Mississippi College

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Proceedings of the

Fall 2021 Mississippi College STEM Research Symposium

November 19, 2021
Math, Chemistry, Computer Science (MCC) Lobby
Mississippi College
Clinton, MS

SCHOOL OF SCIENCE AND MATHEMATICS

Departments of Biology, Chemistry & Biochemistry, Engineering, Computer Science & Physics, Mathematics, and Physician Assistant Studies

Proceedings of the
Fall 2021 Mississippi College STEM Research Symposium

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About the
Fall 2021 Mississippi College STEM Research Symposium

Student Poster Presentations

Undergraduate and graduate students from the Mississippi College School of Science and Mathematics are invited to submit an abstract and present a poster. Each student presenter should be a current student of the Department of Biology, Chemistry & Biochemistry, Engineering, Computer Science & Physics, Mathematics, or Physician Assistant Studies. New researchers with one semester of data and seasoned researchers with a complete project are all welcome to present.

Guest Poster Presentations

Faculty and alumni posters are welcome as guest presenters as space permits.

Symposium Sponsors & Acknowledgments

The Fall 2021 Mississippi College STEM Research Symposium is sponsored by the Mississippi College School of Science and Mathematics and the Mississippi College Office of Research.

Refreshments and gift cards for recipients of People's Choice Awards are provided by the Mississippi College Office of Research.

The MC Medical Dental Alumni Association provides two overall awards for best research projects judged by qualified faculty.

Members of the Mississippi College Chapter of Tri-Beta provide their assistance with voting and coordination of the event.

Easels for posters are provided by the Department of Chemistry.

Special thanks to event host Abdallah Zaitar and event photography provided by various students and faculty.

Symposium Schedule and Poster Guide
Fall 2021 Mississippi College STEM Research Symposium

Date ……. November 19, 2021

Location ……..…… College Math, Chemistry, Computer Science (MCC) Lobby

Poster Presentations and Refreshments ……..…….…… 1:30 AM – 4:00 PM

People's Choice Voting ……..……...……. 1:30 AM – 3:30 PM

People's Choice Awards ……..…… 3:30 PM – 4:00 PM

POSTERS

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9	**Joshua D. Gramm**	**Conventional Strain Energies of Thiaziridine and the Thiazetidines**

10	**Claire Stokes**	**A New Extraction and Quantification Method to Detect Polystyrene Plastics in Biological and Environmental Samples**
11	**Lillian Sisson**	**Chemical Analysis and Biotoxicity Assessment of Plastic Bioremediation Using Tenebrio molitor Larvae**
12	**DeKayla R. Bridgewater**	**Analysis of the MSH2 Gene for Diagnosis and Risk of HNPCC**
13	**Rebecca L. Grewe and Ethan L. Tullos**	**Establishing a Drosophila melanogaster Model for Studying the Effects of Dietary Lipids on Growth, Development and Behavior**
14	**Makenzie P. Phillips**	**Detection of a Shared Single Nucleotide Polymorphism of the C, V, and Z Haplogroups within the Human Mitochondrial Genome**
15	**Makenzie P. Phillips**	**ELISA Analysis for the Presence of HIV Antibodies**
16	**Saisha A. Coleman and Jadyn A. Hasley**	**Analyzing Hereditary Non-Polyposis Colorectal Cancer Inheritance within Family Members**
17	**Joseph C. Price and J. Bryden Herring**	**Evaluation of a Single Nucleotide Polymorphism in the Human TAS2R38 Gene to Predict Bitter Tasting Ability**
18	**Bryant Johnson**	**The Impact of Predator Activity and Demographics on White-tailed Deer Social Networks**
19	**Sydney Melton**	**The Role of Matrix Metalloproteinases in the Neurodegenerative Polyglutamine Disease Spinocerebellar Ataxia Type 1**
20	**Elijah Rummells**	**Analysis of Rural White-tailed Deer Scraping Networks to Model the Spread of Communicable Diseases**
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Abstracts
Fall 2021 Mississippi College STEM Research Symposium

Poster #1

Characterization of Gamma Ray Imaging System for Use in Depleted Uranium Remediation Efforts: Shielding the Gamma Ray Imaging System

McCormick, CE; Allen L; Crider, BP; Henkel, B.; Lusby, SD; Sansing, S; Unz, RJ; Magers, DH

The United States Army tests munitions made from depleted uranium (DU) at Yuma Proving Grounds in Yuma, AZ. Continued testing of these DU munitions has led to a build-up of DU, causing concern for the surrounding environment and creating health risks. The DU emits gamma radiation, and it may corrode and migrate in the arid desert environment. Identifying and locating DU in the environment is crucial in the effort to remove it and allows implementation of a targeted removal strategy. The Germanium Gamma-Ray Imager (GeGI) is being prepared for deployment on autonomous robotic platforms to find and image sources of Depleted Uranium. Because of the high background radiation in such an environment, it is necessary to shield the GeGI so that it can detect the desired source without interference from background radiation caused by the natural decay of elements in the soil. Lead, a metal with a high atomic number, is very dense, making it one of the best materials to absorb gamma radiation, particularly at low energies. The main considerations for the design of the shield are its effectiveness and its weight, which must be as light as possible to allow for use on the self-contained, autonomous robotic platforms. The development of the lead shield will be presented, as well as details of the considerations for the design and data-based validation of its functionality.

Presenting Author: Caitlin E. McCormick

Department: Engineering, Computer Science & Physics

Research Mentor: David H. Magers, Ph.D

Research Sponsor: Mississippi College Department of Chemistry & Biochemistry, Computational Chemistry Group

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Poster #2

Preparation of Macrocyclic Polyphenylethynylarene Ethers

Steen, B, Selby, TD

Dendrimers are defined as highly branched, symmetrical, monodispersed macromolecules that have compact, 3-dimensional, spherical shape. They are comprised of a central core molecule, a

layer of inner branching units, which create internal cavities, and an outer layer of surface groups. Typically, surface groups are not linked together or cyclized, which contributes to their spherical shape. Highly conjugated dendrimers can be used for the innovation of electronic and photonic applications like organic light-emitting diodes and solar cells. The problem with the conventional dendrimer is the efficiency of the intramolecular energy transfer decreases with increasing dendrimer size. This decrease in energy transfer is due to the twisting around the single bonds of dendrons, which results in a loss of conjugation, which reduces the light harvesting properties in the entire molecule. This research presented here is centered around the synthesis of flat, 2-dimensional architectures with an extended pi-conjugated system. Tying the branching units together through ether linkages, prevents rotation around the single bonds and maintains a flat structure. Before attempting the synthesis of one of these large dendrimers, we are preparing several macrocyclic model systems while optimizing reactions conditions. All of the model structures can be prepared from the same key intermediate structure, (3-ethynylphenoxy) (tert-butyl)dimethylsilane. Cyclization can be accomplished by simple nucleophilic substitution reactions.

