

# ***THE RESEARCH DRAGON***

"Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less."  
-M. Curie



**COMMACK HIGH SCHOOL  
RESEARCH YEARBOOK**

**2021-2022**

**A CELEBRATION OF RESEARCH AT  
COMMACK HIGH SCHOOL**

**Tuesday May 31st, 2022**

**7:00 pm**

**EVENING EVENTS**

Poster and Video Presentation of student projects

Slide Show Presentation... Lakshanna Raveendran, Soyoun Moon

Introduction.....Brandon Berkoff

Opening Remarks.....Ms. Jill Johanson  
Director of Science, K-12

Student Reflections.....Shivani Muthukumar, Jin Ko

Alumni Comments

Honoring Our Seniors.....Grace Kim, Rishin Chatterjee

Senior Picture Compilation....Lakshanna Raveendran, Soyoun Moon

Closing Remarks.....Brandon Berkoff

Welcome to our Celebration of Science Research. This evening, we pay tribute to the creativity, hard work, and success of our students over the past school year. Participating in the science research program requires personal commitment, dedication to the completion of a project from start to finish, and the enthusiasm to overcome the obstacles and enjoy the success along the way.

At each science fair that we have participated in, our students represented the Commack community in a respectful and professional manner. They were all well prepared and eager to share their efforts and results with science fair judges.

This evening, we honor our students for their involvement and participation in the Commack High School science research program.

Thank you.

*Research Staff*

Ms. Andrea Beatty  
Ms. Jeanette Collette  
Dr. Daniel Kramer  
Mr. Robert Smullen  
Ms. Jeanne Suttie

Ms. Jill Johanson, Director of Science, K-12

*With gratitude, we would like to acknowledge the following people who have helped our staff and students in so many ways throughout the year to make our research program successful.*

Susan Abbott, Anthony Capiral, Donna DiBiase, Lisa DiCicco, Chris DiGangi, Fran Farrell, Lea Gargiulo-Erikson, Paul Giordano, Dolores Godzieba, Dr. John Kelly, Amanda Klvana, Dr. Barbara Kruger, Dr. Fred Kruger, Barbara Lazcano, Brenda Lentsch, Diana Lerch, Luann McNicholl, John Mruz, Margaret Nappi, Dr. Stephanie O'Brien, Bill Patterson, Jackie Peterson, Stephanie Popsky, Mary Puglia, Jose Santiago, Genny Sebesta, Thomas Shea, Dr. Lorraine Solomon, Zach Svendsen, Laura Tramuta, Fern Waxberg, and Frann Weinstein.

Dr. Lutz Kockel, Stanford University, for his unwavering collaboration with the StanMack program.

Michael Litterello, Charles Marchese, Marc Caruso, Robert Dubriske, and our fabulous custodial staff.

Ms. Lipenholtz, Ms. Allen, Mr. Eric Biagi, Mr. Keltos, Mr. Elmore, and the administrative staff for their continued support.

Mr. Flatley, Dr. Cox, Ms. Newman, Ms. Goldberg, Mr. Grodotzke, Dr. Inforna, Dr. Santorello, and the members of our Board of Education for their support and recognition of our program.

# **SCIENCE FAIR PARTICIPATION**

## **REGENERON SCIENCE TALENT SEARCH**

Sangit Gunasakaran  
Ashley Hsu  
Michael Jang  
Soyoun Moon- Regeneron National Scholar  
Lakshanna Raveendran  
David Yang  
Inaya Syed

## **JUNIOR SCIENCE AND HUMANITIES SYMPOSIUM**

*Students must apply to the symposium and be selected to present their projects.*

Sangit Gunasakaran  
Ashley Hsu  
Michael Jang  
Soyoun Moon  
Lakshanna Raveendran  
David Yang

## **JUNIOR SCIENCE AND HUMANITIES SYMPOSIUM - NORTHEAST REGIONALS**

Sanjit Gunasekaran  
Ashley Hsu  
Lakshanna Raveendran  
David Yang

## **HARVARD SCIENCE RESEARCH CONFERENCE**

Juliette Amram  
Ishana Chadha- Innovation Challenge winner  
Alisha Khan  
Manya Khatri- Innovation Challenge winner  
Jin Ko  
Flora Lin  
Farah Raufi  
Lakshanna Raveendran  
Mehek Sawhney- Innovation Challenge winner  
Zeynep Tasoglu- Innovation Challenge winner

**COLUMBIA UNDERGRADUATE SCIENCE JOURNAL**  
**RESEARCH SYMPOSIUM**

Ashley Hsu

**EXPLORATION OF THE MOON AND ASTEROIDS**  
**BY SECONDARY STUDENTS**

Brandon Berkoff

**BARCODE LONG ISLAND: DOLAN DNA LEARNING CENTER**

*Barcoding Gladiators:*

Gabriela Kuriakose  
Shivani Muthukumar  
Farah Raufi

*Team Commack2:*

Ishana Chadha  
Manya Khatri  
Mehek Sawhney

**TOSHIBA/NSTA EXPLORAVISION PROGRAM**

Ishana Chadha  
Akarsh Chilakala  
Manya Khatri  
Aaron Mathew  
Farah Raufi  
Mehek Sawhney

**MEDICAL MARVELS CHALLENGE**

2nd Place Team, Long Island Region

Jin Ko  
Sahaj Pandey  
Saharsh Peddireddy  
Amantej Rana  
Peter Tine Jr.  
James Yu

## **LONG ISLAND SCIENCE AND ENGINEERING FAIR, ROUND 1**

Ishana Chadha  
Mitchell Ghermezian  
Sangit Gunasakaran  
Ashley Hsu  
Michael Jang  
Manya Khatri  
Edward Liao  
Soyoun Moon  
Saharsh Peddireddy  
Harry Poulouse  
Farah Raufi  
Lakshanna Raveendran  
Mehek Sawhney  
David Yang

## **LONG ISLAND SCIENCE AND ENGINEERING FAIR, ROUND 2**

Soyoun Moon - 1st Place Animal Science, **ISEF Finalist**  
Lakshanna Raveendran - 1st Place Biochemistry and Microbiology, **ISEF Finalist**

## **NEW YORK STATE SCIENCE AND ENGINEERING FAIR, ISEF DIVISION**

Ishana Chadha- Round 2 Finalist, 3rd place Biomedical & Health Sciences  
Sangit Gunasakaran  
Ashley Hsu- Round 2 Finalist, 1st place Computational Biology- **ISEF Finalist**  
Michael Jang  
Manya Khatri  
Edward Liao  
Soyoun Moon  
Saharsh Peddireddy  
Harry Poulouse  
Farah Raufi  
Lakshanna Raveendran  
Mehek Sawhney- Round 2 Finalist, 3rd place Biomedical & Health Sciences  
David Yang

## **INTERNATIONAL SCIENCE AND ENGINEERING FAIR**

*Results to Be Announced*

Ashley Hsu  
Ashley Moon  
Lakshanna Raveendran

## **WAC LIGHTING FOUNDATION INVITATIONAL SCIENCE FAIR**

Arda Alptekin- Honorable Mention (3rd place), Computer Science  
Linsdey Chung  
Justin Davitashvili  
Jason Duffe  
Jessica DeYulio  
Mitchel Ghermezian- Honorable Mention (3rd place), Earth and Environmental Science  
Sanjit Gunasekaran  
Avi Gupta  
Steven Homenides  
Robin Hwang  
Alisha Khan  
Manya Khatri  
Yashica Kumar  
Edward Liao  
Karen Li  
Melina Nicou- Honorable Mention (3rd place), General Biology  
Matthew Pace  
Sahaj Pandey  
Abigail Pappachen  
Saharsh Peddireddy- Honorable Mention (3rd place), Chemistry  
Amantej Rana  
Farah Raufi  
Lakshanna Raveendran- 1st Place, Biochemistry  
Ayan Sheikh- Honorable Mention (3rd place), Computer Science  
Ishaan Singh  
Asmaa Zahran  
Jonathan Zhang



## **KATHY BELTON SCIENCE FAIR AT MOLLOY COLLEGE**

Ishanna Chadha- 1<sup>st</sup> Place, Biomedical and Health Science  
Michael Florentino- 1<sup>st</sup> Place, Microbiology  
Jack Hatcher  
Sahaj Pandey- Honorable Mention, Physics and Engineering  
Saharsh Peddireddy  
Amantej Rana  
Mehek Sawhney- 1<sup>st</sup> Place, Biomedical and Health Science  
Ishaan Singh  
Jonathan Zhang

## **LONG ISLAND SCIENCE CONGRESS, SENIOR DIVISION**

*Results to Be Announced*

Naomi Amram  
Gabriella Barth  
Brandon Berkoff  
Jillian Cestaro  
Matthew Chacon  
Michael Florentino  
Sarah Franzen  
Ava Glick  
Ethan Gordon  
Tiffany Gracia-Suarez  
Jack Hatcher  
Dan Kamensky  
Abigail Kleiman  
Daphne Koutsoukos  
Nicholas Mendez  
Grace Papazoglou  
Alexandra Schuval  
Lilly Schwan  
Don VeonTulloch  
Alexa Vrionedes

## **LONG ISLAND SCIENCE CONGRESS, JUNIOR DIVISION**

*Results to Be Announced*

Akarsh Chilakala  
Jaclyn Clements  
Haris Entizar  
Amana Gardezy  
Chloe Gullo  
Trevor Hagemo  
Zaarah Ishak  
Ava Javaheri  
Natalia Kazimierczyk  
Julia Kim  
Emily Kraus  
Emma Li  
Aaron Mathew  
Andrew McConaghy  
Daniel Meneses  
Shivani Muthukumar  
Nicholas Palmeri  
Abigail Parisi  
Samie Park  
Kayla Rafft  
Lucas Vazquez  
Gianna Velasquez

## **SOUTH ASIAN AMERICAN WOMEN'S ALLIANCE SCIENCE FAIR**

*Results to Be Announced*

Defne Aktuna - Honorable Mention, Biological Sciences  
Juliette Amram  
Samantha Borre  
Samuel Bryd  
Rishin Chatterjee - Honorable Mention, Earth and Environmental Sciences  
Anthony DuBois  
Grace Kim - Honorable Mention, Earth and Environmental Sciences  
Inaya Syed  
Aareb Jatoi - Honorable Mention, Earth and Environmental Sciences  
Jim Ko  
Julia Leahy  
Anna Rohring  
Shreya Sriram - Honorable Mention, Biological Sciences  
Peter Tine Jr.  
James Yu

## **NEUROLOGICAL SURGERY P.C. HEALTH SCIENCE COMPETITION**

*Results to Be Announced*

Sofia Ahmed  
Isaar Chadha  
Ishana Chadha  
Jasmine Carpio  
Mitchel Ghermezian  
Ethan Gullo  
Katherine Hochberg  
Ashley Hsu - Selected to Compete in Finalist Round  
Gabriella Kuriakose  
Meiya Lin  
Lia Maglione  
Crystal Migliaccio  
Soyoun Moon - Selected to Compete in Finalist Round  
Eshani Mukherjee  
Harry Poulouse -Selected to Compete in Finalist Round  
Mehek Sawhney  
Samantha Singh  
Maheen Waqar  
Maryum Waqar  
David Yang - Selected to Compete in Finalist Round

### **FAIR OPT-OUTS**

Victor Angielczyk  
Sarah Levine  
Ashley Lewis  
Zeynep Taşoğlu

## **STUDENT SUMMER RESEARCH PLACEMENTS**

*Each year, Commack students participate in a variety of summer research opportunities. These diverse experiences include:*

Brookhaven National Lab High School Summer Research Program (HSRP)  
Cold Spring Harbor Internship Program  
Cold Spring Harbor Laboratory DNALC Coding Camp  
Cold Spring Harbor Laboratory DNALC Summer Camp  
Genome Science at DNALC  
New York University Biology Department  
ICaRe Cancer Research Program at SUNY Old Westbury  
iResearch Institute  
Summer Immersion Program (SIPS)- Girls Who Code  
SUNY Stony Brook Garcia Program  
SUNY Stony Brook Simons Summer Research Program  
SUNY Stony Brook Laboratories  
Computer Science and Informatics Summer Research Experience at Stony Brook  
Independent research laboratory assignments

# ABSTRACTS

## STAN MACK PROGRAM

*Jordan DiPrima, Ashley Hsu, Gina Kim, Flora Lin, Soyoun Moon, Amber Syed,  
Brennan Thomann*

### **Creating Unique Transgenic Flies Lines as a Tool for studying Neuroendocrine Disorders: An International Collaboration**

*Drosophila* are highly suitable for research since they serve as a model for studying the role of the transposable elements. Mechanisms of glucose homeostasis are conserved between flies and humans, and the fruit fly allows for easier access for conducting genetic manipulations when compared to the common rodent model. The goal of this course was to allow students to use transposon biology to create unique transgenic fruit flies to be used as tools in professional labs around the world for scientists interested in doing tissue-specific genetic manipulation while studying neuroendocrine disorders, specifically diabetes. Students work in partnership with Stanford University in collaboration with students from all over the globe participating in the Stan-X Program.

