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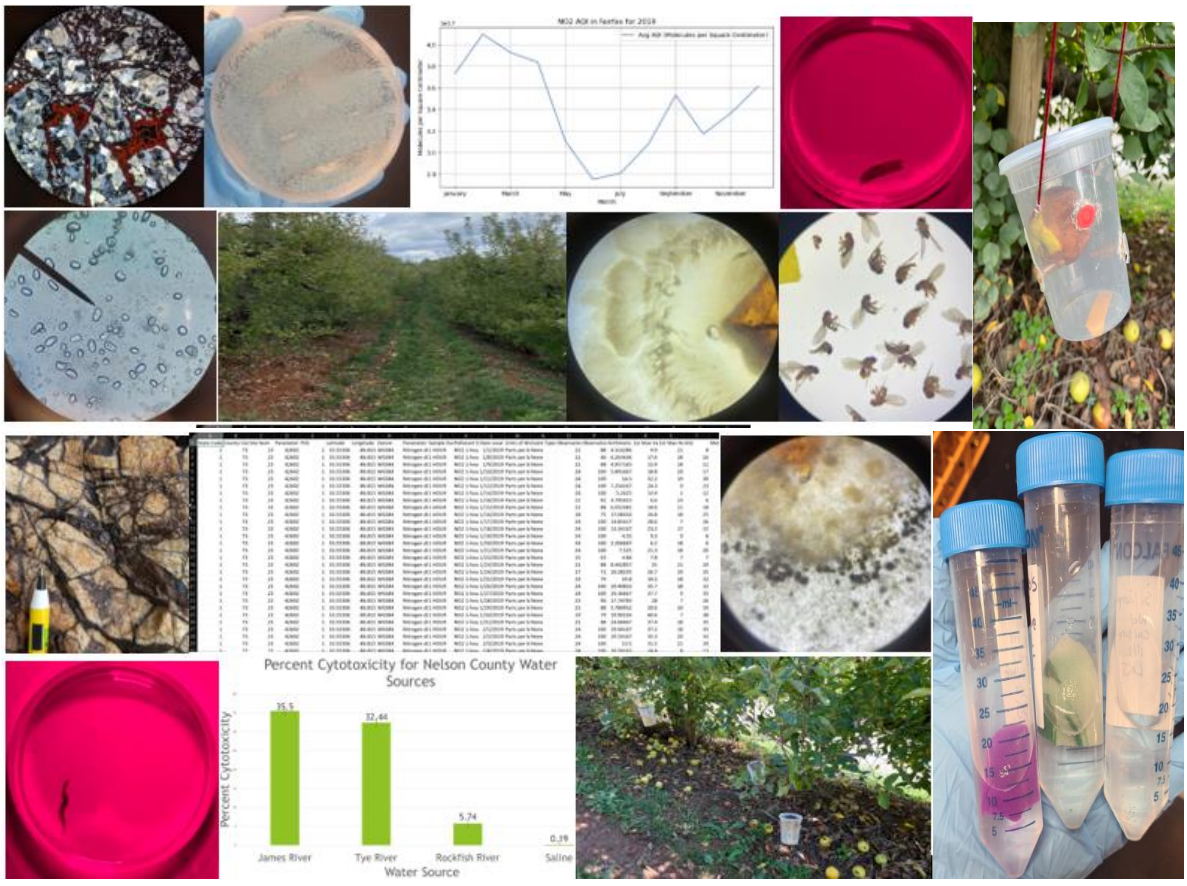
PIEDMONT VIRGINIA COMMUNITY COLLEGE

2023 Fall Science Poster Symposium

SCIENCE 299 Independent Research Abstract Booklet

Science 299 projects are semester-long independent research projects done by students pursuing an A.S. in Science. Students complete this course as a requirement for graduation. Students complete their research under the guidance of PVCC science faculty mentors.



