taylor Galavotti, and Kevin Suh*
Department of Biology, High Point University

Phytochemicals are chemicals that are produced by plants to help them fight infections. These chemicals can also have health benefits to humans when consumed. Cruciferous vegetables such as cauliflower, broccoli, cabbage, and kale all possess a specific phytochemical called erucin. In this study, we measured the effect of erucin on the invasiveness and metastatic potential of cervical and triple negative breast cancer cells using ibidi plates. Cells were cultured in ibidi plates that contain a silicone divider in order to separate the cells into four regions. After overnight seeding, the silicone divider was removed leaving a cell-free 500 µm cross-shaped gap between the four regions of cells. Erucin was added to the plate with only 1% fetal bovine serum containing media to maximize cell migration. During the following days, cells migrate to cover the gap. Triple negative breast cancer cells are known to be very aggressive. As expected, these cancer cells migrated and filled the gap much faster than the cervical cancer cells. When treated with erucin, both types of cells did not migrate to cover the gap as quickly as the untreated control cells. These results suggest that erucin can be used to combat invasive and metastatic behavior in cancer cells.

(P.13-Fr) The Design of Microfluidic Channels for Incorporation of Artificial Cilia

Tommy Lotito, Jenna Mastropolo, Briana Fiser*
Department of Physics, High Point University

The Reynolds number is a dimensionless number used to classify fluid flow where viscosity plays a significant role in regulating fluid velocities or flow patterns. In a low Reynolds number environment, it is difficult to achieve effective mixing because flow is laminar rather than turbulent like at high Reynolds numbers. Microfluidic channels create a fluidic environment with a low Reynolds number, posing a mixing issue within the channel. To develop these 75-500 µm channels, we designed them in CAD software and printed them using a resin 3D printer. Copies were then made using polydimethylsiloxane. We propose that active mixing can be achieved in the channels by lining the channel with artificial cilia 10 µm or 25 µm in size and manipulating their movement with magnetic fields. Additionally, cilia create fluid flow which could possibly prevent the buildup of biofilms on surfaces.

(P.14-Fr) Fourier Series Analysis of Hot Subdwarf Binaries Observed by NASA's TESS Spacecraft

Bryce Smith[1], Thomas Kupfer[2], and Brad Barlow*[,1]
[1]Department of Physics, High Point University
[2]Department of Physics and Astronomy, Texas Tech University, Lubbock, TX

Hot subdwarfs were previously red giants that were stripped of their outer hydrogen layers by nearby orbiting companions. Their unique formation pathways can tell us much about cosmology and help us understand which objects can survive the red giant engulfment phase. To fully understand existing hot subdwarf systems, we need to be able to measure periods, velocities and inclination angles. Traditionally, these parameters could only be determined with eclipsing systems, despite non-eclipsing systems significantly outnumbering them. Recent high signal-to-noise data from NASA's TESS mission allows us to analyze non-eclipsing systems in detail for the first time. Using these data, we measure an asymmetry in the reflection effect due to relativistic beaming. This feature allows us to measure the individual velocities of both stars. Additionally, through simple Fourier analysis, we can determine the inclination angles even without eclipses. Being able to use the reflection effect to analyze hot subdwarf systems opens up a plethora of systems for analysis that were previously ignored, but are equally significant to their eclipsing counterparts.

(P.15-Fr) Novel Expression and Characterization of Lactate Monooxygenase from *Halopiger salifodinae*

Makenzie Wiseman, Abigail Nimmo, and Kelsey Kean*
Department of Chemistry, High Point University

Lactate monooxygenase (LMO) and lactate oxidase (LOX) are proteins that are part of the α-hydroxy acid oxidase group and use flavin mononucleotide (FMN) to carry out their chemistry. LMOs are thought to exist in several classes of species including bacteria. Here, we report the first study of a putative LMO from *Halopiger salifodinae* (HsLMO) to characterize HsLMO's activity and verify whether LMOs are found in archaea. *Mycobacterium smegmatis* LMO (MsLMO) and *Aerococcus viridans* LOX (AvLOX) have been previously characterized and are good comparisons to use when developing new protocols. These proteins were produced using recombinant protein expression in *Escherichia coli* and purified by affinity chromatography. Activity assays were used to monitor the production of acetate in LMOs and peroxide or pyruvate in LOXs. This project will help us better understand the distribution and importance of LMOs found in nature.