Transposons are sequences of DNA that move from one location in the genome to another using a cut and paste mechanism. Our transposable "P element" migrated from the X chromosome to either the second or third chromosomes. When P elements are inserted in different sites in the *Drosophila* genome they trap different enhancers. Once an enhancer trap is created, the enhancer's spatiotemporal expression pattern can be visualized by crossing in a second P element carrying a green fluorescent protein (GFP) construct.

This project began by creating an F0 cross using females from the fly stock StanX-4 line and males from  $\Delta 2-3$  line containing the gene for transposase, to cut out the transposable element and allow it to jump into another part of the genome. From these crosses, jump starter males (which carried the StanX-4 gene) were found and crossed with virgin Double Balancer females. From this F1 cross, goal males with the transposed StanX-4 were found and again crossed with virgin Double Balancer females to identify which chromosome the P element jumped to. Afterwards, a brother-sister cross was performed using the offspring from the F2 generation to make F3, creating a stable stock. The location of the P element insertion was verified by larval brain dissection and fluorescent microscopy along with Inverse PCR and Sequencing (performed by Phillips Exeter Academy). The students then mapped and characterized their insertions. Once characterized, these novel strains containing a trapped enhancer will be stored at the Bloomington *Drosophila* Stock Center at Indiana University Bloomington.

# SENIORS

*Defne Aktuna, Shreya Sriram*

## **The Effect of Bisphenol A on the Viability, Motility, and Locomotion Rate of the Third Generation of *C. elegans***

Bisphenol A (BPA) is a chemical compound used to make plastics and resins. BPA is known to cause Alzheimer's disease, cardiovascular problems, childhood asthma, and neurological problems in humans. Studies have shown that BPA increases in the nematode, *C. elegans*, are linked to premature mortality and reduced life expectancy with short and long-term exposures, potentially impacting offspring. The purpose of this investigation was to determine the effects of BPA on future generations based on the viability, motility, and locomotion rate to model human impact, since the *C. elegans* genome possesses homologs of about two-thirds of all human disease genes. Three groups of *C. elegans*, with BPA exposure in concentrations 100  $\mu\text{M}$ , 500  $\mu\text{M}$ , or 1 mM within food along with one without BPA exposure, were raised separately. When the *C. elegans* reproduced, the offspring were repleted for the second and the third generations. The locomotion rates were compared between the control group and experimental groups for the three generations. It was hypothesized that as the amount of BPA given to a generation of *C. elegans* increases, the locomotion would decrease in future generations of *C. elegans*, as the effects of BPA can thus pass on from generation to generation. Overall, the results generally demonstrated that as the concentration of BPA given to the *C. elegans* increased, the distance they moved from the center decreased; therefore, the locomotion decreased. In the third generation, all the values of the distances traveled were less than the values in generations 1 and 2. This means that the BPA reduced the locomotion ability of the *C. elegans* after the first two generations. The ANOVA shows that there was no difference between the Control and Concentrations for Generation 2 and 3 but did show a difference for Generation 1. Our t-test illustrated that there was a difference between the Control and the Low (100  $\mu\text{M}$ ), the Control and the Medium (500  $\mu\text{M}$ ), and the Control High (1mM) for Generation 1.

*Victor Angielczyk & Matthew Pace*

### **Diagnosing Melanoma Using a Convolutional Neural Network (CNN)**

Melanoma is a cancer that when diagnosed early, poses a relatively small danger when compared with other forms of cancer. This form of localized melanoma is referred to as stage I/II. The 5 year survival rate of these localized forms of melanoma are 99% . However, this quickly changes as melanoma metastasizes. This spread across the body, which is referred to as stage III/IV or regional/distant melanoma, makes the cancer much harder to treat. The 5 year survival rate drops considerably for these forms, all the way down to 65% and 25% respectively . This drastic difference in the 5 year survival rates shows that early identification is vital in treatment of melanoma. In order to detect melanoma early in patients, dermatologists either look for suspicious areas and/or order a skin biopsy. This can be time-consuming, is labor intensive, and is a process prone to errors. With recent advances in computer technology and machine learning, computers are increasingly used to help doctors and other medical professionals diagnose and deal with various illnesses. These computers can have a comparable or even higher accuracy than doctors, which is essential for the early diagnosis of Melanoma. A popular machine learning algorithm that is being used in these fields is known as a Convolutional Neural Network (CNN). CNNs are the predominant type of algorithm used in image classification. We used one of python's many machine learning libraries, specifically, Tensorflow. The convolutional neural network was trained using images from the ISIC database, which contains thousands of images of skin lesions that were filtered by specific diagnoses. Once the classifier was trained, images were put through it, and based on how accurate it was, the precision, specificity and sensitivity of the classifier was calculated.

*Isaar Chadha*

### **Analysis of the Impact of Interrupted Sleep on Caloric Intake**

EMS responders are a pivotal force in communities, protecting and saving lives on a daily basis. Given the effects of sleep deprivation on poor eating choices, a question can be raised as to how disrupted sleep, common in shifts for overnight responders, affects caloric intake. A google form was sent to an ambulance core and distributed personally to individuals known to the research to collect survey data. The data included a sleep diary and food journal taken for two separate days, one day accounting for an overnight shift and one where the participant did not volunteer on an overnight shift. There was insufficient quality data to draw a conclusion. Several data was not specific with the sleep diary and food journal.

*Lindsey Chung, Steven Homenides, Yashica Kumar*

### **Comparing the Effectiveness of Herbal Medicine and Antidepressants in Treating Traumatic Brain Injuries in *Drosophila melanogaster* by Measuring Cognitive Function**

Traumatic brain injury occurs following an instantaneous outside force, ultimately impairing the brain. Costly surgical procedures are needed to treat these injuries. Research has shown that antidepressants, such as sertraline (zoloft), can promote neurogenesis, which is a process where neurons are generated from neural stem cells. In previous studies, sertraline has been shown to be neuroprotective in vitro and in vivo. The purpose of this study was to investigate safer alternatives, such as herbal medicine and antidepressants, which have shown to cause long-term risks. A “high-impact trauma (HIT) device” was constructed to inflict traumatic brain injury. The antidepressant and herbal medicines, two immortals and ginseng, were placed in the molasses tube of fruit flies. To measure the extent of effectiveness for antidepressants and herbal medicine, locomotive and memory assays for measuring cognitive brain function of *Drosophila melanogaster* were used. Reduction of inflammation was indirectly assessed by improved cognitive ability. Through the various assays, cognitive function was measured demonstrating the differences between the experimental and control groups. It was hypothesized that herbal medicine would be just as effective as the antidepressants in treating traumatic brain injuries in *Drosophila*. Results demonstrated that, for the crawling assay, there is a statistical difference between the control, sertraline, ginseng, and two immortals as the p-value was calculated to be 0.00189, which is less than 0.05 significance level, using a single factor ANOVA. This signifies that herbal medicine can be effective in improving traumatic brain injuries.

*Justin Davitashvilli, Jason Duffe*

### **Industrial Manganese Toxicity on Aquatic Ecosystems**

Algae are essential producers that contribute to about half of global primary productivity. Common industrial byproducts are being discarded in bodies of water; therefore, it is important to understand how it affects the health of the algae. Manganese is a common pollutant found in bodies of water near factories and other industrial plants. The purpose of this project was to explore the impact of manganese on the population of freshwater organisms to gauge the effects of man-made waste in waterways. Algae were placed into various solutions of manganese. A spectrophotometer was used to measure the concentration of algae growth. We hypothesized that the algae growth would decline in increasing concentration of manganese. Our hypothesis was partially supported, in that most of the algae was killed at the higher concentrations, however, the Manganese was hard to keep in solution. At the 1.0 mg/mL and 0.5 mg/mL of Manganese, the absorbance was less than the control (100% Pond Water with no Manganese), meaning the algae had a better survival. This could be because manganese is required for certain life functions. At the 2.0 mg/mL Manganese, the absorbance was greater than the control (100% Pond Water with no Manganese), meaning the algae had a worse survival, but there was a drop on Day 3 where the manganese precipitated out of solution. These results support that industrial pollution does impact marine ecosystems.



*Jessica DeYulio*

### **The Conversion of Solar Energy into Fuel through the Catalytic Activity of Various Concentrations of Metal Oxides**

There has been an increased dependency on fossil fuels, making up 80% of our energy, while it has become apparent that they are limited. Fossil fuels have been contributing to climate change, so it is necessary to find renewable energy sources, such as solar energy. Solar fuels are necessary for the use of energy, so there would still be energy at times that there is no sun. The objective of this project is to find cost effective nitrates of earth abundant metals that would be useful catalysts for the oxygen producing half reaction in solar fuels. The metal nitrates tested were  $\text{Fe}(\text{NO}_3)_3$ ,  $\text{Co}(\text{NO}_3)_2$ , and  $\text{Al}(\text{NO}_3)_3$  by mixing in 27 different ratios and pipetting 10  $\mu\text{l}$  aliquots on a glass electrode. The oxygen production of each mixed metal nitrate was tested by submerging the electrode in a degassed 0.1 M NaOH solution under a box. Then it was exposed to UV light and pictures were taken through a yellow filter. The photos showed bright spots and the brightness of the spots determined the catalyst activity after image processing with ImageJ. The mixed metal nitrate solution that produced the most oxygen was the solution in the ratio Al:Fe:Co 60:0:40 with a catalyst activity of 1.8405. All the spots with Co performed better than the spots with Fe. However, both Fe and Co had the greatest catalytic activity at 40%.

*Jason Duffe- See Justin Davitashvilli*

*Sarah Franzen*

### **The Maillard Reaction: The Effect of pH on the Browning of Various Foods**

Maillard reactions are a combination of small, simultaneous reactions occurring during the transformation of proteins and sugars in food by heat. The reactions result in the production of new flavors, smells, and appearances. In this study, the relationship between pH and the Maillard Reactions was examined. Potatoes, onions, carrots, and chicken were cut into one inch cubes and 8-10 pieces of each food were dipped in distilled water, sodium hydroxide, and acetic acid. The food was all placed in the 325°F oven for 40 minutes and observed in 10 minute intervals. The observed data resulted in trends relating an increase in pH to increased rate in browning and also showed a positive correlation between the amount of protein and the rate of browning. The food dipped in a sodium hydroxide solution was visibly higher on a qualitative brownness scale in comparison with that of an acetic acid solution, supporting the results as the sodium hydroxide had the highest pH. This experiment suggests that the best time to eat food is when it has reached a brownness level of either 2 or 3, as this is a level where food is fully cooked but does not include an excessive level of brownness.