Presenting Author: Bailey Steen

Department: Chemistry & Biochemistry

Research Mentor: Trent D. Selby, Ph.D.

Research Sponsor: Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry

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Poster #3

Synthesis of Macrocyclic Diaminopolyphenylethynylarenes and Diaminopyridinylethynylarenes

Stewart, M, Selby, TD

Conjugated dendrimers are known for their ability to harvest light. Typical dendrimers, or those that are more well known, can lose conjugation because there is no stability in the dendrons to keep them from twisting at single bonds. This instability increases with increasing size of the dendrimer. The loss of conjugation leads to a reduction in the ability of the dendrimers to harvest light. Planar conjugated dendrimers, however, would likely be better candidates for harvesting light due to the functional group linkages in the dendrons. The focus of this project is on using bridged amine or imine linkages to potentially stabilize a planar dendrimer. With these bridged-linkages, the dendrimer cannot lose its conjugation, regardless of size. As a result, the dendrimer's ability to harvest light is not affected or lost, making it more effective and more efficient than three-dimensional dendrimers. Before attempting the lengthy synthesis of such dendrimers, we are preparing smaller model systems in order to optimize reaction conditions and verify the hypothesis mentioned above. To prepare these model compounds, trimethyl[2-(3-nitrophenyl)ethynyl]silane is a molecule of focus. This key molecule is synthesized from bromoaniline and

trimethylsilylacetylene, deprotected to 1-ethynyl-3-nitrobenzene, reacted with 1,2-diiodobenzene in a Sonogashira reaction, and reduced to obtain amino groups. An alternative synthesis involves reacting 3-ethynylbenzeneamine with 1,2-diiodobenzene under Sonogashira reaction conditions. Current work involves cyclizing the diamino molecule through formation of a carbon bridge between the two nitrogen atoms.

Presenting Author: Megan Stewart

Department: Chemistry & Biochemistry

Research Mentor: Trent D. Selby, Ph.D.

Research Sponsor: Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry

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Poster #4

Conventional Strain Energies of Three-membered Heterocycles

Ivey, RP; Case, MM; Magers, DH

The conventional strain energies for cyclopropane, aziridine, oxirane, silirane, phosphirane, thiirane, germirane, arsirane, and selenirane are determined within the isodesmic, homodesmotic, and hyperhomodesmotic models to compare the effect of third-row and fourth-row elements to second-row elements on the strain energies of three-membered rings. Optimum equilibrium geometries, harmonic vibrational frequencies, and corresponding electronic energies are computed for all pertinent molecular systems using self-consistent field theory, second-order perturbation theory, and density functional theory (DFT). The DFT functionals employed are Becke's three-parameter hybrid functional using the LYP correlation functional, the M06-2X high nonlocality hybrid functional from Thular and Zhao, and the ωB97XD functional from Head-Gordan and coworkers which includes empirical dispersion. The basis sets employed are Dunning and coworkers' correlation consistent basis sets: cc-pVDZ, cc-pVTZ, and cc-pVQZ. We gratefully acknowledge support from the Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry.

Presenting Author: Ryan P. Ivey

Department: Chemistry & Biochemistry

Research Mentor: David H. Magers, PhD

Research Sponsor: Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry

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Poster #5

Regioselectivity of Acid-catalyzed Epoxide Ring-opening Reactions

Chastang, BR and Magers, DH

Epoxide opening reactions occur through two known mechanisms: base catalyzed, in which nucleophilic attack opens the ring, followed by a proton transfer to produce the substituted alcohol, and acid catalyzed, in which the oxirane oxygen is protonated via proton transfer, followed by nucleophilic attack to produce the substituted alcohol. There is little debate about base catalyzed reactions involving the least substituted carbon in the epoxide due to the lack to steric hindrance to nucleophilic attack. Two leading textbook authors, however, disagree about the regioselectivity involving acid catalyzed epoxide opening reaction when the carbons are primary and secondary. Joel Karty asserts that the more substituted carbon is attacked in the acid catalyzed mechanism and offers bond length data to augment his argument. David Klein suggests that the less substituted carbon is attacked when the competing electrophiles are primary versus secondary due to "the steric effect predominating over the electronic effect." To investigate these dissenting opinions, we consider a series of asymmetric derivatives of oxirane. Specifically, the optimized equilibrium geometries of 2-methyloxirane, 2,2-dimethyloxirane, 2,2,3-trimethyloxirane, 2-ethyloxirane, 2,2-diethyloxirane, 2,2,3-triethyloxirane, 2-tert-butyloxirane, and 2,2-di-tert-butyl-oxirane are computed using SCF theory, second-order perturbation theory, and density functional theory. The DFT functionals employed are Becke's three-parameter hybrid functional using the LYP correlation functional, the M06-2X hybrid functional from Thular and Zhao, and the ωB97XD functional from Head-Gordan and coworkers. The basis sets employed are Dunning and coworkers' correlation consistent basis sets, cc-pVDZ and cc-pVTZ. Bond lengths should be indicative of bond strength; thus, the different C-O bonds are compared in each optimized structure and each protonated optimized structure.

Presenting Author: Breanna R. Chastang

Department: Chemistry & Biochemistry

Research Mentor: David H. Magers, PhD

Research Sponsor: Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry

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Poster #6

The Conventional Strain Energies of Cyclopropylborane, Borirane, Boretane, the Diboretanes, Borolane, the Diborolanes, Borinane, and the Diborinanes

Hood, KE; Rocray, RM; Magers, DH

In 2012, Rubina and Rubin reported the first generation and spectroscopic identification of boretane through a strain-release-driven ring expansion of cyclopropylborane. Prior to this

discovery, all four-membered boracycles which had been reported were unsaturated. In the current study, we build upon this discovery by calculating the conventional strain energies of cyclopropylborane , borirane, boretane, 1,2-diboretane, 1,3-diboretane, borolane, 1,2-diborolane, 1,3-diborolane, borinane, 1,2-diborinane, 1,3-diborinane, and 1,4-diborinane within the isodesmic, homodesmotic, and hyperhomodesmotic models. Optimum equilibrium geometries, harmonic vibrational frequencies, and corresponding electronic energies are computed for all pertinent molecular systems using SCF theory, second-order perturbation theory, and density functional theory (DFT). The DFT functionals employed are Becke's three-parameter hybrid functional using the LYP correlation functional and the M06-2X high nonlocality hybrid functional from Thular and Zhao. Three correlation-consistent basis sets are employed: cc-pVDZ, cc-pVTZ, and cc-pVQZ. Results are compared to the conventional strain energies of cyclic hydrocarbons. We gratefully acknowledge support from the Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry.