(P.16-Fr) Endocast of *Hyaenodon raineyi*: Implications for Neuroanatomy in Hyaenodonta

Elyse Zeffiro, Heather Ahrens*
Department of Biology, High Point University

Endocasts allow for the visualization of anatomical features of the endocranial cavity. The first known endocasts were natural, made of stone preserved in fossil crania. Technological advancement has allowed for widespread modeling and assessment of digital endocasts with high-resolution computed tomography (CT) scanning of fossils. We used Avizo Lite 9.4 to create a digital endocast of *Hyaenodon raineyi*, an extinct mammalian predator from the late Eocene (36.5 – 33.7 mya). In *H. raineyi*, description of the endocast provides insight regarding brain morphology, including neocorticalization, or expansion of the telencephalon. Due to damage of the fossil, both the rostral and caudal portions of the endocast could not be reconstructed. However, some inferences could still be made regarding the arrangement of neocortical sulci and several cranial nerves. The rhinal sulcus found in the specimen was positioned ventrally indicating a relatively large neocortex. The piriform lobes were clearly identifiable and indicate reliance on the olfactory system in *H. raineyi*. Other key features found include the presence of three neocortical sulci and absence of the alisphenoid canal. We estimated the body mass as 4.93 kg, utilizing an osteological correlate of the first lower molar. The identification of these anatomical structures provides a comparison, and visible variation of sulci, across known North American species of the genus *Hyaenodon*.

Note that the following posters abstracts are cross-listed in the Oral Presentations:

- **(P.10-Fr) See Th.8 (Joshua Ekanem, Zane Sobejana, Morgen Story and Jackson Sparks)**

2022 SuRPS Faculty Participation and Projects

Department of Biology

Dr. Heather Ahrens
(Geoscience/Anatomy)

"Neurosensory Anatomy in Extinct Carnivores"

High-resolution computed tomography (CT) scanning allows for non-destructive investigation of the internal anatomy of fossils. In mammals, scientists can model the endocranial cavity and bony labyrinth, which serve as proxies for the brain and inner ear, respectively. These data are valuable for the documentation and evaluation of patterns of evolution in brain morphology, brain size, and sensory systems. Endocasts in mammalian carnivores are of interest due to the dramatic turnover of mammal groups during the Paleogene (66 to 23 million years ago). In particular, some authors have suggested that the ancestors of modern carnivores had larger relative brain sizes, as well as additional neuroanatomical adaptations, that may have contributed to their success over contemporaneous carnivore clades that went extinct.

For this project students will use CT scans to digitally render models of the endocranial cavity (endocast) and bony labyrinth (inner ear) of a fossil carnivore. Subsequently, students will describe the morphology of the neurosensory system using their generated data and interpret broader aspects of ecology, behavior, and evolution of mammalian carnivores.

Dr. Dane Kuppinger
(Environmental Ecology)

"Fire History of the Sauratown Mountains"

The southeastern United States contains isolated sub-xeric forest communities that are dependent upon fire to maintain their structure and species composition. Because fire effects are dependent upon the fire frequency, seasonality, and intensity, knowing the historical fire regime for a location can greatly aid land managers as they design appropriate management plans. Luckily this history is preserved within the tissues of the trees themselves. Trees that are injured by the fire and survive can retain a record of it through altered growth rings and charcoal deposited between growth rings when the tree is examined in cross-section. Pilot Mountain State Park has one of these fire dependent plant communities and recent work (Kuppinger & Rich 2019) has established the park's fire history back to the mid-1800s. This proposal would build on that work through one or more lines of research.

The first project will add to the fire history of Pilot Mountain by analyzing cross sections of stumps left over from hand-logging in the early 1900's. These samples should enable the fire history to be extended to the early 1800's. The second project will take advantage of the recent fire at Pilot Mountain to collect additional samples; thereby adding to the number and geographic distribution of trees included in the park's fire history. The final project will begin developing a fire history for Hanging Rock State Park.