Mara Cox-Geology 299

Origin of breccia in Antietam Formation, western Blue Ridge, Virginia

A crushed-up rock, breccia, marks the western front of the Blue Ridge Mountains. Breccia is formed through the fracturing of another rock type and cementation of the resulting angular fragments. Pieces of the fractured rock are called clasts, and the material cementing them together is termed matrix. This study examines breccias formed within Cambrian-aged quartzite of the Antietam Formation. Two compositions of matrix can be found in these breccias: a silica matrix and one made from iron and manganese oxides. Research geologists have theorized that these breccias were formed through faulting and are therefore fault breccia. However, some breccias show textural characteristics which are inconsistent with faulting alone, including a texture where many large clasts "float" untouching, separated by wide zones of matrix. I decided to test the hypothesis that these samples are fault breccias. I observed bedrock outcrops and collected samples at three locations: (1) south of Elkton, Virginia, (2) in the bedrock streambed of Naked Creek south of Stanley, Virginia, and (3) adjacent to a stream northeast of Luray, Virginia. These samples were then compared to the common characteristics of fault breccias and other documented breccia textures, which included breccias formed through hydraulic fracturing. I visited the United States Geological Survey in Reston, Virginia to speak with researchers there. In consultation with Dan Doctor, I was able to examine thin sections of Antietam breccias, and to document key microtextural characteristics via photography. We were able to clearly differentiate four different generations of matrix, which we were able to correlate across samples. Will Odom shared Ar/Ar dates of one mineral from the most recent generation of Fe/Mn cemented breccia, the potassium manganese oxide cryptomelane. Odom's dates were surprisingly young, ranging from 36 to 2 Ma (million years ago). This is far more recent than the putative faulting which emplaced Blue Ridge rocks atop Valley & Ridge carbonates during the Alleghanian Orogeny (~300 to 250 Ma). Odom's cryptomelane forms only in the uppermost 100 meters of the crust, where meteoric water is capable of oxidizing iron and manganese. We created a multistage model for the formation of various cements within these samples. The model involves both the grinding action of traditional faulting as well as low-pressure implosion sites, dubbed rhombochasms, where slight jogs along the fault trace opened up zones of dilation. The breccias with textures featuring clasts touching one another are interpreted to have formed along the tabular stretches of the fault, while the "clasts floating" texture is interpreted as having formed due to hydraulic fracturing within the rhombochasms. Initially, both textures would have been cemented by silica gel. Later, as uplift removed the overlying rock mass, the Antietam breccias got closer to Earth's surface. Once they got within 100 meters of the surface, meteoric water was able to soak into the breccias and replace the silica cement with iron and manganese oxides. This happened at least twice, based on the evidence of multiple distinct iron/manganese oxide cements. The youngest cement has been dated (36-2 Ma) and constrains the timing of when the Antietam breccias rose to that depth. The initial hypothesis of these being fault breccias was still plausible, though a fuller picture has now emerged that accounts for variations in texture due to slight variations in the orientation of the fault zone and variations in cement via multiple cycles of fluid infiltration, dissolving and replacing breccia cements.

Faculty Advisor: Mr. Callan Bentley

Gwynyth Hansen – Biology 299

Qualitative Analysis of Endophytic Fungi Composition Based on Morphology in Live Leaves versus Dying (Red) Leaves of White Oak and Red Maple

Endophytes are microscopic organisms, usually bacteria, fungi, or protists that form a symbiotic relationship inside a larger organism. Foliage Endophytic Fungi are fungi that live inside of a plant's leaf and are known to produce secondary metabolites that can de-stress a plant or protect it from other potential microbial pathogens. This allows the plant to live in more stressful conditions. Currently, there is no published research on the Endophytic Fungi belonging to central Virginia's native plants. Many of the trees native to Virginia are deciduous; their leaves change colors, die, and abscess from the tree during autumn. Since there are fungal endophytes living in the leaves, the question is how the composition of the fungal endophytes changes between a healthy green leaf, and a dying leaf prior to abscission. The hypothesis of this experiment is that there is a difference in the morphological growths of fungi cultured between living and dying leaves collected from the same tree at the same time. This was tested by surface-sterilizing sampled leaves from *Acer rubrum* and *Quercus alba* and plating the leaves on agar that promotes fungal growth. The morphological features of the fungal growths cultured were then categorized to observe potential differences. It was found that the dying leaves had a more diverse array of fungal growths, indicating there was a difference between the composition of fungal endophytes depending on leaf health. It was also found that in the White Oak, there was a significant difference in the number of fungal growths per plate, with the dying leaves having more growths on each plate compared to the living leaves. This supports the hypothesis and is a first look into the fungi that help support our native trees of central Virginia.

Faculty Advisor: Dr. Marlena Yost

Andrew Hazelwood – Biology 299

Evaluating the Effects of Collagen Peptides on Glutamate-induced Hyperactivity in Planarians (Schmidtea mediterranea): A Behavioral Analysis

Freshwater planarians, increasingly recognized in brain research for their regenerative abilities and relevance in drug abuse studies, were utilized to explore the potential neuroprotective role of collagen in mitigating hyperactivity induced by glutamate. The study aimed to replicate previous findings that demonstrate increased activity in planarians in response to glutamate and assess the neuroprotective effects of collagen peptides, hypothesizing that pretreatment with collagen peptides would reduce glutamate-induced hyperactivity. Planarians exposed to glutamate exhibited increased hyperactivity, while pretreatment with collagen peptides appeared to mitigate this effect. The results suggest a potential protective role of collagen against glutamate-induced hyperactivity. Planarians, due to their straightforward centralized nervous system, are less susceptible to confounding variables and serve as an excellent model for evaluating pharmacological agents. Future studies could concentrate on specific types of collagen peptides

and investigate additional compounds for neuroprotection in planarians. Thanks are extended to Professor Anne Allison and Ms. Gwyn Puckett for their guidance in this research project.