Presenting Author: Kaylee E. Hood

Department: Chemistry & Biochemistry

Research Mentor: David H. Magers, PhD

Research Sponsor: Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry

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Poster #7

Relative Stabilities of Derivatives of 9-methylanthracene and 9-methylene-9,10-dihydroanthracene and Derivatives of 6-methylpentacene and 6-methylene-6,13-dihydropentacene

Sullivan, EP; Plunkett, AW; Magers, DH

In 1949, Clar and Wright reported that 6-methypentacene exists as 6-methylene-6,13-dihydropentacene at room temperature due to a [1,5]-sigmatropic hydrogen shift (*Nature* 1949, *163*, 921). Thus, the aromaticity of the central ring and the planarity of the overall compound is destroyed by this shift. The same does not occur in anthracene. While the 9-methylene derivative of anthracene is a local minimum, the planar 9-methyl derivative is the more stable. In the current study we investigate if certain derivatives of these anthracene systems stabilize the methylene system relative to the methyl, and if certain derivatives of these pentacene systems stabilize the methyl derivative relative to the methylene. Specifically, nitro and trifluoromethyl derivatives of anthracene are considered, and amino and methoxy derivatives of pentacene are examined. Optimum equilibrium geometries, harmonic vibrational frequencies, and the corresponding zero-point vibrational energies are computed for each set of isomers using density functional theory. The DFT functionals employed are the M06-2X high nonlocality hybrid functional from Thular and Zhao and the ωB97XD functional from Head-Gordan and coworkers which includes empirical dispersion. The basis sets employed are Dunning and coworkers' correlation consistent basis sets

cc-pVDZ and cc-pVTZ. We gratefully acknowledge support from the Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry.

Presenting Author: Emily P. Sullivan

Department: Chemistry & Biochemistry

Research Mentor: David H. Magers, PhD

Research Sponsor: Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry

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Poster #8

Ab Initio Analysis of Polarizability in Molecular Piezoelectric Response for Organic Dimer Systems

Zetterholm, DL; Magers, DH

In seeking to describe macroscale piezoelectric response, having a better understanding of piezoelectric response at the single-molecule level is a necessity. In the case of organic molecules, there are millions of possible candidates which possibly have the desired properties, revealed in the magnitude of the d_{33} coefficient. In seeking to extend research done by Daniel Lambrecht and co-workers which discovered a possible relationship between first-order polarizability of a molecule and its piezoelectric response (d_{33}), the current study seeks first to confirm this relationship with different levels of computational theory and to extend the previous work to application, where new molecules with even higher responses can be designed from principles discovered in the calculations. These results specifically take the calculations from Arun Gagrai and coworkers' previous results and model them in the Hartree Fock level of theory to see if the relationship is maintained, and then consider the extension of period 16 of the Periodic Chart to see if the relationship is maintained for heavier atoms, for which relativistic effects would need to be considered for in their computation, using tailored basis sets and effective core potentials. We gratefully acknowledge support from the Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry.

Presenting Author: David L. Zetterholm

Department: Chemistry & Biochemistry

Research Mentor: David H. Magers, PhD

Research Sponsor: Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry

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Poster #9

Conventional Strain Energies of Thiaziridine and the Thiazetidines

Gramm, JD; Magers, DH

The conventional strain energies for thiaziridine, 1,2-thiazetidine, and 1,3-thiazetidine are determined within the isodesmic, homodesmotic, and hyperhomodesmotic models to investigate the effect of third-row elements on the strain energies of three- and four-membered rings. Optimum equilibrium geometries, harmonic vibrational frequencies, and corresponding electronic energies are computed for all pertinent molecular systems using self-consistent field (SCF) theory, second-order perturbation theory (MP2), and density functional theory (DFT). The DFT functionals employed are Becke's three-parameter hybrid functional using the LYP correlation functional and the M06-2X high nonlocality hybrid functional from Thular and Zhao. The basis sets employed are Dunning and coworkers' correlation consistent basis sets: cc-pVDZ, cc-pVTZ, and cc-pVQZ. In addition, cc-pV(D+d)Z, cc-pV(T+d)Z, and cc-pV(Q+d)Z basis sets are also investigated to determine the effect of the extra *d* function for sulfur on the overall results. Results are compared to the conventional strain energies of small cyclic hydrocarbons and to other heterocyclic systems. We gratefully acknowledge support from the Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry.

Presenting Author: Joshua D. Gramm

Department: Chemistry & Biochemistry

Research Mentor: David H. Magers, PhD

Research Sponsor: Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry

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Poster #10

A New Extraction and Quantification Method to Detect Polystyrene Plastics in Biological and Environmental Samples

Stokes, C, Melton, S, Sisson, L, Cevallos, A, Harris, A, Holmes, M, McCormick, C, Schuler, W, Sullivan, E, Ivey, R, Selby, T, and Hearst, S

Plastic pollution is a major global problem impacting every environment around the world. Many plastics are resistant to degradation due to their unique chemical structures allowing plastics to accumulate in the environment. For these reasons, biodegradation of plastic waste is a major area of research that receives great attention from scientists worldwide. New research has shown that insect larvae from the darkling beetle family (*Coleoptera: Tenebrionidae*) can ingest and degrade plastic waste such as Polystyrene (PS) foam. A major challenge for studying biodegradation of PS by insects is the lack of an accurate extraction and quantitative method to measure PS levels in

frass. In this study, we developed a new method to extract and detect PS in the frass of insects and from soil samples. PS was purified from insect frass using density separation and centrifugation techniques. To confirm the accuracy of this new method, QA/QC analysis was performed using recovery rates of laboratory control samples (LCS) and matrix spikes (MS). We also tested this new technique to measure PS levels in soil samples collected at littering sites where trash and plastic waste has accumulated. We demonstrated the importance of the density separation step of our new method for PS detection using contaminated soil samples Overall, we have developed a new technique to extract and quantify PS in biological and environmental samples. We speculate that this simple technique will allow scientists to measure PS in environmental samples and help contribute to a solution to the world's PS plastic pollution problem.