*Sanjit Gunasekaran*

### **Creating a Sybase to MySQL Database Conversion Algorithm**

Database Management Systems (DBMSs) are software that allow data to be stored, organized, accessed, and updated in a digital format. One of the first DBMSs available for enterprise use was Sybase DB. It was adopted by many organizations, such as Brookhaven National Laboratory's Collider-Accelerator Department (BNL C-AD), in the 1980s to make a switch to digital record keeping. Although Sybase was effective in the past, new DBMSs have since been released that surpass Sybase's capabilities. Sybase's operating costs and increasing difficulty of use have also contributed to a desire to move away from Sybase. Sybase has also announced an End of Maintenance (EOM) of December 2025. These factors have led to the C-AD and similar organizations desiring to move away from Sybase. The C-AD desires to transfer to a DBMS called MySQL because it addresses most of the problems they were having with Sybase. In this project, an algorithm that transfers databases from Sybase to MySQL was written to assist the C-AD and similar organizations. The algorithm was coded using Python for logic handling and SQL to interface with databases. The algorithm worked by generating SQL queries that could effectively recreate database elements present in the Sybase environment in the MySQL environment. The algorithm was able to consistently transfer 6 of the main database components, and work is currently being done to determine how the remaining components can be converted. This algorithm provides a solid baseline that will allow organizations to begin their database conversion away from Sybase to MySQL.

*Avi Gupta, Asmaa Zahran*

### **The Effectiveness of Earthworm and Termite Activity on the Restoration of a Landfill Environment**

With increasing population growth there is a need for more farm land. As fields grow on top of landfills, problems arise as there is a demand for fertilized soil in order to produce quality vegetation. This increase in landfill based farms poses a threat for further development of vegetation and the food chain. Earthworms are known to help by indicating soil health in temperate and humid tropical ecosystems. Termites are key decomposers in soil functions, and also help the ecosystem. This project was carried out to see how earthworms and termites could help the environment by restoring soil health. Earthworms and termites were placed singularly and combined in controlled environments with similar simulated landfill pollution. Kidney beans were grown in these environments and plant height was measured over time. The plant height demonstrated how healthy the soil was in the environment, and determined the effectiveness of an insect and/or annelid. Results showed the trials that contained both termites and earthworms grew the tallest. After collecting all the data and comparing it to contrasting trials, both earthworm and termite plants grew an average of 30.35 cm while the control only grew to an average of 15.00 cm. Based on the results from this experiment, earthworms and termites are a great addition to unkept soil to produce crops. Furthermore, the earthworms and termites assisted in decomposing any waste products left in the soil in a more efficient way, allowing a new conversation in the future of the creation of farms on top of landfills.

*Steven Homenides - See Lindsey Chung*

*Robin Hwang*

### **Development of a Block-Based Object-Oriented Programming Language using the Java Virtual Machine**

Java is one of the most widely used programming languages in the world. This is due to the accessibility of the Java Virtual Machine (JVM) across most operating systems, including but not limited to Windows, MacOS, and Linux. The JVM provides the runtime environment and syntax interpreter for the Java programming language . Additionally, the concept of object-oriented programming allows for not only the assignment of non-primitive data types, but also allows for the morphing of variables from one data type to another. The purpose of this project was to develop a “drag and drop” block-based JVM language, similar to the block-based language Scratch™ by the Massachusetts Institute of Technology, but with objects and without a stage. This was to emulate the object-oriented paradigm in the Java 8 programming language as closely as possible, since the default Java environment does not include a stage. The creation of this language allows novice programmers to code and organize Java 8 code using visual elements, improving efficiency and saving time from a commercial standpoint. The language was coded using the Java WindowBuilder library, which allowed the creation of a graphical user interface. Then, JButton components were placed on the interface that, when clicked, either created new classes, instance variables, objects, or methods as necessary. The appropriate .txt file that each class corresponded to was updated with any changes the user made through the interface. Due to the nature of JButton components, the “drag and drop” nature of this project was replaced with a “press and drop” system. Finally, instead of the JVM, the Java Development Kit (JDK) was used to improve the efficiency of this program.

*Ashley Hsu*

## **Improved Visualization of Dimensionality Reduction Plots with Controlled Downsampling**

Large biomedical datasets routinely consist of more data points than can be displayed faithfully on a computer monitor. Computer screens are incapable of representing high-volume datasets with perfect one-to-one pixel resolution, resulting in arbitrary data loss. This is problematic for researchers since critical details are obfuscated. The general problem of loss of data due to insufficient sampling is called the aliasing effect when signals are sampled at a rate incommensurate to that of the original signal. Displaying data on a computer screen is a form of downsampling since the screen only samples a portion of the complete data. For single-cell RNA-sequencing data, this implies ignoring entire cells or genes, which is not consistent with biological principles. In this project, I aim to lessen the information loss between the original data and what is visible to the researcher. To accomplish this, I have designed and implemented software, called AHggregate, to automatically cluster similar data and then downsample, with a targeted use case of single-cell RNA-sequencing data. I apply my methodology to publicly available single-cell transcriptome data obtained from Tabula Muris and demonstrate with heatmaps and dimensionality reduction visualizations that the salient features of the data are preserved. While this study focuses on single-cell RNA-sequencing data, I expect that the methods developed here have applications to other large datasets. AHggregate creates better visualizations, advancing computational biology by enabling scientists to better understand the human condition through more accurate diagnoses, better targeted treatments in personalized therapies, and more precise insights into tumor activities.

*Michael Jang*

### **A Deep Learning Model to Detect Malignant Non-Small Cell Lung Cancer (NSCLC)**

Lung cancer poses itself as one of the most common and deadliest forms of cancer, Early detection of Lung Cancer is crucial to ensuring the survival of patients. Current treatments utilize medical imaging, Computed Tomography (CT) and Medical Resonance Imaging (MRI), to discover abnormalities. If cancer is suspected, a biopsy is completed to examine the tissue in the targeted area for cancer. The purpose of this project was to provide an alternative method to differentiate between types of non-small cell lung cancer (NSCLC) and benign tumors to improve diagnosis times and reduce workload on pathologists. Using Tensorflow and Keras in python, a Convolutional Neural Network (CNN) was developed to classify histopathological images of NSCLCs to determine the type of NSCLC present in each image. The model was trained off a training set of 3000 images, before validating the learning process through a validation set of 2000. A test set was used for evaluation. Based on the results, the accuracy and loss were calculated depending on how well the model was able to identify the class of the test images. The dataset used was publicly available. The CNN produced a 98% accuracy on the test data. This demonstrates that the CNN model can perform at a competent level meaning that it could be used in a professional environment alongside pathologists. This shows the potential that CNNs have in the field of pathology to aid the understaffed field of pathology with computer assisted detection for the accurate diagnosis of NSCLC tumors.

*Daphne Koutsoukos, Grace Papazoglou*

### **The Effect of Glyphosate on 2nd Generation Regeneration Time in Planarians**

Glyphosate is especially harmful to aquatic ecosystems and important to research the effects it has on various organisms because of the way that it inhibits the uptake of minerals of plants. The regenerative properties of *Dugesia tigrina* make the organism a good gauge for the impact a given toxin can have on an ecosystem. The impact of glyphosate was examined over the rate of 2 regeneration cycles in addition to the planarians' acute stress levels. This was explored through the use of different concentrations, as well as a control, through multiple trials. Mean, hypothesis testing, and bar graphs were utilized in order to determine the impact of glyphosate on the number of c-shapes observed as well as the first and second regeneration rate. The mean regeneration rate was 1 day longer in the first regeneration directly in the glyphosate and 2 days longer in the second regeneration. The 1st generation p-value was 0.049 and the 2nd generation p-value was 0.0122, demonstrating how there was in fact a statistical difference between the planarians regeneration fully in artificial pond water compared to the first regeneration being in a 25ppm glyphosate solution.

*Yashica Kumar- See Lindsey Chung*

*Sarah Levine*

### **Thermal Expansion of Perlite Microspheres as a Cryogenic Insulator**

Liquid hydrogen is a preferred fuel for aircraft and requires specialized containment. Since the fuel is cryogenic, internal insulation is key to an optimal tank. The most efficient insulation given the space constraints is perlite: a mineral composed of microspheres that can adopt a foam-like structure when heated. This perlite will be used for a mock cylindrical container with a 16" diameter sandwiched between two PVC pipes. This project is a proof of concept, with a thermosensor within endothermic fluid serving as a mock liquid hydrogen. The heat transfer will be determined via  $Q=AUT$ . Four different-layered containers will be tested: one without perlite or polystyrene, one with perlite only, one with polystyrene only, and one with both. Polystyrene is a similar porous foam substance used currently in hydrogen storage technologies and is a good base to determine the significance of perlite within the foam insulator market. The design consists of a semi-circle of PVC, with smaller layers of perlite, another PVC layer, and then polystyrene. In the center is a thermosensor within an endothermic fluid to mimic the nature of cryogenic substances. Perlite is a significant material not only for aerospace but could be used widely in storage and environment control for dozens of applications. One may not wish to use perlite for large, flat sheets of insulation, but for individual components the insulation demonstrates ideal qualities. The next step in the process is testing.

*Karen Li , Abigail Pappachen*

### **The Effect of Citrus Extract Exposure on Cell Differentiation Modeled in Planaria**

Citrus fruits and their peels have become the subjects of medical research for their potential as a source of medicinal compounds including carotenes, pectin, and a range of polyphenolic compounds. Previous research concluded that lemon extract can induce the apoptosis of MCF-7 breast cancer cells via Bax-related caspase-3 activation. With the potential of lemon extract to impede cancer cell proliferation, the potential of lemon extract cancer prevention can be postulated. Though these potential treatments can successfully inhibit cell proliferation, the exposure is not specified enough to target only “bad” cells. Understanding the impact of lemon extract on healthy stem cells is beneficial to understand the possible effects of using lemon extract in treatments for humans. Planaria were selected as a healthy cell model because of their ability to regenerate post-division. Their rate of regeneration will indicate the quality of function of their stem cells, the neoblast stem cells which allow them to regenerate. The purpose of this investigation was to determine the effect of lemon extract exposure on cell differentiation, modeled in planaria. Different groups of planaria were exposed to varying amounts of lemon extract for a 48 hour period then cut right behind the eyes, recording the time taken to regenerate to the eyes. It was found that the planarian exposed to lemon extract displayed regeneration times, on average, 1.4 days greater than those not exposed. Thus, it can be concluded that the addition of extract will inhibit stem cell proliferation and function, though the extent to which each increase in concentration affected regeneration could not be determined.

*Soyoun Moon*

### **Exploring Sexual Dimorphism and Sex Hormone Receptor Expression in the Bed Nucleus Of the Stria Terminalis (BNST) in the Monogamous Prairie Vole**

Sex differences in the brain can be seen in the behavior of rodent species such as approaches towards mating, acts of aggression, and parenting, which are regulated by gonadal sex hormones. Developmental sex hormones organize neural circuitry while adult sex hormones activate sex-typical behaviors. Moreover, estrogen organizes and activates rodent sex-typical behaviors. In males, testosterone is released from the testes neonatally. This is converted to estrogen in the brain by an enzyme called aromatase. A perinatal hormone surge establishes the sex difference in brain structure in mammals. However, specifically in the prairie vole, sexual dimorphism is not as evident in parental/social behaviors compared to other rodent species. For example, both sexes in the monogamous voles form pair bonds and co-parent while promiscuous rodent species do not. There is also less dimorphism in genital anatomy in early life, adult body size, and basal corticosterone in voles. It was hypothesized that a contributing factor to limited sexual dimorphism in social behavior of prairie voles is diminished sexual dimorphism in the bed nucleus of the stria terminalis (BNST), a known area in the brain that exhibits sexual dimorphism. To identify sexually dimorphic cell populations in this region in prairie voles, Nissl staining and in situ hybridization were used for established markers of dimorphic populations, including estrogen receptor alpha (Esr1) and androgen receptor (Ar). These markers were examined in juvenile and adult voles, establishing a trajectory for the development of BNST dimorphism in the prairie vole. It was found that there was no statistically significant difference between male and female voles in P14 (juvenile) and adult voles.