Faculty Advisor: Dr. Anne Allison

Andrew Holstein – Chemistry 299

Analysis of Nitrogen Dioxide Pollution in Fairfax, VA: Pre-, During and Post-COVID

Nitrogen dioxide (NO_2) is a member of oxides of nitrogen (NO_x) and one of the common air pollutants. High concentrations of NO_2 adversely impact both human health and the surrounding environment. This research investigates NO_2 pollution levels over Fairfax, Virginia, focusing on the impact of the COVID-19 lockdown on emissions in 2020. Given Fairfax's significance as a major trucking hub, as well as a route for government officials heading to Washington DC, this data analysis explored whether lockdown measures influenced NO_2 emissions. Utilizing publicly available data collected from EPA ground-based measurements, we have presented the summary of NO_2 pollution trends (years 2019, 2020, and 2021) in the form of line graphs and box-and-whisker plots. Python software, JupyterLab and Microsoft Excel were used as data analysis tools and one-way ANOVA (Analysis of Variance) test was used for statistical analysis.

The results revealed a significant difference in 2020 emissions compared to both 2019 and 2021 (P-value ~ 0.07), rejecting the null hypothesis. The mean NO_2 levels in 2020 were also notably lower than the lower quartiles of the surrounding years. This underscores the impact of reduced human activity; especially in a pivotal supply hub, on lowering emissions, providing valuable insights for environmental policies and sustainable practices.

Faculty Advisor: Dr. Harish Subedi

Lee Joyce – Biology 299

Efficacy of Cosmetic Applicators' Antibacterial Properties to Staphylococcus aureus

America's thriving cosmetic industry has made efforts since the pandemic to market antimicrobial products, but there is currently no regulation to confirm the validity of these advertising claims. Beauty enthusiasts recommend routine cleaning of common makeup applicators, such as brushes and beauty blenders, as these can become saturated with microbial growth due to repeated contact with skin and cosmetic products. Bacteria such as *Staphylococcus aureus* and *Escherichia coli* predominately thrive on these surfaces, as well as viruses and fungi. Given this knowledge, the cosmetic industry has introduced antimicrobial properties to products, but it is unknown whether these steps are effective in preventing microbial growth. The hypothesis

is that the sponges with antimicrobial advertising will not inhibit the growth of *S. aureus*. The intention of this work is to use the studies from microbiology to investigate real product claims relevant to consumer interest. This study tested three make up sponges, known as beauty blenders, to assess their individual antibacterial properties against the application of *S. aureus*, a gram-positive pathogenic bacterium commonly found on human skin. Two of the sponges are composed of absorbent plant-based material; The Uvé product's specific composition of antimicrobial property is not described by the manufacturer, but the ecotools product is comprised of bamboo infused with silver nanoparticles to inhibit microbial growth. The third product is a generic silicone sponge consisting of a hydrophobic surface to prevent microbial adhesion. Testing followed similar procedures as demonstrated in other studies to investigate bacterial loads of makeup sponges, differing in that one unused product was quartered into pieces by a sterile scalpel to create four criteria for testing. These four groups were an initial control testing for pre-existing bacteria directly out of packaging, a saline control set for contrasting culture results after 30 hours, and two pieces, one damp and one dry, with applied culture for analyzing after 30 hours elapsed. Microbial loads were calculated using spectrometry and serial dilution to apply approximately 100,000 cells of *S. aureus*. Each sponge piece was placed in sterile saline to extract bacteria by vortex, then diluted to obtain countable plates, and distributed on nutrient agars in set amounts for incubation. A lack of growth present after incubation led to the conclusion that the sponges were in fact antibacterial in property and further investigation was performed to ensure the quality of these results by ensuring that the culture was not desiccating on the sponges. Only one colony forming unit was discovered on the damp ecotools applicator and one plate was contaminated due to human error, thereby not providing enough data for statistical analysis. Future testing may elaborate on this investigation by centrifuging the entire saline extraction to check for the possibility of over-dilution and also include a generic sponge without antimicrobial properties as an additional control.