Presenting Author: Claire Stokes

Department: Chemistry & Biochemistry

Research Mentor: Scoty Hearst, PhD

Research Sponsor: Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry

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Poster #11

Chemical Analysis and Biotoxicity Assessment of Plastic Bioremediation Using *Tenebrio molitor* Larvae

Sisson, L, Stokes, C, Melton, S, Selby, T and Hearst, S

Plastic pollution is a worldwide environmental problem impacting ground water, rivers, oceans, soils, and landfills. Many plastics take anywhere from 20 to 500 years to decompose allowing plastic pollution to accumulate in the environment adversely affecting wildlife, wildlife habitats, and humans. Recent research has found that the larvae of *Tenebrio molitor* can consume and degrade the common plastic polystyrene. In this study, we examine the bioremediation potential of *Tenebrio molitor* larvae for other common plastics such as: Polyethylene Terephthalate, High Density and Low Density Polyethylene, Polyvinyl Chloride, Polypropylene, as well as various forms of polystyrene. *Tenebrio molitor* larvae were fed different types of plastics and their plastic consumption rates and growth rates were determined. Insect tissues and waste products were analyzed for physical and chemical biodegradation of plastics using Fourier-transform infrared spectroscopy alongside UV spectroscopy. Using a new technique, we purified polystyrene from *Tenebrio molitor* frass material and quantified the percentage of polystyrene in fras. Larvae showed a significant preference for polystyrene as compared to other types of plastic. *Tenebrio molitor* larvae also preferred polystyrene plastic as compared to polystyrene foam. In fras samples, polystyrene plastic was more degraded as compared to polystyrene foam when normalized to polystyrene consumption weights. Taken together, the feasibility of plastic bioremediation using *Tenebrio molitor* larvae seems to be plastic specific. Use of insects in bioremediation is a growing

concept with great potential as a green chemistry solution to the worldwide plastic pollution problem.

Presenting Author: Lillian Sisson

Department: Chemistry & Biochemistry

Research Mentor: Scoty Hearst, PhD

Research Sponsor: Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry

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Poster #12

Analysis of the MSH2 Gene for Diagnosis and Risk of HNPCC

Bridgewater, DR, Hanna, M, Le, JK, Whitworth, TM, Ceasor, CM, Coleman, SA, Edwards, LN, Ellison, XJ, Hasley, JA, Jones, JP, Kazadi, MM, Kunwar, K, Patel, SC, Raj, I, Zaitar, AS, Phillips, MP, and Whittom Reiken, AA

Hereditary Non-polyposis Colorectal Cancer (HNPCC) accounts for about 3% of the individuals diagnosed with colon cancer. Using polymerase chain reaction (PCR), restriction enzyme digestion, and gel electrophoresis techniques, we assessed colon cancer risk through identifying gene markers related to HNPCC in patient samples. Nine patient samples were tested for the presence of a mutation in the MSH2 gene, a gene highly associated with HNPCC. By comparing results to three controls, there were 6 patients identified to be heterozygous for the specific MSH2 mutation associated with HNPCC. These patients were recommended for additional testing for other indicators of HNPCC.

Presenting Author: DeKayla Bridgewater

Department: Biological Sciences

Research Mentor: Angela A. Whittom Reiken, PhD

Research Sponsor: Mississippi College Department of Biological Sciences

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Poster #13

Establishing a *Drosophila melanogaster* Model for Studying the Effects of Dietary Lipids on Growth, Development and Behavior

Grewe RL, Tullos EL, Coleman MM, Chhetry AG, Martin DS, Riley JW and Reagan JW

Unlike vertebrate animals, which are able to synthesize cholesterol, insects are cholesterol auxotrophs. Consequently, an exogenous source of sterol is required for successful progression through the larval stage of development. Therefore, to examine potential mechanistic links between dietary lipids, developmental milestones and survival behaviors, we maintain a colony of wild-type (Oregon R strain) *D. melanogaster* on a chemically defined diet that contains 11.50 g/L essential amino acids, 8.12 g/L nonessential amino acids, 78.4 g/L carbohydrates (sucrose, glucose, trehalose, lactose), 0.87 g/L lipids, 1 g/L RNA, 0.50 g/L DNA, and 3.20 g/L micronutrient mix (standard diet). To determine the effect of cholesterol starvation on larval development, synchronous eggs, obtained from flies maintained on the standard diet were transferred to diets that were identical to the standard diet except for the absence (0 %) or presence of cholesterol (0.05%). Six days later the larvae were collected, photographed and stored at -80^{o}C for further analysis. Prior to storage, mass was determined for several larvae from each dietary condition on a Sartorious analytical balance. In the absence of dietary cholesterol, larvae mass was reduced by 55% (0.1198 $\pm$ 0.016 µg vs 0.2662 $\pm$ 0.014 µg). Larvae size, determined by length at the midline of the longitudinal axis, although more variable than mass, was similarly affected. These data demonstrate that our laboratory has successfully modified a commercially available diet which allows for the design of experiments to test the effects of dietary lipids on relevant parameters related to growth and development of *D. melanogaster* larvae.

Presenting Authors: Rebecca L. Grewe and Ethan L. Tullos

Department: Biological Sciences

Research Mentor: Jerry W. Reagan, PhD

Research Sponsor: Mississippi College Department of Biological Sciences

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Poster #14

Detection of a Shared Single Nucleotide Polymorphism of the C, V, and Z Haplogroups within the Human Mitochondrial Genome

Phillips, MP, Lane, JA, Herring, JB, Ho, HT, Mays, AS, Patterson, LL, Price, JC, Tchuenkam, LM, Watkins, D, and Whittom Reiken, AA

Within the human mitochondria (mt) genome, Hypervariable Regions (HVR1, HVR2, and HVR3) in the control region have a high mutation rate, resulting in numerous Single Nucleotide Polymorphisms (SNPs). Detection of haplotypes (various combinations of SNPs) within HVR1 and HVR2 are commonly used for human genealogical testing. A group of similar haplotypes (SNPs) that share a common ancestor are known as a haplogroup. In addition to DNA sequencing, Polymerase Chain Reaction (PCR) in combination with restriction enzyme analysis can be used to verify the presence of specific SNPs. Given a specific set of primer sequences and the specific MseI restriction endonuclease prior to experimentation, our first task was to explore bioinformatics resources to determine the region of mtDNA that would be amplified by the PCR primers and identify the associated SNP recognized by MseI and its associated haplogroups. Expected band

sizes for both the presence and absence of the specific SNP were calculated. The sequence to be amplified by PCR was determined to be within HVR1. We located the SNP recognized by MseI and found it is commonly associated with haplogroups C, V, and Z. Next, using buccal cells, we isolated DNA, performed PCR to amplify the previously determined region of mtDNA, and performed MseI restriction enzyme analysis. The presence or absence of the SNP recognized by MseI was determined based on a combination of our bioinformatics data and results of laboratory experiments. Analysis of additional unique SNPs will be required to confirm the specific haplogroups.

Presenting Author: Makenzie P. Phillips

Department: Biological Sciences

Research Mentor: Angela A. Whittom Reiken, PhD

Research Sponsor: Mississippi College Department of Biological Sciences

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Poster #15

ELISA Analysis for the Presence of HIV Antibodies

Phillips, MP, Lane, JA, Herring, JB, Ho, HT, Mays, AS, Patterson, LL, Price, JC, Tchuenkam, LM, Watkins, D, and Whittom Reiken, AA

Enzyme-linked immunosorbent assay (ELISA) is considered to be the standard of immunoassays. ELISA is used to detect and quantify substances such as antibodies, antigens, proteins, bacteria, and viruses. We used ELISA to test several patient samples for HIV antibodies followed by qualitative and quantitative analysis of the data. Positive or negative diagnoses for the patient samples were determined by comparing the data to positive and negative controls.