*Eshani Mukherjee, Samantha Singh*

### **Detecting Possible Relations between Copy Number Variation and Gene Expression Levels in Multiple Myelomas**

Multiple myeloma (MM), also known as Kahler's disease, is a malignant condition of the uncontrolled multiplication of plasma cells in bone marrow. Some symptoms of MM include but are not limited to anemia, pain in the bones that are affected, spontaneous bone fractures, and increased susceptibility to infections. The causes of myelomas are not clearly understood. The purpose of this investigation was to look at gene expression and Copy Number Variation (CNV) to find patterns in genes associated with multiple myeloma to understand possible genetic causes. The data for this project was obtained from the Catalogue of Somatic Mutations in Cancer (COSMIC). The Copy Number Variation data compared to gene expression data and their frequency in selected somatic mutations. Since the extent to which copy number variation contributes to human disease is not yet known, this project will aid in determining its influence on Multiple Myeloma in relation to gene expression. The CNV and the Z-score of the KRAS, HRAS, and NRAS were compared using a scatterplot and the relationship between the two was analyzed. Based on the data collected, there is no correlation between the Z-Score and CNV of a gene; for KRAS the correlation coefficient was 0.300 and for NRAS it was 0.033. Since both numbers are less than 1, it can be concluded that there is little to no correlation between these two variables.

*Melina Nicou*

**The Effects of Zinc Chloride on the Progression and Development of Cognitive Decline in Alzheimer's Disease in *Drosophila melanogaster***

Alzheimer's Disease (AD) is a neurological disorder that leads to the progressive decline in memory and cognitive function. Zinc (Zn) is a transition metal that is commonly found in the environment and in the brain as it is used in small quantities for development. However, zinc has the ability to bind to the N-terminal hydrophilic part of A $\beta$  ultimately causing aggregation of A $\beta$  as well as the production of reactive oxygen species leading to oxidative stress. It also causes the aggregation of Tau, a protein used to make microtubules that becomes bundled into filaments in an AD brain. This aggregation does not allow intramolecular disulfide bonds to form and promotes intermolecular bonds between cysteine residues. The objective of this experiment was to determine the effect that zinc chloride would have on an AD model of *Drosophila melanogaster*. In order to find this effect, 3 drops of 10% zinc chloride solution was dissolved into the food of the *Drosophila*. The *Drosophila* were then allowed to feed on this for five days before a Rapid Iterative Negative Geotaxis Assay was performed. To conduct the RING assay 9 fruit flies were distributed into 3 separate tubes. These tubes were then harshly tapped against the lab bench, ensuring that each fly fell to the bottom of the tube. The flies were then given five seconds, following the last tap, to climb the tubes. This was recorded, and the heights climbed in cm were observed from the recording. The AD flies that ate food with zinc chloride climbed significantly less than those that did not eat the food, (2.16 cm vs 5.27 cm,  $p= 3.14 \times 10^{-11}$ ). This suggests that zinc chloride has a negative impact on the cognitive function of *Drosophila* with AD.

*Matthew Pace- See Victor Angielczyk*

*Grace Papazoglou- See Daphne Koutsoukos*

*Abigail Pappachen- see Karen Li*



*Harry Poulouse*

**Antibiotic Homogeneity as a Method of Reducing Antibiotic Resistance in  
*Escherichia coli* and *Serratia marcescens***

The spread of antibiotic resistance to multiple strains of bacteria has caused the resurgence of once-curable diseases in our societies. According to the CDC, antibiotic resistance causes around 2.8 million infections and around 35,000 deaths per year in the US alone. Novel resistance mechanisms have impeded our ability to treat common bacterial diseases such as pneumonia, tuberculosis, blood poisoning, and gonorrhea. Using homogeneous antibiotic treatment (antibiotics of the same class) is generally seen to be disadvantageous compared to other treatments as it is believed to increase the rate of cross-resistance. However, a recent study done at the Max Planck Institute for Evolutionary Biology challenged this assumption through a study observing the evolutionary response of *Pseudomonas aeruginosa* strain PA14 to both homogeneous and heterogeneous sets of antibiotics. The results from this study show that fast-switching procedures involving homogeneous sets led to the highest rates of extinction. The purpose of this project was to utilize the method of fast-switching and observe the evolutionary response of *Escherichia coli* and *Serratia marcescens* to homogeneous and heterogeneous sets of antibiotics. Monotherapies of Carbenicillin (CAR), Cefsulodin (CEF), Meropenem (MER), Gentamicin (GEN), Streptomycin (STR), and Tobramycin (TOB) were tested. The homogenous sets CAR-CEF-MER and GEN-STR-TOB and the heterogeneous sets of CAR-STR-MER and STR-MER-TOB were also tested. Cell counts of *E. coli* and *S. marcescens* were measured and analyzed using spectrophotometry. For generation 1 of both *E. coli* and *S. marcescens*, the heterogeneous sets outperformed the homogenous sets. However, in generation 2, the homogenous sets began to converge in performance with the homogenous sets and actually outperformed them in generation 3. Results may support homogeneity as a viable treatment method in a clinical setting to treat *E. coli* and *S. marcescens* related infections.

*Lakshanna Raveendran*

### **Characterizing the Secretion of the *Francisella* Protein FTL\_1123**

*Francisella tularensis* is a gram-negative, highly infectious bacteria. It is the causative agent of the disease tularemia, which suppresses and evades intracellular innate immune responses. Recently, studies have examined the involvement of ToIC protein channels in *F. tularensis* pathogenesis because of its role in the secretion of virulence factors and therefore the survival of *F. tularensis* into host cells. ToIC channels often secrete proteins containing RTX (repeat in toxin) motifs which rely on secretion signals found in the C-terminus of such proteins. Using BLAST it was determined that the C-terminus of the FTL\_1123 protein expressed by *F. tularensis* has a region of local similarity to the RTX protein FrpC expressed by *Neisseria meningitidis*. This suggested that the predicted RTX motif in FTL\_1123 may serve as a domain required for its secretion through ToIC channels. Studies conducted aimed to determine if FTL\_1123 is secreted in a ToIC dependent manner and whether its predicted RTX domain is required for outer membrane localization. It was found that FTL\_1123 localized to the outer membrane without ToIC channels. However, these results cannot ascertain whether FTL\_1123 is secreted in a ToIC dependent manner because of limitations regarding overexpression to detect the protein. Additionally, it was found that the predicted RTX motif was significant to FTL\_1123 outer membrane localization. These results clarify the role of the predicted RTX motif and ToIC in *F. tularensis* secretion systems. This may allow scientists to create novel therapies and gain an improved understanding of host uptake and infection mechanisms.

*Samantha Singh- See Eshani Mukherjee*

*Inaya Syed*

### **Developing an Effective Method for Filtering Water**

As we grapple with issues like pollution, climate change, and a rapidly growing population, pressure is put on our natural resources. Given the significance of water in sustaining life, it's important to have access to clean water. The demand for water filtration is high because of the health risks associated with impure water. Many people around the world suffer from poor sanitation and resulting hygiene issues. Carbon filtering is a good way to remove sediment and chlorine. The purpose of this experiment was to determine which ratio of materials will purify water the best. Soda bottles were used as a base for the constructed filtration system. Various amounts of soil, gravel, and activated charcoal were added to systems. Water was run through the filtration set-up and the end product was run on a spectrophotometer to determine turbidity readings, with the lowest absorbance being the most filtered. Although the combination of 8g of Soil, 3g of Activated Charcoal, and 3g of Gravel had the lowest absorbance and was the best filtration system, there was no difference between the different filtrations systems because of the large variation in data displayed by large overlapping error bars. Knowing this ratio could allow poor countries to devise quick inexpensive filtration systems, therefore further research is needed.

*Zeynep Taşoğlu*

### **Predicting Regionals Spikes in COVID-19 from Tweets**

Since the release of a vaccine to combat the spread of COVID-19, there has been hesitancy by people to receive it. Vaccine hesitancy is a complex and context-specific phenomenon that varies across time, place, and vaccines. The leading reason for vaccine hesitancy is credited to the spread of online vaccine misinformation on mediums like Twitter and has been recognized as a major global health problem since. This research aimed to predict vaccine hesitancy in regions of the United States to help authorities take necessary precautions to prevent the further spread of the virus. Through the usage of a Twitter API, Tweepy, tweets with specific hashtags related to the vaccine and the pandemic along with their date, location, number of likes, and retweets were collected. Machine learning tools of text and sentiment analysis in the language of R were used to predict the tweet's stance on vaccinations. It was hypothesized that the usage of Tweepy will be able to forecast potential COVID-19 spikes in regions within the United States. It was also hypothesized that there will be a correlation between retweets and likes and predicted spikes, due to the rapid spread of misinformation they can induce.

*Maryum Waqar, Maheen Waqar*

### **The Effect of Sucrose Reward based Olfactory Training Neurofibromatosis Type 1 *Drosophila***

Neurofibromatosis Type 1 (NF-1) is a genetic condition that causes tumors to grow along nerves. Although the tumors are benign they can deteriorate cognitive abilities. These complications are considered among the highest causes of lifetime morbidity in NF-1 individuals. The purpose of our project was to assess memory based on how the NF-1 *Drosophila* perform in the choice-based T-maze after having been conditioned with banana and yeast scents through olfactory and sucrose-reward based training. We hypothesized that more flies would choose the banana and sucrose scent pathway due to the triggers associated with ripened fruit and the reward pathways they have formed post the sucrose conditioning. The experiment had the fruit flies conditioned first with yeast for 60 seconds and then with banana and sucrose. After conditioning the flies' memory was tested via a T-maze set up with the two scents in individual chambers and time was given for the flies to choose a pathway. On average more flies chose the banana and sucrose chamber (16 flies) over the yeast chamber (11 flies). The error bars don't overlap, indicating a significance to our results. The calculated p-value was 0.0106 which allows us to reject the null and accept the alternative hypothesis. Therefore, a statistically significant number of flies preferred the expected route (banana) over the other (yeast). Performance index calculations show that overall, the flies performed as expected for most trials except for two where the values were negative.

*David Yang*

### **The Combined Effects of Thalidomide and Kaempferol on Various Cancer Cell Lines**

Thalidomide, a common immunomodulatory agent, and kaempferol, a naturally occurring flavonoid that has been established as an ideal chemosensitizer, have both been used in experimental trials to show their possible synergistic effects with other compounds. Both have shown various anticancer effects and manipulation of various pathways altered in human cancers, most notably the P13K (Phosphatidylinositol-3-kinase)-Akt (Protein kinase B) signaling pathway and interference of VEGF (Vascular endothelial growth factor). As no study has been conducted on the combined effect of thalidomide and kaempferol in cancer, the purpose of the study was to investigate possible synergistic anticancer effects of thalidomide and kaempferol in cancer cell lines and elucidate the possible mechanisms that underlie this effect. It is shown here that combined kaempferol and thalidomide treatments significantly increased caspase activity ( $p = .0471$ ) while mitigating both cell survival ( $p = 2.09 * 10^{-7}$ ) and wound healing ( $p = .017$ ) in Colo-320 cells. All three markers show that combined treatments may have the potential to mitigate this specific cancer cell line, however, this is not true across all cancer cell lines. The use of both individual treatments and combined treatments on HTB-I I neuroblastoma cells yielded increases in cell survival ( $p = 7.75 * 10^{-9}$ ). This directly opposes the assumptions that kaempferol and thalidomide would have similar anti-cancer effects across cancer cell lines. This data supports further investigation and potential utility of kaempferol and thalidomide synergistically in certain anticancer treatment regimens.

*Asmaa Zahran- See Avi Gupta*

# UNDERCLASSMEN

*Sofia Ahmed, Katherine Hochberg*

## **The Effects of Various Genres of Music on Perceived Stress Levels in High School Students**

In recent years, stress levels have increased exponentially, particularly in younger people. Cheaper and more efficient ways to cope with stress are extremely important and in demand considering the toll that stress takes on a person's mental and physical health. The effect of listening to various genres of music (classical major, classical minor, jazz) was observed over the course of three weeks on perceived stress levels. Eight participants listened to assigned pieces within three different genres, and one week was allocated to each genre. During each week, at two checkpoints (Wednesday and Saturday), all participants completed Perceived Stress Scales (PSS) to determine their level of stress. These scores were compared to the control group of scores (scales filled out prior to listening to any assigned music). The results of this study determined that classical minor, classical major, and jazz genres do not have significant stress reduction impact. The PSS scores from after listening to music when compared to control PSS scores did not make a significant difference. All p-values were greater than 0.05 meaning there is no statistical difference. The Classical Minor Week p-value was 0.94, the Classical Major Week p-value was 0.96, and the Jazz Week p-value was 0.74.

