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2021 Fall Science Presentations

Science 299 independent research projects are semester-long independent research projects that students pursuing an A.S. in Science are required to complete prior to graduation. Students carry out their research under the guidance of a PVCC science faculty member as mentor. The Abstracts of projects completed in Fall 2021 are included in this booklet.

Special thanks to the following laboratory staff for facilitating student projects:

Mark Little (Chemistry)

Pam Schoppee Bortz (Biology)

Joshua Sprouse (Biology)

Feby Abraham – Biology 299

Altitude Preference of Drosophilds at Carter's Mountain Orchard

Analyzing the distribution of fruit fly species (Drosophilidae) with respect to elevation within an ecosystem can uncover essential natural history information that could be of use to the agricultural industry. Consistent fluctuation in environmental conditions can cause stress which can impact the fitness of fruit flies. Altitude is one among other environmental factors that can affect the fitness of drosophilids. My hypothesis is that drosophilid species distribution will differ with elevation at high and low sites at a single apple orchard (Carter Mountain Orchard, Albemarle County, Virginia), which might suggest some species are better adapted to the different conditions. Fruit flies were collected using insect nets from high elevation (350.5 m) as well as low elevation (321.6 m) sites within the orchard on four days (09/30/21-10/22/21). The collection continued until roughly the same number of flies were caught from both elevations each day. The collected samples were frozen at -20C and a dissecting microscope was used to differentiate between species. The prevalence of the five most common fly species was compared at the two elevation sites. The results show a significant difference in the species distribution between low and high altitudes ($X2$ (4, $N = 2389$) = 195.9777, $p = < 0.00001$). *Zaprionus indianus* was found to be the most prevalent at the higher altitude. However, Drosophila melanogaster was the most prevalent at lower altitude, supporting the original hypothesis. *Drosophila robusta*, *Drosophila suzukii*, *Chymomyza amoena*, *Leucophenga varia*, and Unknown(black) were some other species that were found while analyzing the flies. Broader study regarding species distribution with respect to temperature could also be a factor to consider for further studies.

Faculty Advisor: Dr. Joanna Vondrasek

Han Dang - Chemistry 299

Determination of Copper Ion Concentrations in Drinking Water Using Spectrophotometric Method

There is an expansion of global population due to increased industrialization. Industrial procedures are responsible for excess discharge of heavy metals into the environment. While low copper concentration in the human body causes copper deficiency, higher amounts cause copper toxicity. Both copper deficiency and copper toxicity can lead to serious health issues.

The purpose of this project was to determine the concentrations of copper ions using spectrophotometric method. Two commercially available filters (Brita and PUR) were used to remove the copper ions. In addition, home-made filters made up of banana peels and apple peels were also used. The copper concentrations were measured before and after the filtration process. Copper reagent was added to each of the $Cu^{2+}(aq)$ standard to form a pink colored solution and absorption at 560 nm was measured using spectrophotometer. A calibration plot of absorbance versus Cu^{2+} concentration (ppm) was created. Among the four filters, PUR filters were most efficient at removing Cu^{2+} ions (83% removal) from solutions. Brita filters removed 70% of Cu^{2+}. Home-made filters were not as efficient as commercial filters, but filters made from apple peels were more efficient (25% copper removal) than those made from banana peels (25% copper removal). Research on making inexpensive home-made water filters would be helpful for the people from the developing countries who cannot afford expensive water filters.

Faculty Advisor: Dr. Harish Subedi

Kyle Monroe – Chemistry 299

Determining the Quality of Raw Spring Water: Safe or Unsafe to Drink?

Spring water is water that flows from an aquifer to the earth's surface. When safely sourced, spring waters are considered the healthiest waters to drink on account of their associated mineral profiles which help vitalize our bodies. However, springs which are unregulated may become contaminated in a number of ways. In this project, several unregulated springs were located, sampled, and then tested for common known sources of contamination. It was hypothesized that if between 6-8 springs were tested, then at least one of them would prove positive for contamination; in other words "unsafe to drink". Samples from six springs were collected, and each was put through a series of tests to determine if they were contaminated, in terms of (1) coliform bacteria and/or (2) unsafe levels of the following elements and compounds: lead, fluoride, iron, copper, total chlorine, nitrite, nitrate, hydrogen sulfide, sulfate, zinc, sodium chloride, manganese, and ammonium. The specific tests performed were: test strips in the form of multi-panel and bacteria, ISE (Ion-Selective Electrode) test for Ammonium, and Spectroscopy for the presence of Copper. All samples proved negative for the presence of bacteria, copper (via spectroscopy), and ammonium. Based on the multi panel strips, all samples tested within safe

levels of all other elements and compound with the exception of two; the Wayside Spring sample tested above the safe level for Nitrate, and the Hickory Spring sample tested above the safe level of Lead. Although this proves the hypothesis, future seasonal testing, as well as professional licensed testing is needed to verify these findings.

Faculty Advisor: Frances Rees

DeMya Preston – Chemistry 299

Which Is More Effective? Store-bought Natural Shampoo or Shampoo Made at Home

There are so many bad chemicals found in shampoos sold in stores like sodium chloride, parabens, and sodium lauryl sulfate to name a few. As many know, natural shampoos are sold in stores now. Many have switched to natural store-bought shampoo, but you can also make shampoo out of products you may already have in your home or can find at your local store. In this experiment I tested the effectiveness of three different shampoos, two made in the lab and one bought from the store that is considered natural. The shampoos made in the lab where a Coconut Milk shampoo and a Castile Herbal shampoo, the store-bought shampoo was Trader Joes Tea Tree Tingle shampoo. The ingredients in the coconut milk shampoo were 1 can coconut milk, 2 tbsp honey, 1 tsp jojoba oil, 1 tsp apple cider vinegar, 1 tsp olive oil, and 1 tsp lemongrass essential oil. The castile herbal shampoo contained 4 oz of water infused with an herbal tea bag, 2 oz castile soap, 0.5 tsp jojoba oil, and 1 tsp lemongrass essential oil. I chose lemongrass as the essential oil because of its anti-dandruff properties. Simple lab procedures and simple math was preformed to make solutions and conduct test. Four tests were conducted a pH test, grease removal test, foam test, and a dirt dispersion test. The castile herbal shampoo was proven to be the most effective shampoo.