Presenting Author: Makenzie P. Phillips

Department: Biological Sciences

Research Mentor: Angela A. Whittom Reiken, PhD

Research Sponsor: Mississippi College Department of Biological Sciences

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Poster #16

Analyzing Hereditary Non-Polyposis Colorectal Cancer Inheritance Within Family Members

Coleman, SA, Hasley, JA, Jones, JP, Kazadi, MM, Raj, I, Bridgewater, DR, Ceasor, CM, Edwards, LN, Ellison, XJ, Hanna, M, Kunwar, K, Le, JK, Patel, SC, Whitworth, TM, Zaitar, AS, Phillips, MP, and Whittom Reiken, AA

Hereditary Non-Polyposis Colorectal Cancer (HNPCC), aka Lynch Syndrome, is a type of colorectal cancer that affects the colon and rectum. It occurs when both copies of one of the four "caretaker" genes are mutated. Pedigree studies based on HNPCC have demonstrated that the genetic inheritance in families is autosomal dominant. We gathered the family history of a patient having family members diagnosed with HNPCC. The family history was organized into a pedigree to determine HNPCC inheritance and whether family members should be screened for cancer. We found that the pedigree indicates that HNPCC is inherited within the family in an autosomal dominant manner and that this patient is at risk for developing HNPCC. It was our recommendation that the patient and family members seek genetic testing and annually screen for HNPCC.

Presenting Authors: Saisha A. Coleman and Jadyn A. Hasley

Department: Biological Sciences

Research Mentor: Angela A. Whittom Reiken, PhD

Research Sponsor: Mississippi College Department of Biological Sciences

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Poster #17

Evaluation of a Single Nucleotide Polymorphism in the Human TAS2R38 Gene to Predict Bitter Tasting Ability

Herring, JB, Price, JC, Ho, HT, Lane, JA, Mays, AS, Patterson, LL, Phillips, MP, Tchuenkam, LM, Watkins, D, and Whittom Reiken, AA

Humans can differentiate sweet, salty, sour, bitter, and umami tastes. The inability to taste bitter molecules is variable recessive trait within the human population and there are about thirty different genes for bitter taste in mammals. The specific gene for the human Phenylthiocarbamide (PTC) receptor cell, TAS2R38, has three different nucleotides that correlate to different intensities of the bitter taste of PTC. We used NCBI BLAST to identify and align the AY258598.1 PTC taster and AY258597.1 PTC non-taster DNA sequences and located the three nucleotide positions in TAS2R38 that vary within the human population. Given a specific set of Polymerase Chain Reaction (PCR) primer sequences and the HaeIII restriction enzyme, we determined the sequence recognized by HaeIII as GGCC and identified the DNA sequence to be amplified by the PCR primers, including the nucleotide at position 145 associated with PTC tasting within the amplified region. The forward primer, designed to introduce a G nucleotide mutation during amplification, results in the GGCC sequence only in the taster allele. HaeIII recognizes the GGCC restriction site, resulting in two taster allele DNA fragments. Introduction of the mutation within the amplified sequence of the non-taster allele results in the GGGC sequence, so it remains uncut by HaeIII. Expected band sizes for both the presence and absence of the GGCC sequence were calculated.

Using PCR and restriction enzyme analysis, we determined the presence or absence of nucleotide 145 in DNA isolated from buccal cells and compared the results to corresponding PTC paper taste tests.

Presenting Authors: Joseph C. Price and
J. Bryden Herring

Department: Biological Sciences

Research Mentor: Angela A. Whittom Reiken, PhD

Research Sponsor: Mississippi College Department of Biological Sciences

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Poster #18

The Impact of Predator Activity and Demographics on White-tailed Deer Social Networks

Johnson, B, Rummells, E, and Hearst, S

White-tailed Deer (Odocoileus virginianus) are medium-sized ungulates native to North and South America. White-tailed Deer display a wide range of social networking behaviors and create social networking sites called scrapes in their environment by rubbing or licking trees, scrapping the ground with their hooves, and by marking the ground with their scent. In our previous study, we described a new method to examine White-tailed Deer social networks using scraping behavior. In this study, we examine how different factors such as predator activity and male demographics influence scraping networks in distinct rural study sites. Our data suggests that predator activity in the form of coyotes, feral dogs, and human hunting activity can drastically impact White-tailed Deer social networks. We compare how predator activity impacts scraping activity and shapes scraping networks. These factors, especially hunting activity, can also influence the demographics of social networks. Here, we show how social demographics among males can influence network activity and overall network density. Our modeling data suggests that male network density is a major factor that can influence the spread of communicable diseases, such as Chronic wasting disease (CWD) in White-tailed Deer. This is due to the fact that male White-tailed Deer are infected three times more often than as compared to females and that males scrape more than females. Overall, we suggest that predator activity and male demographics are important factors that shape White-tailed Deer social networks. Also, these factors influence network density, which could significantly impact transmission of communicable diseases like CWD.

Presenting Author: Bryant Johnson

MC Department: Biological Sciences

Research Mentor: Scoty Hearst, PhD

Research Sponsor: Mississippi College Department of Chemistry and Mississippi College School of Science & Mathematics Office of Research

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Poster #19

The Role of Matrix Metalloproteinases in the Neurodegenerative Polyglutamine Disease Spinocerebellar Ataxia Type 1

Melton, S, Burton, M, Carpenter, K, Sisson, L, and Hearst, S

Spinocerebellar ataxia type 1 (SCA1) is a fatal neurodegenerative disease caused by a polyglutamine mutation in the ataxin-1 protein. Currently, there is no treatment for SCA1. SCA1 mice display similar neurodegeneration as SCA1 human patients and are the model of choice for exploring treatments for the SCA1 disease. Matrix metalloproteases (MMPs) are present in many cells of the central nervous system. MMPs are endopeptidases that once activated participate in the regulation of diverse physiological and pathological processes. MMPs have gained much attention as therapeutic targets in neurodegenerative disorders due their key role in neuroinflammation, and their destructive degradation of the blood brain barrier. MMPs have been shown to be a therapeutic target in other polyglutamine diseases such as Huntington's disease. MMPs have been shown to degrade the Huntingtin protein contributing to the neurodegenerative pathology. In this study, we explored the role of MMPs in the SCA1 disease using cell culture and the SCA1 mouse model. Cell culture experiments revealed a possible role of MMPs in the proteolysis of mutant atxin-1 aggregates. Transcriptome analysis of the SCA1 mouse cerebellum revealed significant upregulation of destructive MMPs as compared to WT mice. Currently, we are testing the efficacy of MMP inhibitors in SCA1 mice. As this study progresses, we will test for improvements in neurodegenerative behavior deficits, changes in key neuronal proteins, and a reduction in histological markers of SCA1 neurodegeneration. Completion of this study may reveal that MMPs are possible therapeutic targets that may play a pathogenic role in the SCA1 disease.