*Arda Alptekin, Ayan Sheikh*

## **Modified Computer Coolant for Higher Heat Dissipation and Lower Central Processor Temperatures**

Technology demands a great deal of heat dissipation when cooling processors. The CPU die sits on a silicon chip with an attached heat spreader to ensure full coverage of the surface. The top of the integrated heat spreader (IHS) requires thermal paste to fill in any unsmooth surfaces reinforcing fully flush contact with the cold plate. Coldwater enters the CPU block through the inlet and exits as warm water throughout the outlet. The water travels to a radiator to be cooled with 120mm static pressure ball-bearing fans and the water returns to the pump/reservoir to be pumped back towards the CPU cold plate. This style of cooling is adequate for modern processors, but with evolving CPU architecture and the yearly wattage increase, these coolers will struggle. To combat this we increased the rate at which the coolant picks up heat from the micro fin channels. Cooling is important for the processor as it allows it to reach its full processor speed and wattage output. Cooling that is inadequate could harm processor health in turn giving the silicon a shorter lifetime. We accomplished better CPU temperatures by formulating different coolants with three ingredients, propylene glycol, ammonia, ethylene glycol, and water. We added corrosion inhibitors to prevent galvanic corrosion and set up coolant sensors at the inlet of the radiator to track the coolant temperature. To measure the CPU temperature we accessed hardware monitoring software in the computer and copied over the data graphs once the testing period was complete. We tested two different groups, a full water loop as control, one part of propylene, liquid ammonia, and ethylene diluted in water in a 10/10/10/70 split. Our experiment concluded that the test group coolant of the propylene and ethylene would dissipate heat the best and produce the lowest peak temperatures. Our results obtained illustrate that the test group 10/10/10/70 solution produced the lower package temperature, as well as lowered the coolant temperature. This resulting temperature drop was not as much as what we predicted and will need further testing to see if we can modify it further, possibly with the introduction of nanofluids.

*Juliette Amram*

### **Effect of Varying Doses of Calcium on *Drosophila* Flies with Alzheimer's disease**

The purpose of this investigation was to observe the effect of calcium levels on fruit flies, *Drosophila melanogaster*, with Alzheimer's disease by feeding them increasing amounts of a calcium solution and measuring how they performed with a negative geotaxis assay. It was hypothesized that the optimal amount of calcium was approximately 12 mg/mL. Five flies were placed in test tubes and recorded on video as they climbed to the top using the Rapid Iterative Negative Geotaxis Protocol. Timing the flies as they climb a test tube provided a quantifiable measure of their physical ability. Three trials were conducted in each group. When both groups of flies were given 100 mL of the Ca<sup>2+</sup> solution, the average distance climbed by the control group was 2.5cm and the average distance traveled by the experimental group was 5.4cm. At 200 mL, the control group traveled 0.9cm and the experimental group traveled an average of 5.2cm. At 300 mL, the control group traveled an average of 5.5cm and the experimental group traveled an average of 1.6cm. The hypothesis was supported. This demonstrates that calcium is helpful to Alzheimer's patients. Alzheimer's patients have difficulty regulating calcium amounts in the brain due to buildup of proteins. Adding more calcium to their diet helped bring the experimental flies closer to a balanced amount of calcium, helping them function better. The control flies traveled less because adding calcium to their diets caused them to consume more calcium than needed.

*Naomi Amram, Alexandra Schuval*

### **The Importance of Antennae in a Darkling Beetle and its Ability to Sense Food and Properly Function**

Darkling beetles are prone to having large antennae that aid olfactory sensing when searching for food sources. The beetle's antennae have a specific structure which work together to pick up on specific scents and obstacles in the insect's environment. This experiment tested the importance of the flagellum in the antennae and its ability to help the insect sense food when altered or damaged. With a damaged flagellum, the beetle's ability to forage for food should be weakened. After parts of the beetle's antennae were cut off, its behavior was observed in a plastic chamber. There were sections in the chamber containing positive and negative food sources: lime juice (acid: negative) and a potato (positive). In five-minute increments, the quadrant that the beetles were in was noted. It was hypothesized that a fully functioning pair of antennae would allow a darkling beetle to detect the positive food source more efficiently compared to damaged antennae. Results showed that keeping at least one flagellum intact still allowed the beetle to discover and approach the potato, but movement was limited. A chi test revealed that there was a difference in beetle movement with or without antenna ( $p=1.2114E-16$ ), this can be seen when the left antenna was cut off, the darkling beetles moved primarily to the right quadrant and when both antennae were cut off, the beetles hardly moved.

***Gabriella Barth***

### **Frozen Water Bears: The Most Effective Way of Cryopreserving Tardigrades**

Tardigrades are small, resistant water organisms, also known as water bears. They can be found in many different environments, but thrive on mosses and wet sand. The purpose of this investigation was to uncover if glycerol acted as an effective cryoprotectant for tardigrades. This could affect the medical world drastically and create more laboratory storage. The hypothesis was that glycerol would help to prevent cellular damage of tardigrades because glycerol is known to stop ice crystals from forming and puncturing through cell walls. Data was collected by creating a dry ice acetone bath at -78 degrees Celsius to simulate cryopreservation. Then the dilutions of glycerol in the sample were changed and then the vials were soaked. Once completed the frozen samples were viewed under a microscope. It was found that there was no difference between the different concentrations of glycerol and crystal ice formations near the tardigrades. Trials must be repeated for more accurate data sampling.

***Brandon Berkoff***

### **Molecular and Ice Water Content in Different Lunar Regions**

Studies show evidence of water ice in permanently shaded regions of the moon. The aim of this study was to determine which regions of the lunar surface might have higher concentrations of both molecular water and water ice using imagery and topography data from the Lunar Reconnaissance Orbiter. Extracting water ice and water molecules from the lunar surface will enable scientists to expand lunar research and allow the moon to be used as a gateway for future deep space missions. Water molecules and ice can be extracted and broken down into their components of hydrogen and oxygen and used to refuel launch vehicles for missions into the deep solar system. Two prominent features of impact craters are central peaks and ejecta blankets. The ratios between central peaks and their respective craters and ejecta blankets and their respective craters can be an indication of hydration on the surface of a celestial body. The region(s) of the moon determined to be most abundant in molecular and ice water was based on crustal strength by analyzing the ratios between central peak diameter to crater diameter and ejecta blanket radius to crater radius. Four different regions of the moon were selected for analysis based on geologic formation and geographical features: the lunar North Pole, lunar South Pole, lunar maria, and lunar highlands. Cross sectional profiles were taken of craters within these regions and each craters diameter, central peak diameter, and ejecta blanket radius was measured. Results showed the lunar maria region had the highest average ratio between crater diameter and central peak diameter, 0.232, and crater radius and ejecta blanket radius, 1.998. There was a statistically significant difference in the crater radius to ejecta blanket radius between the lunar maria region to the three other regions. North Pole to maria had a p-value of 0.0003, South Pole to maria a p-value of 0.0035, and highlands to maria a p-value of 0.0009. These ratios were then compared to the ejecta mobility ratios of other planetary bodies with known ice contents, Mars and Ceres, to draw further conclusions as to how likely it is that the regions analyzed have significant concentrations of ice and molecular water. This comparison further showed that the lunar maria region could have a significant ice content.



*Samantha Borre*

**To What Extent Does Activity Have an Effect on Blood Oxygen Levels In Musicians,  
Compared to Non Musicians**

Blood Oxygen Saturation is the measure of how much blood is able to circulate throughout the body, at any given point. The human body needs a specific amount of oxygen in the bloodstream, to survive and function, which is approximately 92- 100%. An SpO<sub>2</sub>, or blood oxygen saturation level, reading taken, using a pulse oximeter, is a test used to measure the amount of oxygen saturation in the bloodstream. In a 2012 study conducted by several scientists, it is stated that the disturbance of homeostasis induced by mild amounts of exercise can vary depending on multiple factors. One of these factors was exercise and prior training. While practicing a musical instrument, good breath support, or control of one's airflow/breathing is important in supporting the sound and quality of a song. Musicians get many hours of practice, working on their breath support, the longer they have been playing their instrument. In this study, the levels of oxygen present in the blood of various groups of musicians were observed using a Pulse Oximeter, to support the claim "Practice, and prior training, is necessary to support good blood oxygen levels". My hypothesis was that musicians would have more consistent, and higher SpO<sub>2</sub> readings. A survey was sent out to help classify each participant as either a musician, or non- musician. Each participant took an SpO<sub>2</sub> reading, before and after, running a lap around the track (400 meters). Finally, the before and after data was put into a spreadsheet in excel. The results showed that musicians do show more consistent before and after readings than non-musicians, with higher numbers on average according to the Paired T-test, taken for the before and after data of each participant, (musician= 0.0492 non-musician= 0.0085). Therefore, the hypothesis that musicians would have more consistent SpO<sub>2</sub> readings, was supported.

*Samuel Byrd, Anthony DuBois*

### **Sodium Bicarbonate to Counteract Sulfuric Acid in Aquatic Ecosystems**

Toxic leachate collecting at a low point near landfills is a common process by which sulfuric acid can enter bodies of water. Leachate is formed when rainwater percolates through landfills, thus dissolving harmful products of natural decomposition, such as acids. A pretreatment method for collected leachate is required, since a highly acidic living environment slows down regeneration rates in planarian and can increase mortality within the population. This reduces biodiversity and the overall health of local habitats. Planarians are flatworms that are frequently used as model organisms for their capability to regenerate into two separate individuals. Sodium bicarbonate was the chosen buffer due to its ability to neutralize sulfuric acid. The ability of sodium bicarbonate to counteract sulfuric acid, and its effects on regeneration, were tested in experimental groups with 0.0001, 0.0002, and 0.0003 mol sulfuric acid concentrations, and 20 mg of dissolved sodium bicarbonate in its own group. Additionally, a mixture of sulfuric acid and dissolved sodium bicarbonate was tested. Planarians were exposed to each environment until full regeneration was achieved. The hypothesis was that the regeneration rate would be slowed by the acidic solutions, but the effect would be negated with the addition of sodium bicarbonate as a pH buffer. It was indeed found that acidic solutions decreased regeneration rates, and that a pretreatment with sodium bicarbonate has no significant difference compared to the control. However, when combined with sulfuric acid, the planarian died within several days. This poses uncertainty to whether there is a chemical base that can neutralize sulfuric acid in an ineffective manner. The experiment brings awareness to the issue of acidification, and proposes a possible solution which can be further researched in additional experimentation.

*Jasmine Carpio, Meiya Lin, Lia Maglione*

### **The Effective Concentration of Er Xian Tang on *E.coli* as a Treatment for Urinary Tract Infections in Women**

A urinary tract infection (UTI) is defined as a bladder infection where a person may experience pelvic pain, pain when urinating, an increased need for urination, and even blood in the urine. Urinary tract infections occur more frequently in women than in men and are mainly caused by *Escherichia coli* (*E. coli*). Studies have shown that around 50%-60% of women will experience a urinary tract infection in their lifetime. In 2021, the CDC reported that over 13,000 deaths are linked with urinary tract infections each year. *E. coli* can enter the urinary tract from stool due to improper wiping, birth control, sex, and pregnancy. Chinese Herbal Medicines (CHM) have been found to decrease the presence of *E. coli* in the bladder epithelial cells. The purpose of this study was to determine if the Chinese Herbal Medicine (CHM), Er Xiang Tang, can be as effective as the Western prescribed medicine, Kanamycin in killing *E. coli*. If Er Xiang Tang can be an effective remedy for treating UTIs it would be a cost-effective benefit for those who lack health insurance. To test the efficacy of Western Medicine against Chinese Herbal Medicine different concentrations of Er Xian Tang and Kanamycin were exposed to *E. coli*. Using a Spectrophotometer, the amount of bacterial growth was determined. Results indicate that the concentrations of Er Xian Tang used in our experiment were not as effective as Kanamycin but suggests that higher concentrations of the extract may be. When combining the two treatments, it appeared to reduce the kanamycin potency. Further research needs to be done looking at concentrations of Er Xian Tang greater than 200uL, to be an effective inexpensive treatment of UTIs to poorer countries.