Faculty Advisor: Frances Rees

Kayla Scott - Biology 299

How Specification Distributions of *Drosophila* Varies Over A Season

Drosophila, commonly referred to as a small fruit fly, is more than just the household pest that invades fermented rotten fruit, decaying produce, and garbage cans. These tiny poikilothermic organisms depend on external sources to achieve optimal body temperature due to their inability to regulate body temperature on their own. The collected data is essential to study evolutionary biology based on how well *Drosophila* species adapt to their surroundings. This study aims to determine how *Drosophila* species distribution varies over a season. In autumn, as the average temperature decreases due to seasonal changes, the diversity of Drosophila species will increase. *Drosophila* species samples were collected bi-weekly from September 10th to November 22nd at Carter Mountain (Latitude N 37° 59’ 19.791”, Longitude W 78° 28’ 28.66”) in Albemarle County, Charlottesville, Virginia. All *Drosophila* species samples were captured with a BioQuip Drosophila Net, placed into various BioQuip 59 ml (77 x 32mm) clear styrene collecting vials,

properly euthanized, and then separated in the individual species classification under a Nikon SMZ645 Dissecting Microscope. Only three specific *Drosophila* species were observed and recorded after this study; Drosophila *Melanogaster / Simulas*, *Drosophila Indianus,* and *Drosophila Suzuki*. The temperature stayed consistently within 60-70 degrees until mid-November. At 43 degrees, there was no sign of *Drosophila* or any other *Insecta* activity. As a result, data confirmed species distribution did not vary significantly throughout the collection, ultimately rejecting the original hypothesis. Nonetheless, interestingly when temperature records dropped drastically, the sudden activity of all *Drosophila species* or any other *Insecta* vacated. Evaluating how these species distributions relate to temperature allows for researchers to obtain a comprehensive understanding of how organisms adapt to their environment changes to maintain homeostasis.

Faculty Advisor: Anne Allison

Angel Stanley – Biology 299

Generational Resistance of Klebsiella pneumoniae To Natural Agents Honey and Salt

The bacteria *Klebsiella pneumoniae* is bacillus shaped and has been studied in the medical field for infections as it is the second most common gram-negative pathogen. Its resistance is on the rise with antibiotics. This brings out question of if there are other possible antibiotics that could be more effective; especially natural agents, such as salt and honey which are known to be preservatives. The hypothesis of this work is that *K. pneumoniae* would development of resistance over time and that the rate of resistance would be the same between both the inorganic agent, salt, and the organic agent, honey. The methods for this experiment were mainly the Kirby Bauer method and an LB Broth. The Z.o.I.s was measured by a ruler using centimeters from one edge of the zone to the other. Resistance was analyzed over a total of 3 generations and the entire experiment was done twice. The results show that all except the sugar plates had no change whatsoever, while the sugar appeared to induce growth except for right next to the filter paper. The trial of LB Broth had shown growth in all but the sugar broth, possibly due to the caramelization of the sugar. In conclusion, *Klebsiella pneumoniae* did not show any significant susceptibility to the honey or salt; looking back at the hypothesis, these results show a rejection of it. This can be related back to what is known about these subjects, showing that perhaps further testing is needed.

Faculty Advisor: Melinda Clark

Celina Vasquez – Biology 299

Drosophila Biodiversity in Fuji versus Jonagold Apples in Carter's Mountain

The difference in *Drosophila* biodiversity composition between Fuji and Jonagold apples was investigated by comparing the prevalence of the five most common fruit fly species found in Carter's Mountain. Fruit flies are a common pest in orchards. Understanding their behavior and fruit preference would give insight into possible ways to manage them. The type of fruit that fruit flies use for their sustenance also determines the nutrition their offspring receive, as fruit flies lay their eggs on the fruits. In previous studies, fruit flies have been shown to be attracted to yeast production. Sugars and antioxidants in the fruits help facilitate yeast production. Fuji and Jonagold apples have different nutritional values, with Fuji apples having more sugar and antioxidant levels. It was hypothesized that due to these nutritional differences, there would be a greater variety of fruit fly biodiversity composition in Fuji versus Jonagold apples when comparing the five most common fruit fly species. Fruit flies were collected from Carter's Mountain in separate vials labeled Fuji and Jonagold. The fruit flies were euthanized by freezing them at -20℃. They were examined under a dissecting microscope and were counted and separated by species. Utilizing data from the five most common species, a Chi-square analysis was used to determine if there was difference in species prevalence between Fuji and Jonagold apples. It was found that *D. melanogaster* were more prevalent in Fuji apples, whereas *D. hydei* and *Z. indianus* were more prevalent in Jonagold apples. A statistical difference in prevalence of the other two species, *D. robusta and D. suzukii*, was not found. Future research will be needed to further confirm these results and to gain a better understanding as to why in certain species there is a difference in prevalence in Fuji and Jonagold apples.

Faculty Advisor: Dr. Donna Hoefner

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