Dr. Jackson Sparks
(Entomology/Genetics)

"Red Pigments from Plants Modulate Insect Feeding Behavior and Development"

Color is perhaps the most conspicuous of plant characteristics, yet we are only just beginning to understand how anthocyanin pigments may affect plant-insect interactions. Several studies have demonstrated that aphids and caterpillars preferentially feed on green over red leaves, but it remains largely unknown how different anthocyanins may taste or smell to insects, how consumption of these pigments impact growth and development, and whether these effects vary between insects depending on feeding strategy (e.g., frugivores or herbivores). The Sparks Lab is measuring shifts in feeding behavior of adult and larval vinegar flies in response to pure anthocyanins. Students are also investigating how anthocyanin-enriched diet affects growth and development. Students generating data for these projects may travel to Vancouver in Fall 2022 or Baltimore in Fall 2023 to present their work at the largest entomology conference in the world.

Dr. Kevin Suh (Genetics/Molecular Biology)

“Targeting mTOR Signaling Pathway in Human Cancer Cells Using Fenbendazole”

Drugs such as fenbendazole and mebendazole are used for the treatment of a variety of parasitic worm infestations. Recently, these drugs have gained considerable attention because of their unexpected effects against cancer. In our preliminary studies, we observed that fenbendazole inhibits the growth of human cervical cancer cells. We also observed cell fragmentation and membrane blebbing, which are key characteristics of apoptotic cell death, after treating the cells with fenbendazole. The mammalian target of rapamycin (mTOR) kinase is an important component of PTEN/PI3K/Akt signaling pathway, and regulates cell proliferation and apoptotic cell death. The mTOR signaling pathway is often activated in tumors and regulates gene expression and protein synthesis for cancer cell proliferation. Therefore, the mTOR signaling pathway is an important target in cancer research. In this study, we will target mTOR signaling pathway to elucidate the mechanism of anticancer activity of fenbendazole using multiple different methods such as Western blotting, immunocytochemistry, and enzyme-linked immunosorbent assay.

Department of Chemistry

Dr. Brian Augustine (Materials Science/Nanotechnology)

“Fabrication and characterization of metal-coated polymer nanoporous membranes”

Thin films of poly methylmethacrylate (PMMA) can be produced with novel micro/nanostructures when they are deposited from solutions of tetrahydrofuran (THF) under specific deposition conditions. A complicated plate-like structure with large open pores can be created by spin-casting PMMA films from THF solutions. The same structure does not form when deposited from other solvents such as chloroform and toluene. These solvents result in much more uniform, smooth films as one would expect. The microstructure of the THF-deposited films reveal pores on the order of 1 - 10 µm, and the remaining PMMA structures are on the order of 50 - 500 nm. Atomic force microscopy (AFM) has been used to confirm a layered plate-like morphology. The microstructure suggests that nanoporous membranes can be fabricated which can be used in a variety of applications such as filtration, chromatography, battery membranes, catalysis, biosensors or many applications that require a high surface area material. Combining the film structures with electroless Ni, a novel nanostructured polymer could result in not only a high surface area material, but a material that could be metal coated or a metallic nanostructure with a high surface area. Taking advantage of the enhanced surface activation of the electroless pre-treatment with other vapor phase deposition techniques such as atomic layer deposition (ALD) could result in a metal-coated nanoporous material which are extremely difficult to fabricate using conventional microfabrication technologies. SuRPS students will learn microfabrication, surface characterization using AFM, and metal deposition techniques applicable to biomedical devices.