Presenting Author: Sydney Melton

MC Department: Biological Sciences

Research Mentor: Scoty Hearst, PhD

Research Sponsors: Mississippi INBRE from the National Institutes of Health under grant number P20GM103476, Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry

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Poster #20

Analysis of Rural White-tailed Deer Scraping Networks to Model the Spread of Communicable Disease

Rummells, E, Johnson, B, and Hearst, S

Odocoileus virginianus (White-tailed Deer) are social animals that thrive in rural and urban settings. Scraping behavior is an olfactory reproductive communication used by White-tailed Deer to establish breeding networks. Male scraping is a complex scent-marking behavior which advertises sociosexual status and location to potential females as well as to competing males. These scent markers are produced in body fluids such as urine, saliva, and glandular secretions released by males onto scrape sites. Chronic wasting disease (CWD) is a fatal, contagious, prion disease occurring in cervids. Infection rates for CWD in male White-tailed Deer are 3 times higher as compared to females. We speculate that the body fluids left at scrape sites are potential modes of CWD male transmission due to the fact that males scrape more often than females, and that multiple males visit the same scrape. In our previous work, we demonstrated disease transmission through an urban network of male White-tailed Deer. Here, we demonstrate the first rural scraping network by combining scraping data from multiple study sites in Yazoo County, MS, spread over 6 miles. Using network analysis, we demonstrate the major types of potential super spreaders. We also documented a case of cutaneous fibromas and demonstrate how these papillomaviruses could potentially spreads through a scraping network from the infected male. This work also demonstrates the future applications of this method for predicting the spread of communicable diseases like CWD or other infectious diseases in rural populations of White-tailed Deer.

Presenting Author: Elijah Rummells

MC Department: Biological Sciences

Research Mentor: Scoty Hearst, PhD

Research Sponsor: Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry

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Poster #21

Construction and Testing of an Electronic Avian Deterrent Device (E.A.D.D.) for Catfish Farms Impacted by Flooding

Dixon, Z, Moore, K, Mills, D, Grant, R, Banerjee, S, Laiju, M, and Hearst, S

Flooding has become a major problem for Mississippians in the past few years, especially for the Mississippi catfish farmers. The Mississippi Delta was hit hard with around 200,000 acres impacted by flooding in June of 2019. Although the flood waters have receded, new problems have emerged making recovery from the flooding disaster more difficult for catfish farmers. A new aquatic habitat produced by flooding attracted more avian pests to the Mississippi Delta region. This increase in avian pest activity has left catfish farmers and their catfish-crops vulnerable causing a huge financial burden to farmers and the catfish industry as a whole. To help reduce this burden, we have built an electronic avian deterrent device (E.A.D.D.), that would be a more long-

term and sustainable solution to the avian pest problems harming catfish farmers recovering from the recent flooding disaster. Here, we detail the construction and field testing of our E.A.D.D. We tested the efficiency in deterring catfish-eating wading birds such as Egrets and Herons away from catfish ponds over a 26-day survey period. Overall, we found that the use of our E.A.D.D. significantly reduced the number of avian pests and was more effective than the current deterrent methods. With further research and development, we suggest that our prototype E.A.D.D. could ideally be used to create a non-lethal bird deterrent device useful for reducing catfish predication from wading birds on catfish farms and ultimately improve crop yields for catfish farmers impacted by seasonal flood related avian pests.

Presenting Author: Zachary Dixon

MC Department: Biological Sciences

Research Mentor: Scoty Hearst, PhD

Research Sponsors: The U.S. Department of Homeland Security under Grant Award Number 2015-ST-061-ND0001-01, Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry

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Poster #22

Test anxiety is associated with a decreased error-related negativity in tasks requiring top-down and bottom-up attention

Matkins, HT and Bourassa, E

On electroencephalography (EEG), an incorrect motor response is followed by a sharp negative deflection most prominent in the central cortex. This error-related negativity (ERN) has been shown to be more pronounced in people with anxiety. The attentional control theory of anxiety posits that a decrease in top-down attentional control (TDAC) causes an increase in bottom-up attentional capture (BUAC), and previous work in our lab has shown that this is true in students with test anxiety (TA). This study hypothesized that students with TA would have a larger ERN than students without TA and that the change in ERN would be larger in tasks requiring TDAC. EEG was measured from students with and without TA during a modified go/no-go task utilizing either TDAC or BUAC. The ERNs were smaller in participants with TA compared to participants without TA and in the BUAC compared to the TDAC condition. Event-related spectral perturbations (ERSPs) over the central cortex in students without TA showed that committing an error caused a significant decrease in early theta power followed by a decrease in alpha power compared to correct trials; these differences were not seen in students with TA. Also, on error trials, students with TA had decreased low-beta power compared to students without TA. These data suggest that in students with TA, conflict monitoring may be hypofunctional and therefore goal-oriented behavior may be less amenable to correction.

Presenting Author: Hunter T. Matkins

Department: Biological Sciences

Research Mentor: Erick A. Bourassa, PhD

Research Sponsor: Mississippi College Department of Biological Sciences

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People's Choice Awards – Physical Sciences
Fall 2021 Mississippi College STEM Research Symposium

During the symposium, attendees voted for their favorite poster presentations for the "People's Choice Awards" sponsored by the Mississippi College Office of Research. 1st, 2nd, and 3rd place presenters were awarded $50, $30, and $20, respectively with an award certificate. Congratulations scholars!