*Jillian Cestaro, Alexa Vrionedes*

### **The Effect of Distractions on Reaction Time**

Reaction time can mean the difference between driving safely or getting into a vehicle hazard. The reaction time varies from person to person depending on a variety of factors, an important one being preceding distractions. The faster a person can respond to a distraction, the more likely they will be to get themselves out of a dangerous situation, this can be applied to driving. The purpose of this experiment was to bring awareness to the impact technology has on reaction time concerning distracted driving. The participants underwent 9 ruler drop tests in which they were subjected to various distractions while being commanded to drop and catch the meter stick as fast as they could, the control did not include a distraction. Their reaction times were measured by the number of centimeters that it took for the subjects to catch the meter stick. The hypothesis was that distractions involving cell phones will have the greatest reaction time. A paired t-test was used to detect a potential statistical difference between the control group and any of the distractions. However there was no statistical difference between the control drop and the drops with a distraction (all p-values  $>0.05$ ), these results did not support the hypothesis. The distraction "texting someone" did get the lowest p-value of 0.053 out of all other distractions in the experiment, however it can be a coincidence. In conclusion, the distractions had little effect on reaction time because they didn't take enough attention away from the participant.

*Matthew Chacon*

### **Splitting Nitrophenol into useful resources using *E. coli* and *Pseudomonas fluorescens***

Pesticides have been a controversial and harmful use in the agricultural industry for decades. Due to some enzymes', like nitroreductase, ability to reduce man-made molecules, their usage has increased to decompose pesticidal chemicals like 4-Nitrophenol, reducing detrimental bioaccumulation that takes place in the environment. Nitroreductase is created by *E. coli* and *Pseudomonas fluorescens* break down nitrites, part of what make up 4-Nitrophenol. 4-Nitrophenol was put into contact with *E. coli* and *Pseudomonas fluorescens* in a petri dish and incubated for a designated time, with the difference in pH from the control being recorded after since a product of the reaction, hydroxide, is basic with the molecule being weakly acidic. The products of the reaction were more acidic than the reactants, being 1-2 pH units less, being the opposite of what the hypothesis predicted even though a reaction did take place. While more research is needed to determine the reaction, the 4-Nitrophenol was most likely decomposed due to the change in pH, therefore can be investigated for environmental decomposition.

*Rishin Chatterjee, Aareb Jatoi, Grace Kim*

### **Effects of Different Soils on Water Absorption**

Floods have dramatic effects on environments and communities in terms of casualties, destruction rates, and financial crisis. In fact, studies have recorded that forty percent of all weather-related disasters from 1995 to 2015 are floods, leading to an estimated 157,000 casualties. Furthermore, flooding has an average cost of 4.6 billion USD per event. Thus, the purpose of the following experiment is to determine which specific earthen materials (rocks, shells, clay, coconut coir, and aged manure) can help abate the water buildup caused by flooding within high risk areas, as modeled by a constructed rainfall simulator. The simulator consists of 3 layers, each housing 3 baskets. The first layer is the water-filled "rain", beneath them are the soil combined with the earthen materials baskets, below them are the collection baskets for the water runoff. The amount of water runoff was measured. The results showed that the soil with Coconut Coir absorbed the most water averaging 868.67 mL, followed by the soil with the Red Vulcan plant absorbing 868.33 mL. The soil with the shells absorbed the least amount of water averaging 496.67 mL. This data supports that Coconut Coir and the Red Vulcan plant can be used to prevent flooding in applicable areas. This data also shows that Aged Manure and Shells do not absorb much water and therefore would not prevent flooding. Since the Coconut Coir was established to be the earthen material that absorbed the most water, there should be future experiments that involve testing the health of different types of plant life, which would be planted in Coconut Coir soil. The test would determine whether or not the plants would be able to function and carry out biological routines that they would normally be able to experience when planted in normal topsoil.

*Ishana Chadha, Mehek Sawhney*

**Effect of ATRX Expression in Combination with MGMT Methylation and/or EGFR Amplification in Glioblastoma Survival**

Brain and other nervous system cancers are the 10th leading cause of death for both males and females. There exist genes that when present can silence the effects that other genes may have. Epidermal growth factor receptor (EGFR) causes cells to grow and differentiate. High levels of expression are common in many cancers. EGFR amplification has been shown to occur in roughly half of all glioblastomas. O(6)-methylguanine-DNA methyltransferase (MGMT) is a DNA repair enzyme. MGMT Methylation inactivates the usual DNA-repair function allowing tumors to be more responsive to radiation or alkylating agent-based therapy, We used de-identified data from the IVY Glioblastoma Atlas project to compare survival days and overall prognosis of a patient with the presence or absence of the ATRX gene using prognostic indicators such as whether or not the patient had MGMT methylation and/or EGFR amplification, along with the level of tumor resection. The concrete function of the ATRX gene is unknown, AT RX mutations have been shown to correlate with alternative lengthening of telomeres. In this study we tested whether the amount of ATRX gene expression will have a positive or negative effect on the prognosis of a patient when combined with MGMT methylation and EGFR amplification. In this study we demonstrated that Survival for those with an ATRX log gene expression less than 6 has an overall greater survival than those with an AT RX log gene expression greater than 6. When the patient has EGFR amplification the patient seems to have the same overall survival time regardless of the expression of ATRX. When a patient has MGMT methylation the patient with an ATRX gene expression less than 6 has a greater survival time. By molecular profiling brain tumors, we can improve diagnostic accuracy, therapeutic target identification and better predict prognosis.

*Akarsh Chilakala, Aaron Mathew, Andrew McConaghy*

### **Effects of Microplastics on *Daphnia Magna*'s Heart and Reproduction Rate**

Microplastics are contaminants that build up in the environment over time. Microplastic pollution is a global concern and has led to the deaths of plants and animals from every habitat and ecosystem around the world. *Daphnia magna* is a small consumer crustacean residing in freshwater that has a translucent appearance and is a part of the subclass of Phyllopoda. They are a source of food for fish and other organisms, which can inadvertently affect humans' longevity and diet, as seafood is one of our main sources of food. Microplastics have the tendency of bioaccumulating in the bodies of various organisms such as daphnia, where the chemicals will stay as the rate of intake is more than what can be excreted. We placed 150 mg/ml of microplastics, among four testing beakers in how much artificial pond water concentration for two weeks: control (no microplastics), 16% group (25 mg/ml), 33% group (50 mg/ml), and 50% (75 mg/ml), respectfully. After two weeks, we carefully observed the health and wellbeing of the *Daphnia magna* by measuring their heart and reproduction rates and recorded our data results in a table. The hypothesis for the number of *Daphnia* eggs was that it would stay constant throughout the experiment and the heart rate of the *Daphnia magna* was expected to decrease. The average results of the groupings are as follows: the control had an average of five eggs and 120 BPM, the 16% group had an average of three eggs and 115 BPM, the 33% group had an average of two eggs and 96 BPM, the 50% group had an average of six eggs and 92 BPM. As anticipated with the hypothesis of this experiment, the heart rate of the *Daphnia magna* decreased significantly, while the amount of reproduction was indifferent. The data collected supports the fact that microcrystalline cellulose particles affect the heart rate but not the reproduction rate of this aquatic microorganism. The contaminants enter the body through ingestion and travel to the stomach, where they are diffused along with the essential nutrients in their food into the blood. The microplastics course through the *Daphnia magna*'s open circulatory system to the heart, where it alters the beat and decreases its pulse rate. The blood doesn't directly circulate towards the brood pouch of the *Daphnia*, so the number of eggs produced there remain unaffected.

*Jaclyn Clements, Emily Kraus*

### **The Effect of Varying Wavelengths of Light on the Stress Levels in *Coenobita* Marine Hermit Crabs**

*Coenobita* marine hermit crabs play a very important role in the bottom dwelling community. They are important for a healthy ecosystem, because by eating decaying matter, hermit crabs process the nutrients and recycle them into a fertilizer. Light pollution from humans can have harmful effects on hermit crabs, and other marine life. Too much stress in the hermit crabs can lead to physical difficulties, and death. It was hypothesized that the behavior will change depending on light wavelength. If the hermit crab was exposed to red light, it would show higher levels of stress. Artificial night light would also increase the stress levels of hermit crabs, because any new environment can be stressful to adapt to. To simulate the different wavelength colors, colored light bulbs were placed over an experimental tank. The control group was observed under ambient light. The experimental groups consisted of green, yellow, and red light. Observations of the control group recorded that they were behaving normally. They ate and crawled around the tank. When placed under the red light for the duration of a week the effects of red light on the hermit crab were decreased movement, and climbing the walls of the tank. Both of these behaviors are symptoms of stress. Under yellow light, a new hermit crab was put in the tank for observation, the hermit crab stayed stationary inside of the tank. Differently from the red light, the hermit crab in yellow wavelengths did not eat. The hypothesis was therefore supported by the data. It is important to monitor and control our light pollution, because it has detrimental effects on organisms such as hermit crabs.

*Anthony DuBois- See Samuel Byrd*

*Haris Entizar*

### **The Effect of Sodium Bromide and Sodium Hypochlorite on Bulb Onion Root Length**

The purpose of this experiment was to test how sodium hypochlorite (NaOCl) and sodium bromide (NaBr) affected bulb onion root length. The sodium hypochlorite and sodium bromide solutions elongated the roots of bulb onions more than water. The concentration of sodium hypochlorite was 12% of 90mL and 6.9% for sodium bromide in a 90mL solution. Wooden sticks were used to pierce the onions to hold them above the solutions. Every week the 120 mL beakers were refilled with the solutions they were labeled with because the water evaporates and reduces the overall volume. The results were that sodium hypochlorite and sodium bromide both grew the onions more than water did. Therefore, the data supported the hypothesis. Onions over the sodium hypochlorite solution grew the most. A change I witnessed was that, for each trial, the root of the onion gradually increased. Sodium bromide grew the onion roots the second most. I witnessed a similar change with the onions under NaBr. They also gradually grew more with each trial. Onions under water grew the least. Although, water also had similar changes. For each trial, the length of the roots increased. According to the graph and p-value, there was a significant difference between the mean root length for sodium bromide and water as well as sodium hypochlorite and water.

*Michael Florentino, Jack Hatcher*

### **The Effect of *E.coli* K-12 on the Innate Immune Systems of Planarian**

Planarians possess innate immune systems, which are present within primitive and less complex multicellular organisms, plants, fungi and insects, composed of stem cells which all share the task of manufacturing various tissues that are important for maintaining homeostasis or in this case regeneration. Humans take part in tissue regeneration like planarians, but we cannot regenerate an entire body. So by studying the regeneration of planarian, information is indirectly gathered about how we can regenerate tissue and whether the innate immune system effectively aids the regeneration process. This was done by observing whether or not planarians can regenerate their photoreceptors whilst their habitat, artificial pond water, is infested with *E. coli*. The amount of *E. coli* within each petri dish varied from group to group. The planarians were cut twice, both times within the same petri dish which they were kept in originally. Overall, our hypothesis was supported, as the data indicates that the planarian, for the most part, were not able to grow their eye spots back faster after being cut a second time than the control group. This suggests their innate immune system does not play a major role in faster wound healing. Although the data does suggest that the 50 µl concentration of *E. coli* bacteria had the greatest influence on wound healing as shown by the fastest eye regeneration time. Further investigation is still needed to confirm these results.