Dr. Meghan Blackledge (Bioorganic)

“Drug repurposing to find and create novel compounds that inhibit antibiotic resistance and biofilm formation”

In the last twenty years, bacterial infections have reemerged as a major health threat. It is predicted that by 2050, deaths from bacterial infections will outpace those from cancer. Bacteria evade treatment through two main mechanisms: (1) development of genetically encoded resistance to antibiotics, and (2) formation of bacterial biofilms that allow the bacteria to tolerate antibiotic treatment and form a reservoir of persistent infection. The Blackledge lab is interested in identifying and synthesizing novel small molecules that can reverse antibiotic resistance and bacterial biofilm formation in medically relevant strains of bacteria. Recently, we have had success identifying amoxapine, an antidepressant, and loratadine, the active ingredient in Claritin, as compounds with the ability to “break” beta-lactam resistance in MRSA and inhibit biofilm formation in Staphylococci. To expand our work repurposing FDA-approved drugs as novel antibacterial therapies, we will be screening a library of FDA-approved compounds for activity against medically relevant strains of bacteria. In addition to searching for more lead compounds, we will be using synthetic organic chemistry to make derivatives of amoxapine and loratadine to better understand the relationship between the compound’s structure and its activity in bacteria. Student researchers in the Blackledge lab have the opportunity to learn assays and techniques in both microbiology and organic chemistry, even if students have not taken these courses yet.

Dr. Keir Fogarty
(Analytical/Biophysical)

"On the Road to Novel Fluorescent Materials: Characterization of Color-Switching Rhodamine B Dimers"

Rhodamine B is a common xanthene dye that has historically been used in dye lasers and textile dyeing. As our understanding of rhodamine B's chemical and photophysical properties have progressed, interest has grown in chemically modifying the basic structure of the dye to expand its utility in a variety of applications. One of the most studied modifications is the conversion of the carboxylic acid of rhodamine B into an amide, which can adopt two forms: a closed, spirolactam form in which the fluorescence of the xanthene core is quenched due to the disruption of conjugation, or an open form which is fluorescent. The transition from the closed to open form is sensitive to both pH and ultraviolet illumination, which enables the use of rhodamine spirolactam (RSLs) in sensing or other dye-activation on/off switching applications. In collaboration with the Lundin lab, we synthesized dimers of the fluorescent xanthene dye, rhodamine B, using RSL-capable linkers. These dimers exhibit surprising optical properties that differ from standard RSLs, which open up potentially new vistas of functionality. Student researchers in the Fogarty lab will explore a multitude of techniques for the study and application of fluorescence technology and organic chemistry.

Dr. Kelsey Kean
(Biochemistry)

"Exploring Flavoenzyme Structure and Function"

Proteins are among the most abundant and functionally diverse biomolecules with the ability to carry out unique and specific functions and chemistries. In the Kean Lab, we are interested in understanding how proteins evolve and are able to carry out their unique and specific chemistries. A key piece to understanding how proteins work – when working correctly, when behaving aberrantly, or when being engineered for a new function – comes from exploring and understanding protein structure and function on a molecular level. One area of interest in our group is understanding flavoenzymes, a group of proteins that use a special flavin cofactor to carry out a wide range of chemical reactions, using lactate monooxygenase (LMO) and its related family members as model proteins. Student researchers in the Kean Lab will have the opportunity to learn techniques in molecular biology, biochemistry, and structural biology.

Dr. Pamela Lundin
(Organic/Polymer Materials)

"Influence of Self-Assembled Monolayer Structure on Film Characteristics of Surface Grafted poly(3-hexylthiophene)"

Dr. Lundin's research group is interested in how single layers of organic molecules on a surface behave. The surface properties can be modified. For example, we have observed the grafting an alkylamine to the surface can decrease the ability of bacteria to colonize and form biofilms. The organic molecules can also behave differently than they do in solution. For example, when a conjugated polymer chain is grafted to the surface, it can adopt conformations that are different from those in a simple film of the polymer with impacts on the properties such as optical activity and hydrophobicity. In SuRPS, our group will continue these investigations into the dynamics of organic molecule-surface interfaces with the goal of developing insights that can influence practical applications.

Dr. Andrew Wommack
(Organic)

"Exploring the Chemical Signals of Plants"

The Wommack Lab will investigate two research areas during the summer of 2022. The first area is the study of cysteine-rich peptides from plants. Following the use of predictive modeling experiments of plant transcriptomes and LCMS analysis, we will execute the total chemical synthesis of these natural products in collaboration with the Hicks Lab at UNC-Chapel Hill. These plant peptides have putative roles in chemical signaling and host defense. We will explore these versatile mechanisms of action by monitoring proteomic changes in bacteria following peptide treatment. In conjunction with these synthetic efforts, we will develop redox-inert, isosteric mimetics of these ridged disulfide-bound biomolecules to further study their structure and function. A second area of collaborative research interest is in the characterization of a family of small molecule plant pigments known as anthocyanins. We are interested in determining the specific structures that plants use to manage the multifaceted challenges from dynamic abiotic and biotic stresses.