Kaylee Hood

1st Place Physical Sciences

The Conventional Strain Energies of Cyclopropylborane, Borirane, Boretane, the Diboretanes, Borolane, the Diborolanes, Borinane, and the Diborinanes

MC Department: Department of Chemistry & Biochemistry

Research Mentor: David H. Magers, PhD

Research Sponsor: Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry

Lillian Sisson

2nd Place Physical Sciences

Chemical Analysis and Biotoxicity Assessment of Plastic Bioremediation Using Tenebrio molitor Larvae

MC Department: Department of Chemistry & Biochemistry

Research Mentor: Scoty Hearst, PhD

Research Sponsor: Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry and Mississippi College School of Science & Mathematics Office of Research

Bailey Steen

3rd Place Physical Sciences

Preparation of Macrocyclic Polyphenylethynylarene Ethers

MC Department: Department of Chemistry & Biochemistry

Research Mentor: Trent D. Selby, PhD

Research Sponsor: Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry

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Hunter Matkins

1st Place Biological Sciences

Test anxiety is associated with a decreased error-related negativity in tasks requiring top-down and bottom-up attention

MC Department: Department of Biological Sciences

Research Mentor: Erick A. Bourassa, PhD

Research Sponsor: Mississippi College Department of Biological Sciences

Makenzie Phillips

2nd Place Biological Sciences

Detection of a Shared Single Nucleotide Polymorphism of the C, V, and Z Haplogroups within the Human Mitochondrial Genome

MC Department: Department of Biological Sciences

Research Mentor: Angela A. Whittom Reiken, PhD

Research Sponsor: Mississippi College Department of Biological Sciences

Joseph Price & Bryden Herring

3rd Place Biological Sciences

Evaluation of a Single Nucleotide Polymorphism in the Human TAS2R38 Gene to Predict Bitter Tasting Ability

MC Department: Department of Biological Sciences

Research Mentor: Angela A. Whittom Reiken, PhD

Research Sponsor: Mississippi College Department of Biological Sciences

MDAA Research Awards
Fall 2021 Mississippi College STEM Research Symposium

The Medical Dental Alumni Association (MDAA) sponsored two overall research project awards and the research teams associated with each project was presented with $250 and a plaque during the MDAA meeting in 2022.
Congratulations scholars!

Grewe RL, Tullos EL, Coleman MM, Chhetry AG, Martin DS, Riley JW and Reagan JW

Presented by Rebecca L. Grewe and Ethan L. Tullos

Establishing a Drosophila melanogaster Model for Studying the Effects of Dietary Lipids on Growth, Development and Behavior

MC Department: Department of Biological Sciences

Research Mentor: Jerry W. Reagan, PhD

Research Sponsor: Mississippi College Department of Biological Sciences

Gramm, JD and Magers, DH

Presented by Joshua D. Gramm

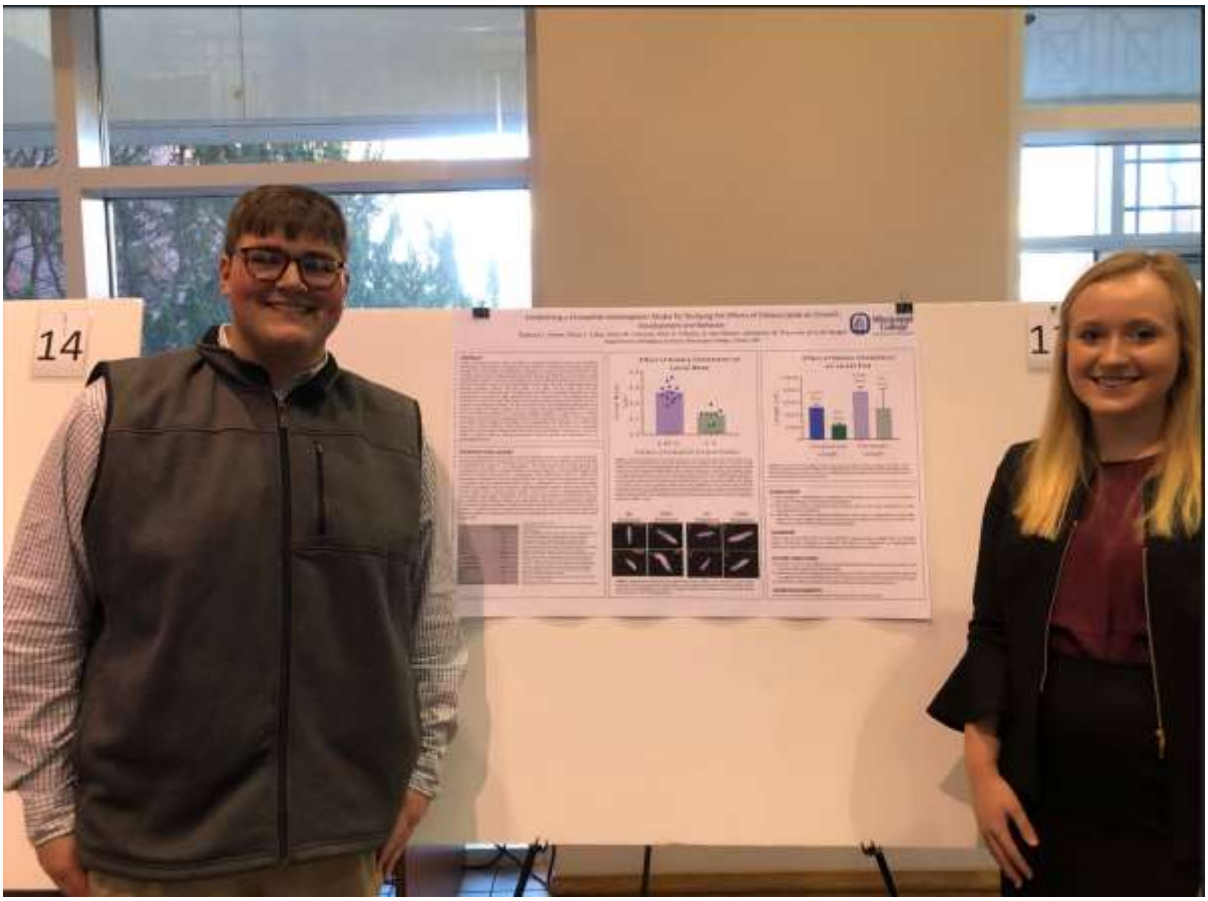
Conventional Strain Energies of Thiaziridine and the Thiazetidines

MC Department: Department of Chemistry & Biochemistry

Research Mentor: David H. Magers, PhD

Research Sponsor: Mississippi College Catalysts, the alumni support group of the Department of Chemistry & Biochemistry