*Amana Gardezy*

### **The Effect of Temperature Changes on Tardigrades in a Salt Stressed Environment**

This experiment evaluated how temperature variations in a salt stressed environment can affect the tardigrades in their survivability and how that can be used to further improve the knowledge on tardigrades. Scientists suggest that with global warming there will be an increase in evaporation making freshwater and saltwater environments saltier. It was hypothesized that the tardigrades will survive/perform best under lower temperature in a salt stressed environment. This information was recorded by keeping three sets of experimental groups and one control group. The control group had 6 tardigrades placed in a beaker with 10 % salinity and at room temperature (21°Celsius). The experimental groups had 8 tardigrades placed in a 10% salinity at a variety of different temperatures such as 50°C ,80°C and 110°C. They were categorized as alive,dead, or in cryptobiosis. The results that were portrayed resulted in tardigrades surviving best at lower temperature in a salt stressed environment rather than surviving best at higher temperatures. Results also showed that the tardigrades in higher temperature went into cryptobiosis. It was shown that as temperature increased survival rates gradually decreased. As a result of the data, it can be concluded that the tardigrades in lower temperature with a salt stressed environment survived and performed best as compared to the tardigrades in the higher temperatures with a salt stressed environment.



*Mitchel Ghermezian*

### **Measuring CO2 Content in Classrooms**

There have been many studies done on the effects of carbon dioxide (CO<sub>2</sub>) on the human body and on cognitive ability. This study showed that levels above 1000ppm cause a decline in cognitive performance, including decision making and problem solving. There were also respiratory symptoms in young children. There have also been studies done on the contents of CO<sub>2</sub> in an office environment and the health effects of exposure to 2000ppm or more include headaches, dizziness, and loss of concentration. However, there have not been studies done on CO<sub>2</sub> contents in classrooms. To measure these concentrations, a CO<sub>2</sub> sensor was placed in 5 different classrooms, and the CO<sub>2</sub> concentration was measured for 24 hours. Data was collected on the room size, the number of vents and windows, and the number of occupants, to see how these each affected concentration. During the school day, results showed that lab rooms, which are much larger than your typical classroom, did not reach the 1000ppm threshold. However, all other rooms, which generally have a standardized size, at some point during the day, reached 2000ppm or higher. This shows that in these classrooms, there are significant negative effects on the students due to these levels, meaning that measures need to be taken in order to protect our students' health.

*Ava Glick, Abigail Kleiman*

### **Using Termite Sounds and the Mosquito Audibility Test to Deter Termites From Wood**

Termites are destructive insects that feed on and destroy wood and can be detrimental to structures. Termites damage about 600,000 homes per year, and people in the U.S. spend about \$5 billion annually to fix termite destruction. Currently, these pests are being controlled by chemicals and pesticides that are harmful to the environment. Termites are skilled at sensing vibrations by using special organs in their feet. They use these daily by banging their heads on wood to create vibrations that alert other termites of food and predators. The frequency of the sound they make is ~500Hz. The Mosquito Audibility Test is a common test that uses increasing frequencies, from 1,000Hz to 30,000Hz, to examine hearing. The purpose of this experiment was to find alternative ways of pest control that are not environmentally harmful by using sound frequencies. Our hypothesis was that by using the sound of termites banging their heads and frequencies in the Mosquito Audibility test, termites could be deterred from wood. Termites were placed in soundproof containers with pieces of wood and played different frequencies in their corresponding containers. The mass of the wood before and after each trial was measured to determine how much wood the termites consumed while the sound was playing. It was found that the mass of the wood generally increased after each trial, however, with the 1,000Hz frequency, the mass decreased by 0.32%. This partially confirmed our hypothesis, but the many limitations faced call for further research.

*Ethan Gordon*

### **The Use of Different Net Configurations on Plastic Removal from Oceans**

The disposal of plastic in the oceans is killing marine sea life and destroying ecosystems. In 2020 alone, 5.25 trillion pieces of plastic waste is estimated to be in our oceans. Currently, Ocean Cleanup is developing a cleanup systems to combat plastic in the Great Pacific Garbage Patch. In order to combat this better Remote Operated Vehicles (ROVs) will have to be manufactured and deployed. To test the most effective netting design to remove plastics, an ROV was constructed with two attached netting sizes. It was hypothesized that the larger narrow net configuration will collect more plastic pieces than the small wide net configuration. Prior to testing all 7 known plastic types were cut into specific size pieces. The results are as follows: the larger narrow net configuration was better at picking up the PETE (polyethylene terephthalate), PVC (polyvinyl chloride), and the PS (polystyrene); meanwhile the small wide net configuration was better at picking up the HDPE (high-density polyethylene) and the PP (polypropylene). Based on these results, it may be better to sweep the ocean with the two types of nets to assure that all or a good majority of the plastics are removed.

*Tiffany Gracia Suarez, Lilly Schwan*

### **How Noise Pollution Effects the Behavioral Patterns of Hermit Crabs**

Noise pollution is unwanted noise. It is defined as regular exposure to elevated sound levels that can affect the health and well-being of living organisms. Marine invertebrates are a key component of all marine ecosystems. They play critical roles in essential ecological processes and form the basis of marine food webs that support other marine life. A sound greater than 70 dB is damaging towards crustaceans, like the hermit crab. The purpose of this experiment was to observe behavior patterns of hermit crabs in response to noise pollution over their threshold. We simulated the crab's natural environment in a tank with an inclining slope. A speaker was placed at the bottom of the tank where bass songs with over 70dB were played. Crab behavior was observed and recorded with and without the bass music in intervals of 3 minutes, 6 minutes, and 9 minutes. Chi Test showed no association between crab behavior and bass music, as the p-value was greater than 0.05 for all 3 intervals (0.44562, 0.65895, and 0.83921 respectively). Therefore, our hypothesis was not supported as noise pollution did not affect our hermit crabs.

**Chloe Gullo**

### **The Rate of Mass Degradation of Plastics on *Pseudomonas fluorescens*.**

Plastics in the environment accumulate at a fast rate due to humans' dependence on the benefits using plastics brings. Organisms adapted to this change and some can degrade different plastics. Using this adaptation humans may be able to control the output of plastics in the environment. One of these organisms is *Pseudomonas fluorescens* which has shown promise as a biological tool in aiding degradation rate. The purpose of this experiment was to identify which primary plastics could be degraded by this organism. It was hypothesized that the *P. fluorescens* will decrease the mass of the plastics greatly. There is a byproduct enzyme that gets excreted when *P. fluorescens* consumes its nutrients. The byproduct enzyme (depolymerase) of the organism is effective in breaking down high impact Polystyrene (PS). To begin the experiment, seven plastics were measured to about 0.03 grams each and placed into individual vials. The vials contained the Luria broth and *P. fluorescens*. The seven objects were placed inside a controlled environment with the temperature of 25 degrees Celsius for a week. The control was the same but without the *P. fluorescens*. Polyethylene Terephthalate, Polyvinyl Chloride, Polystyrene, and Polypropylene had consistent decreases in one or both trials, suggesting the bacteria degraded the plastic. High-Density Polyethylene and Low-Density Polyethylene increased in mass, suggesting they were not degraded by the *P. fluorescens* and the increase in mass was the *P. fluorescens* coating the plastic.

**Ethan Gullo**

### **The Effect of Ingesting Telomerase Enhancement Products on the Longevity of Fruit Flies**

A telomere is the end of a chromosome. When humans age, the telomeres naturally shorten due to cellular reproduction. Telomerase is an enzyme which is responsible for maintenance of telomere length by adding repetitive sequences. Previous research has connected shortened telomeres to several illnesses. Fruit flies were used as model organisms because many of the flies' genes are similar to those found in humans and control the same biological functions. In this experiment, the fruit flies were fed a telomere enhancement drug, to see if it has any effect on the longevity of the fruit flies. Three concentrations of the enhancement drug were prepared: 0.1g/100ml, and 0.2g/100ml, 0.01g/100ml, to represent a human dose of 1 to 2 capsules respectively and a 1/10 concentration, while no drug was used as a negative control. The solutions were incorporated into the flies' food, and any flies' survivability was recorded every two days. Results support that the Telomere Advantage enhanced fly longevity. This is evidenced by 40% of the flies being still alive after 16 days at concentrations of 0.01g/1000mL and 0.2g/1000ml, and 70% of the flies were still alive after 16 days at a concentration of 0.1g/1000ml. The control group, with no Telomere Advantage only had a 30% survival after 16 days. The concentration of 0.1g/1000ml had a less steep slope, meaning more survived longer. This suggests 1 capsule daily is most effective at extending longevity. This research is important as proof of product claim because if taking a supplement can increase longevity, that is a positive outcome.

*Trevor Hagemo*

### **The Effect of a Low Salinity Environment on the Hatching Rate of Brine Shrimp (*Artemia salina*)**

Brine shrimp are well-known to be amazing at adapting to life threatening changes in their environment. This research is important because when climate change happens and precipitation rates can be extreme, in one circumstance the water can get fresher and the brine shrimp will have to adapt. Brine shrimp are zooplankton, an important foundational species in their food web. The collapse of this level will have cascading effects throughout the ecosystem in which they inhabit. In this experiment there were three trials. The control had the optimal amount of oxygen and optimal amount of salinity. The first experimental group had the same amount of oxygen and decreased salinity. For second and third trials the amount of salinity was reduced by different amounts, but the oxygen will be the same throughout all of the tests. The last test was no air stone and just the air that is natural. With 38 ppt, a mean of 85% eggs total hatched, when there were 30 ppt, a mean of 70% eggs total hatched, when there was 22 ppt there was a mean of 45% eggs that hatched, and when there were 14 ppt there was a mean of 20% eggs hatched. This exemplifies that decreasing the salinity has a major impact in these brine shrimp and climate change in the real world would affect them massively.

*Jack Hatcher - See Michael Florentino*

*Zaarah Ishak, Ava Javaheri*

### **Efficacy of Natural Anti-Acne Remedies versus Over-the-Counter Acne Products on Growth of *P. acnes***

*Propionibacterium acnes*, gram-positive anaerobic bacteria, are usually present on oily regions of the skin and in hair follicles, contributing to acne development. With many products on the market claiming to be superb at clearing the skin, people are left with an overwhelming number of options to try without fully understanding what the impacts of differing active ingredients may be. These facial products may also cause unwanted and even skin-damaging side effects, like dry, painful skin outweighing any potential benefits. Instead, turning to natural alternatives can be more gentle and less irritating on the skin while still delivering suitable anti-acne capabilities. In the experiment, cultured *P. acnes* were grown in petri-dishes, discs were placed in each petri dish that contained distilled water (control), tea tree oil, salicylic acid, benzoyl peroxide, salicylic acid and glycolic acid and sulfur. After 7 days, the zone of inhibition was measured. The hypothesis was that natural products, like tea tree oil, have antibacterial properties and would be more effective than benzoyl peroxide and salicylic acid in eliminating *P. acnes*. As salicylic acid typically impacts the environment of the skin without antibacterial effects, this will have a less direct capability to eliminate bacteria, hence why natural products with antibacterial properties were more effective at clearing the skin in this comparison. As a result, tea tree oil was the most effective fighting off *P. acnes* as it kept consistent numbers throughout our trials. Surprisingly, sulfur being a natural alternative did not show any effect when eliminating *P. acnes*.

*Aareb Jatoi - See Rishin Chatterjee*

*Ava Javaheri - See Zaarah Ishak*

*Daniel Kamensky*

### **Different Sources of Light Emissions and their Effect on the Growth of *Chlorella***

Utilizing Microalgae to produce a renewable biofuel is a new and ever expanding area in science that may prove fruitful in helping solve the growing energy crisis in the future by utilizing already existing infrastructure and technology. While microalgae is a feasible source to compete with fossil fuels, some limitations remain in going from the pilot phase to the industrial level, this includes producing an abundant quantity. Previous research has shown that light in the blue range (425-450nm) and red range (600-700nm) will allow *chlorella*, a type of microalgae, to grow sufficiently and in large quantities. The purpose of this study was to determine if the source of light affected the rate of algae growth. Different sources of light were used to determine how they would affect the growth of chlorella over a 14 day period. The light sources used were a white LED (Light Emitting Diode) with Red or blue Cellophane, a Blue LED, and a Red LED. My experiment indicates that there was a slight difference between the growth rates of the blue light and cellophane compared to the control, but an unpaired T-test showed that the difference was not statistically significant. Therefore, the source of light does not affect algae growth and only the wavelength does.