Department of Physics

Dr. Brad Barlow
(Astrophysics)

“A photometric survey of hot subdwarf stars using NASA's TESS spacecraft”

For the past two years, we have been collecting high-cadence photometry of more than 2000 candidate hot subdwarf stars using NASA’s TESS spacecraft. Some of these targets show anomalously high Gaia flux errors, which could be a sign of variability due to eclipses, stellar pulsations, planetary transits, and even relativistic effects. In this ongoing project, we will download, process, and analyze TESS photometry for all hot subdwarfs monitored during Cycle 4 observations. Collectively, these light curves will help (i) permit detailed asteroseismological analyses for an unprecedented number of pulsating hot subdwarfs; (ii) greatly increase the number of known and solved binaries; (iii) determine the influence substellar objects have on stellar evolution; (iv) constrain the presence of planetary companions through precise timings; and (v) generally improve our capacity to draw a statistically meaningful picture of this enigmatic stage of stellar evolution. This work is supported by NASA TESS G.I. grant 80NSSC21K0364.

Dr. Briana Fiser
(Biomaterials)

“Design and Fabrication of SLA 3D Printed Microfluidic Channels for Embedding Artificial Cilia with Applications in Fluid Flow and Biofouling”

Biomimetic systems allow scientists to both harness the power and creativity of nature and isolate and explore the contribution of individual components within complex biological systems. Biology has designed cilia to be both actuators, actively propelling fluids throughout the body, and sensors, discerning changes in flow patterns and mediating ion concentrations. Because of their diversity of applications, biological cilia have been the inspiration for many artificial cilia systems in the last fifteen years. These systems comprise arrays of magnetic actuators with the potential to mix and pump small volumes of fluids within sub-millimeter sized channels, a difficult endeavor in low Reynolds number laminar flow. In this project, students will learn to design in CAD and print microfluidic channels using a resin 3D printer. Additionally, they will learn procedures for fabricating arrays of magnetically responsive artificial cilia, embedding them in microfluidic channels, and measuring resulting fluid flow. Potential applications include the quantification of mixing and the prevention of biofilm development.

Dr. Aaron Titus
(Laboratory Instrumentation)

“Designing, Constructing, and Testing a Custom Apparatus to Investigate Angular Momentum and Torque Using Quadcopter Technology”

This project is a continuation of work to develop a custom apparatus to investigate angular momentum and torque. This version of the apparatus will have propellers on two motors fixed to servos at the end of a beam. Attached to the beam are a microcontroller and onboard sensors to measure the angular speed of the motors and the angular speed of the beam. A remote application will be developed to read sensors and control the servos in order to change the axis of the angular momentum of the propellers as well as their angular speeds. Experiments will include measuring the lift and aerodynamic drag on the propellers and the moment of inertia of the apparatus. Current collaborators are Mr. Matt Eaton, Levi Wenger, and Aidan Kelley in the Webb School of Engineering.

SuRPS 2022 Seminar Series

(Friday's @ Noon, Wanek School of Natural Sciences Room 344)