Event Photos
Fall 2021 Mississippi College STEM Research Symposium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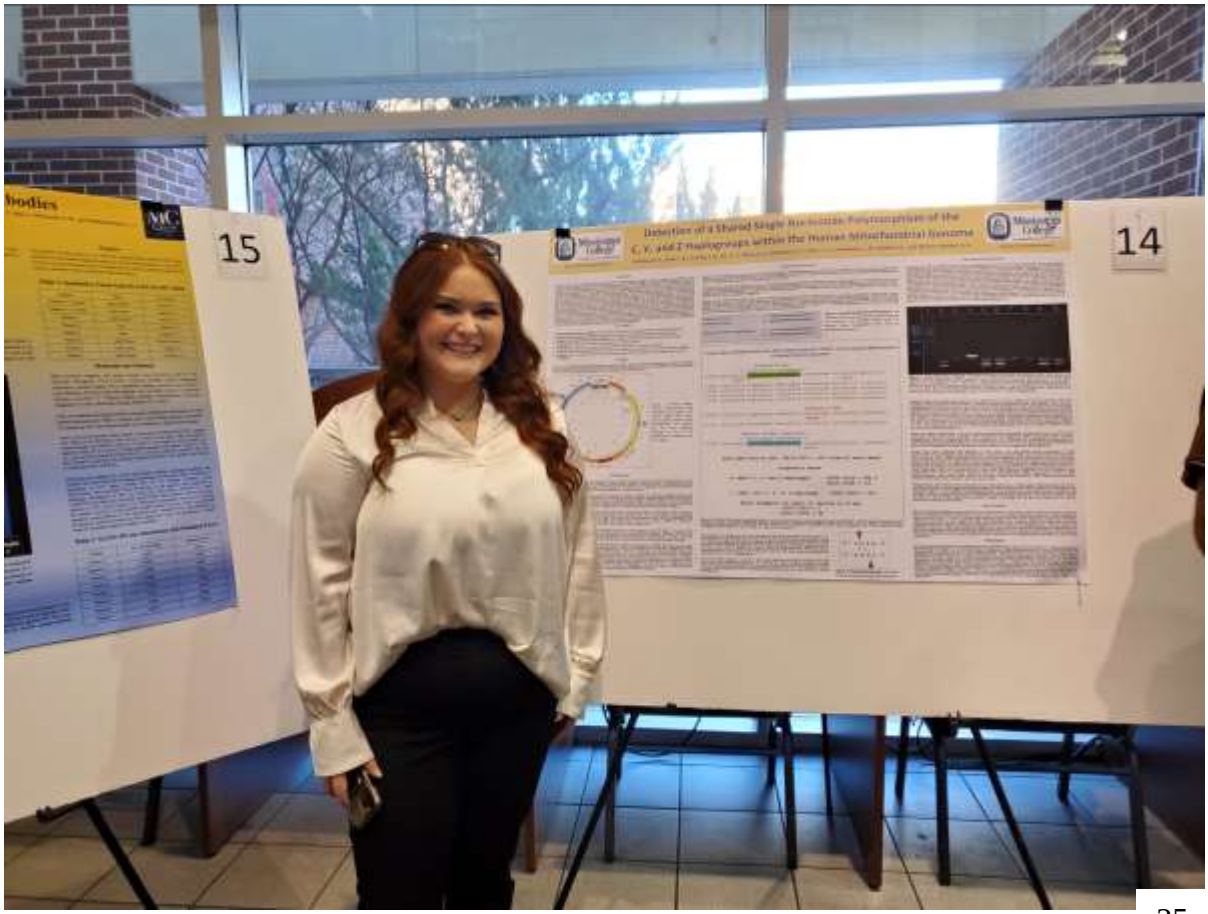
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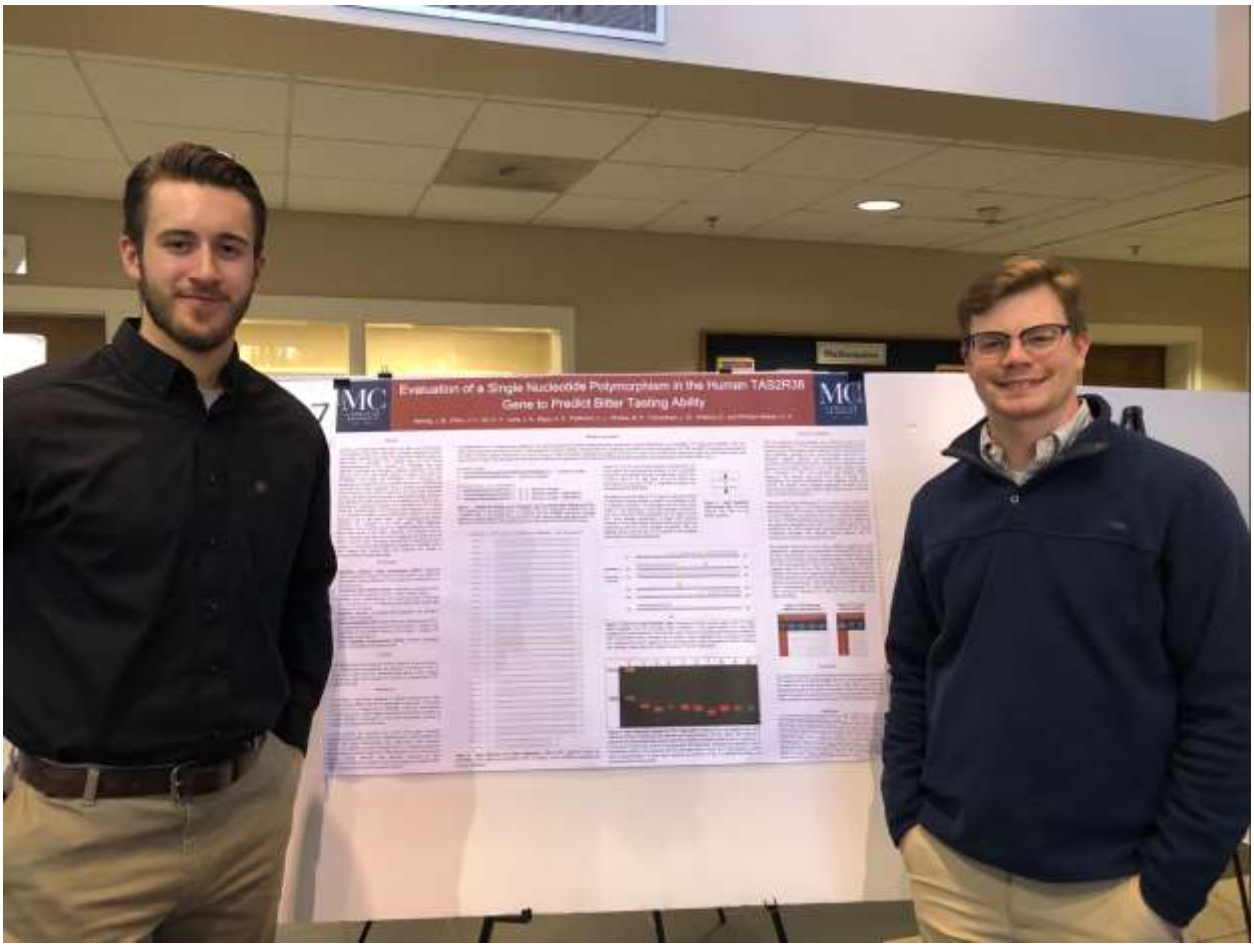
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Gene to Predict Bitter Tasting Ability