Faculty Advisor: Dr. Melinda Clark

Isabella Mays – Biology 299

Callosobruchus maculatus Larval Cells as a Mechanism for Coliform Detection in Water

Concern for the water quality of the James River and its watersheds has increased with the amount of deforestation and development of the surrounding areas. Unfortunately, commercial water quality testing may be cost-prohibitive for continuous water monitoring. Therefore, a biomonitor was proposed as a cost-effective alternative to investigate the water condition of the James River and two of its tributaries in Nelson County, VA, the Tye and Rockfish Rivers. Cells of *Callosobruchus maculatus,* or bean beetles, were subjected to water samples from each river as well as sterile saline and then exposed to Trypan blue dye to distinguish dead from living cells and determine the average percent cytotoxicity as a measure of contamination. These results were then compared to results from commercially available water kits to determine the effectiveness of the biomonitor. It was hypothesized that since all 3 river sources are connected, the average percent cytotoxicity and coliform numbers for each river would be similar. Results showed a significant difference in average percent cytotoxicity of the Tye and Rockfish rivers ($t= 4.158$, $df= 4$, $p=$

0.014). Although all river water samples tested positive for coliforms, a significant difference was found between the James and Rockfish rivers. The nitrate and ammonium levels of each water sample were obtained using Ion-Selective Electrodes. The nitrate and ammonium levels were found within safe guidelines using Virginia standards for river water contaminants. More trials and tests need to be conducted for conclusive results.

Faculty Advisor: Dr. Virginia York

Bianca Rosson – Biology 299

The collection of Drosophila between ripened and rotten Golden Delicious Apples

Drosophila melanogaster are a diminutive species of fly, that are yellowish-blackish flies that have red eyes and/or stripes that cover their abdomens. These flies are attracted to rotten and over-ripe fruits and vegetables (Rosado, 2022). They gorge themselves on bacteria and sugar that come from the decomposing fruits but can also live in household sink drains. The decaying fruit also allows these flies to have a breeding ground, because of the chemicals that are released from the fruits which helps attract males in which they become overly excited and start to reproduce expeditiously over a small amount of time in these types of environments (Potter, n.d.) This study was conducted to test if Drosophila melanogaster prefers rotten over ripe Golden Delicious apples. One rotten vs one ripe Golden Delicious apple was placed in homemade fruit fly traps and pairs of traps were hung from 2 -3 feet off the ground from these trees Carter's Mountain Orchard Trees. Trap collection was from noon until 4pm the next day, for a total of 28 hours. After each collection, fruit flies were identified using a dissecting microscope and the *Encyclopedia of North American Drosophilids Volume 1: Drosophilids of the Midwest and Northeast*. While a variety of fruit fly species were collected, the results of this experiment did not show a statistically significant preference for either fruit. (Chi-Square value of 9.047, df=6, p=0.171) This rejects the hypothesis that fruit flies would prefer rotten fruit. These data suggest that the attraction of fruit flies to ripe vs rotten fruit is similar regarding Golden Delicious apples. Further studies may be needed to ensure the ripe vs rotten fruit chosen were sufficiently different in ripeness to rule out that the ripe vs rotten used were not too similar in the aging process.

Faculty Advisor: Dr. Donna Hoefner

Megan Spradlin - Biology 299

Trap Type Preference of Drosophilae with Golden Delicious Apples in Carter Mountain Orchard

Drosophilae, commonly known as fruit flies, are known as agricultural pests because of their attraction to fruits and vegetables and their ability to negatively affect them by ovipositing and bringing bacteria, contaminating fruits and vegetables. This is an issue because these negative effects can reach orchards, companies, farms, and homes all over the world (Hahn et al. 2023). To manage fruit flies, traps can be used to control populations and reduce damages to fruits and

vegetables (Manrahkan et al. 2017). This study was conducted to test if a homemade trap with naturally rotting apples would be more effective than a commercial Terro Fruit Fly Trap with the provided liquid. This would be beneficial because a trap could be improvised in the home if fruit flies become an issue, without the need of going out to purchase a commercial trap. In addition, it explores fruit fly attractants and their effectiveness. It was hypothesized that fruit flies will have a preference for the homemade traps over the commercial traps. The homemade traps contain naturally rotting golden delicious apples that fruit flies use for food and reproduction. One of each type of trap was placed on the same tree and this was repeated on four different golden delicious apple trees for two weeks during October. Both the homemade and commercial traps were put out on the lower branches at the same time and collected at the same time. The collected flies were identified using a dissecting microscope and the species identification book *The Encyclopedia of North American Drosophilids Volume 1: Drosophilids of the Midwest and Northeast*.

Using chi-square analysis, the results showed no statistically significant preference for either trap type and this rejects what was hypothesized since there was no preference for the homemade traps. Chi-squared analysis results were $X^2(5, N=336) = 1.123$ $p= 0.952$). The results suggest that the commercial Terro Trap attractant closely mimics the vinegar odor of the naturally rotting fruit, therefore the flies appear to be attracted to both trap types equally. Further research can be done comparing just the baits individually, the trap types individually, and different vinegar concentrations to determine the best possible method for trapping these pests.

Faculty Advisor: Dr. Donna Hoefner

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