Date	*Name*	*Affiliation*	*Seminar Title*
Friday, June 10	**Dr. Daniel Whitehead** Associate Professor	Department of Chemistry, Clemson University	*Renewable Nanomaterials for Environmental Remediation Applications*
Friday, June 17	**Dr. Checo Rorie** Professor and Chair	Department of Biology, North Carolina A&T University Greensboro, NC	*Cadmium Elicits a Differential Cellular Response in Triple Negative Breast Cancer Cells*
Friday, June 24	**Prof. Christopher Deppmann** Professor	Department of Biology University of Virginia	*Heavy Metal Neuroscience: Tracking Neural Development with Single-Cell Mass Cytometry*
Friday, July 8	**Prof. Jianjun Wei** Professor	Joint School of Nanoscience and Nanoengineering, Greensboro, NC	*Tuning Nanomaterials and Nanostructure Properties to Develop Sustainable Materials*
Friday, July 15	**Prof. Richard Superfine** Distinguished Professor	Department of Applied Physical Sciences University of North Carolina, Chapel Hill	*Squeezing and Feeding Cells: The Physics of the Cell Nucleus and Immune Cells*
Friday, July 22	**Dr. Tom Hollis** Professor	Wake Forest University School of Medicine Winston-Salem, NC	*Play it Again SAMHD1: Recurring Roles in Cell Cycle Regulation, Viral Restriction, Innate Immunity and Cancer*

Past SuRPS Keynote Speakers

Year	Speaker	Title
2015	**Rachael Parker, Ph.D.** HPU Chemistry 2011 *Virginia Tech*	*Statistical and combinatorial approaches to designing repeat proteins as recognition elements in microbial sensors*
2016	**Sarah Craven Seaton, Ph.D.** HPU Chemistry/Biology 2004 *UNC Asheville Biology*	*Soirées in the Soil: Bacterial Communication, Cooperation, and Competition in the Rhizosphere*
2017	**Laura Lee, Ph.D.** HPU Biochemistry/Physics 2012 *North Carolina State University*	*Boiling Bugs Break Biomass: An Investigation Into High Temperature, Cellulolytic Microorganisms*
2018	**Gavid Coombs, Ph.D.** HPU Biochemistry 2014 *Yale University*	*A Journey Through Research: Peptide-Catalyzed Atroposelective Coupling of Arenes and Quinones*
2021	**Hailey Parry, Ph.D.** HPU Exercise Science/Chemistry 2017 *National Institutes of Health*	*Key to Success – A Note to Future Graduates*
2022	**Elizabeth Reardon** HPU Biology 2017 *Emmes Company, LLC*	*Planting Seeds: A Perspective on Alternative Paths*

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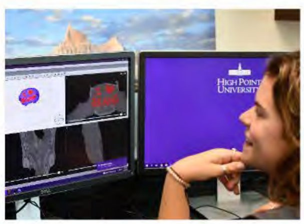

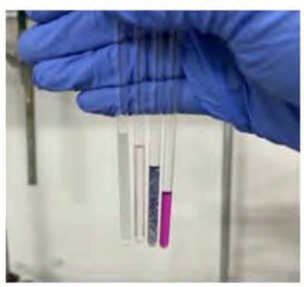





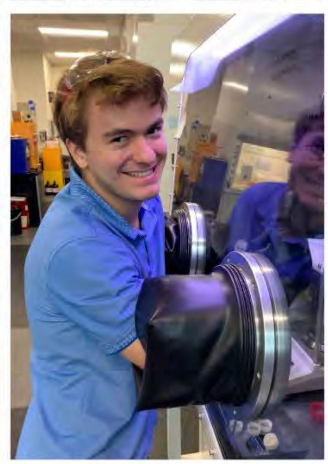
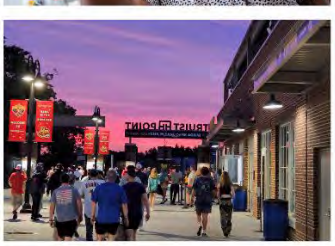

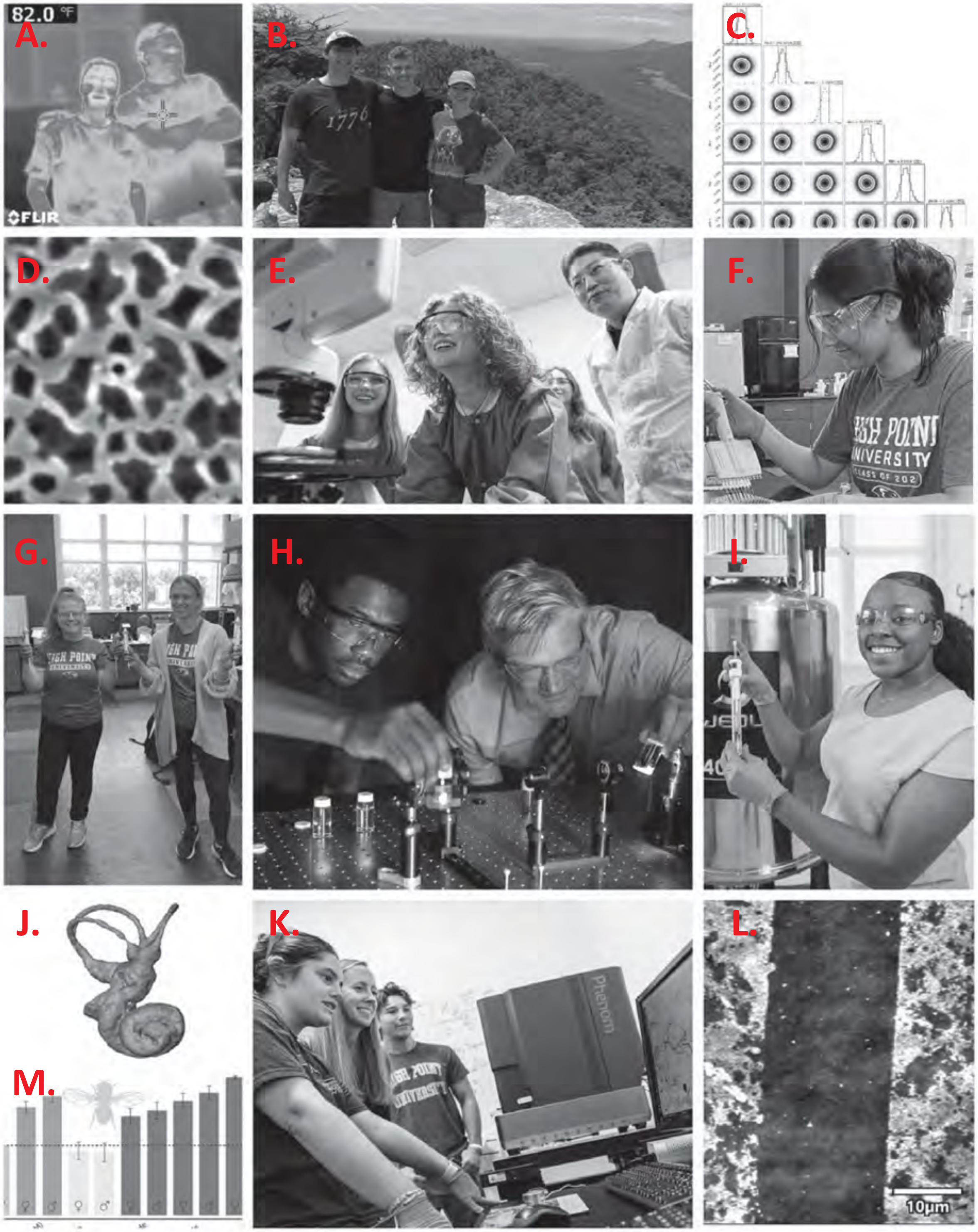

(A.) Infrared thermal imaging from the Titus Lab; (B.) Field work at Hanging Rock State Park from the Kuppinger Lab; (C.) Corner plot of a new binary hot subdwarf system from the Barlow Lab; (D.) AFM image of nanoporous polymer film from the Augustine Lab; (E.) Optical microscopy of cancer cell line in the Suh Lab; (F.) Micropipetting MRSA antibiotic adjuvants in the Blackledge Lab; (G.) Protein purification and expression in the Kean Lab; (H.) Laser dye fluorescence in the Fogarty Lab; (I.) Preparing NMR samples to characterize new molecules in the Wommack Lab; (J.) Digital endocast from Paleocene era mammal from the Ahrens Lab; (K.) Electron micrsocopy of artificial cilia in the Fiser Lab; (L.) AFM image of microcontact printed grafted polymer films from the Lundin Lab; (M.) Drosophila fly preference data from the Sparks Lab

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THE SUMMER RESEARCH {SuRPS} PROGRAM IN THE SCIENCES