*Natalia Kazimierczyk*

### **The Effect of Herd Mentality and Confirmation Bias in Numerical Estimation**

Confirmation bias and herd mentality affect many aspects in life, like politics, medicine, and ordinary decisions such as numerical estimation. By putting more value in confirming beliefs or the views shared by a group, people are led to biased decision making, which could lead to prejudice or irrationality. This research aimed to bring awareness to how such biases affect small decisions, so that people could take them into account when making more important decisions. In this survey, high schoolers were asked to estimate the amount of marbles in different jars and then were given different scenarios that incited confirmation bias and herd mentality. After the introduction of this new evidence, they had to re-evaluate their original decisions. It was hypothesized that participants would change their estimate to match the majority's answer more often. This is because herd mentality is more prevalent in teenagers and is present in decisions that are not based on facts, like numerical estimation. The hypothesis was not supported as most participants did not change their answer after seeing a majority's view. Comparatively, around 86% of participants did not feel influenced by opposing beliefs and instead put value into confirming estimates while only 22% changed their answer to match a majority's estimate. While it is assumed that confirmation bias had more of an effect on numerical estimation than herd mentality, there weren't enough participants to be fully certain in those results. Further research should include more trials or investigate whether other factors can affect numerical estimation as well.

*Alisha Khan*

### **The Effect of Simulated Acid Rain on the Locomotion of a *Zophobas morio***

Acidity in rain is a common occurrence. Species, reliant on water, are sometimes unable to tolerate acidic water. As a result, it is important to conduct an experiment to understand the effects of rain acidity on a *Zophobas morio* locomotion. Prior to the experiment, it was hypothesized that the excess amount of simulated acid rain a Darkling Beetle is exposed to, would result in their locomotion to depress. In order to begin the experiment, several solutions were made with different dilutions of simulated acid rain. These solutions were sprayed onto the Darkling Beetle's habitat, and the locomotion was observed by counting the number of lines crossed on a grid placed underneath the container the insects traveled in one minute. This project concluded with the results that the simulated acid rain decreased the locomotion of the Darkling Beetles. There was a r-squared value of 0.95, which is a strong correlation between simulated acid rain and locomotion. Therefore, the conclusions made supported the idea previously hypothesized.

*Manya Khatri, Farah Raufi*

### **Developing an Algorithmic Model to Identify Faulty Data in High Density Digital Data Storage**

The usage of cloud computing has been drastically increasing in popularity over recent years due to the vast amount of accessible data found on the infrastructure. Cloud computing follows the principle of high-density storage, a concept based on the idea of condensing stored items or data. Based upon how colloquial cloud computing had become over the years, there was a risk of encountering instances of bad data that would possibly damage files. Because of this, it was imperative that bad data could be easily found to ensure important files that a user would need are not corrupted. 60 data files found publicly on the Google Cloud Platform (GCP) were downloaded and meticulously analyzed using the four comparison points of size, project ID, dataset name, and location downloaded. After contrasting the results of the comparison points between our data files and classifying them as good or bad, we were then able to use our recorded and analyzed data to code an A.I. algorithm that could accurately and efficiently detect the characteristics of bad data held within the comparison points, while also automating the entire process.

*Grace Kim - See Rishin Chatterjee*

*Julia Kim, Emma Li, Kayla Rafft*

### **The Effect of Taurine and Panax Ginseng on Planarian Stress Levels**

Taurine and Panax ginseng are chemicals found in energy drinks. Planarias' organ systems, such as the nervous system, share similarities with humans, allowing them to be appropriate subjects in scientific testing. Taurine and ginseng are both said to lower cortisol, the stress hormone, yet not much is known about how these chemicals affect physical performance. The purpose of this study was to contribute to the understanding of the impact of energy drinks on planaria. Planaria were placed in a petri dish filled with each solution lined with graph paper. The planaria adjusted to the solutions for 3 minutes. The number of squares crossed by the planaria was used to find the average velocity. Based on the results, the conclusion was that taurine and ginseng had separate effects on stress levels of planaria. As the concentration of Panax ginseng increased, so did the average velocity. However, as the concentration of taurine increased, the average velocity decreased, but not significantly. Contrary to common belief that ginseng relaxes the nervous system, it was shown to stimulate the nervous system. Taurine was shown to induce stress, proved by the coiling motion the planaria demonstrated. The results showed that the only statistical differences were between the control and 0.04 grams of taurine, the control and 0.1 grams of taurine, and 0.04 and 0.1 grams of taurine. There were no statistical differences between any of the ginseng and the control, nor was there a statistical difference between the ginseng concentrations.

*Abigail Kleiman - See Ava Glick*

*Jin Ko, Peter Tine Jr., James Yu*

**The Effect of Increasing N-(phosphonomethyl) Glycine Volumes on  
*Lemnoideae* O<sub>2</sub> production**

With the rising trends toward weed management, increasing amounts of herbicides have been used, leading to exponentially greater disastrous effects upon the environment and aquatic life as agricultural runoff from heavy industry farms infiltrates still-waters, freshwaters, and aquifers. The purpose of this study is to clarify the validity of this claim by testing Round-Up on Lemnoideae O<sub>2</sub> production. Herbicide usage, most notably glyphosate in the product Roundup, has been increasing and is applied to more than 80% of acres of soybean, cotton, and corn. The former two make up more than 77% of glyphosate usage. Among the various aquatic plants that exist in the world, Lemnoideae also known as duckweed is a small species of floating plant, that was chosen for its significantly efficient asexual reproduction and impactful production of O<sub>2</sub>. Additionally, Lemnoideae has the ability to remove various dissolved solids from the water such as heavy metals and a diverse quantity of chemicals. The study was conducted by distributing Lemnoideae in four different isolated containers containing ~3300 ml of freshwater. Varying volumes of Round-Up were administered to each tank, proportional to the volume of water. Following this step, O<sub>2</sub> levels would be recorded daily in the tanks for three minutes over the following 4 days. It was hypothesized that as the concentration of N-(phosphonomethyl) glycine increased, Lemnoideae production of O<sub>2</sub> would decrease. Data indicates that even a minute volume of Round-Up can notably deteriorate O<sub>2</sub> levels, confirming the original claim of this study.

*Emily Kraus - See Jaclyn Clements*



*Gabriella Kuriakose, Crystal Migliaccio*

### **Effectiveness of Natural Treatments in Opposed to Hydrocortisone for Atopic Dermatitis**

Atopic dermatitis or eczema is a non-infectious skin condition that inflames and affects people's skin worldwide. Eczema is mainly caused by the corneal layer of the skin not renewing enough new skin cells to protect and keep in moisture. Some eczema patients use topical medications like hydrocortisone since it helps reduce inflammation and itchiness. Many studies have suggested that natural treatments, like aloe vera, can have the same effects as hydrocortisone and have less side effects. The purpose of our project was to find out the regeneration time planaria has when exposed to these different treatments, whether natural or chemical. Since we didn't have access to human skin for our experiments, we used planaria since their ability to regenerate its photoreceptors can be compared to a human's ability to regenerate skin. The photoreceptors of planaria were removed and the planaria were exposed to both 10% aloe vera solutions and 1% hydrocortisone solutions. It was hypothesized that the faster planaria were able to regenerate their eyespots the more effective the treatment was. In addition, it was hypothesized that natural treatments, aloe vera, would be more effective with regenerating new and healthy skin, rather than prescribed chemical medications like hydrocortisone. In contrast to natural treatments, prescribed medications have the possible effect of irritating the skin and can cause an allergic reaction. Aloe vera contains glucomannan, mannose- rich polysaccharide, and gibberellin which increases production of collagen stimulating the healing of wounds. These components in aloe vera have the ability of antibacterial, anti-inflammatory, antioxidant, and immune modulatory effects. Experimentation with aloe showed that the planarian took the least amount of time to regenerate their photoreceptors, 8 days. Aloe vera is known to have healing properties and is more effective in generating new and healthier skin. Natural treatments are the safer option and have been proven beneficial overtime.

*Julia Leahy*

### **The Application of the Planarian Motility Assay to Gauge Bio-modulating Properties of Nicotine, L-theanine and Melatonin**

In the past year many teens have turned to vaping as a means to de-stress from pandemic life. The vape is a highly addictive substance with no definitive conclusion on how their usage affects long time users. Planarians are model organisms to test these effects because they share a common ancestor with humans and are used to test the effects of substances on their ability to move and regenerate with its application to humans. The purpose of this experiment is to gain an understanding on how pens containing nicotine differ from the pens containing melatonin and L-theanine and if the Cloudy™ and the Chill™ pens could be used as a replacement for the Vape pen containing nicotine knowing that nicotine has effects that are more adverse. Using a planarian motility assay to test mobility after exposure to nicotine, and changing the concentrations of each substances to 27 ml of pond water combined with 1 ml of nicotine, melatonin and L-theanine solutions to perform the locomotor tests and subsequent dilutions were made after that. The expected outcome was that the nicotine groups would face greater agitated movements when exposed rather than the melatonin and L-theanine groups. The results of the trials supported the hypothesis that the groups exposed to nicotine covered more area and showed greater agitation, while the melatonin and L-theanine groups progressively slowed down until complete stop of motion. The experiment did not prove that the Cloudy pens™ and Chill pens™ would be a better solution for a vape as they would slow down a person's productivity. In a future experiment, the Harmless Cigarette™ would be another pen that could be tested to see if it gives the same relief as a vape without the damage to the body.

*Ashley Lewis*

### **The Effect of Water Hardness on Manganese Toxicity in Bean Plants**

Soil fertility is a major factor that affects plant health, and soil can be spoiled as a result of pollution. Manganese is a major contributor to plant biological systems and toxicity can induce an iron deficiency that can kill the plants. Water hardness, expressed as the concentration of calcium carbonate, can interfere with the plant's cell membrane integrity and cause a decline in plant health. The purpose of this experiment was to determine the effect water hardness has on the survival of plants exposed to Manganese toxicity. Understanding the effects of water hardness and manganese toxicity can help revise environmental guidelines to protect species by requiring anthropogenic sources which cause such detrimental effects to be more regulated. The LC50 for manganese on plant growth was 0.002mg/L. Plants were exposed to different levels of calcium carbonate to evaluate the change in growth of the Manganese toxic plants. Based on the no outlier data, the plants with the 120mg/L (Hard water) + 2PPM manganese grew the fastest, as they had the greatest slope, followed by the 15mg/L (Soft water), followed by the Control. The plants with the 60mg/L (Moderately Hard Water) grew the slowest. This pattern was seen with plant height. My hypothesis was not supported as plant growth was not decreased with increased water hardness in manganese toxicity. This could be explained by the solubility of the solutions. Due to the inconsistencies in seedling sprouting further research needs to be done.

*Emma Li - See Julia Kim*

*Edward Liao, Saharsh Peddireddy*

### **Machine Learning and Data Analysis for Personalized HIV Treatment Plans**

The Human Immunodeficiency Virus (HIV) continues to infect more than 37.7 million people with various symptoms. Untreated, HIV turns into acquired immunodeficiency syndrome (AIDS), where an individual's immune system is extremely damaged and is more prone to opportunistic infections and cancers. Currently, research on therapies to combat HIV has been done to make the virus less morbid and decrease mortality rates, but these treatments are still associated with drug-drug interactions, substantial toxicity, abnormal cost, and difficulties in adherence. Machine learning and data analysis are rising technologies and could be used to predict the most beneficial therapies for a specific individual. Using the pandas library for data analysis the viral load of patients was examined to identify advantageous treatments. Additionally, using the scikit-learn library a model was created to successfully predict the best therapy for a person. As a result of the comparatively small amount of data available from HIV patients, the model was able to make predictions with more than 500/0-600/0 accuracy after identifying correlations between treatment effectiveness and disease state. As more data is collected and is used to train the model, the accuracy of the model will increase. Maraviroc (MRV) was predicted to display promising results in the antiretroviral therapies, but as it is a new drug it was not seen in many treatments and enough data wasn't available to make conclusions on the effectiveness of the drug. Alternatively, Lamivudine(3TC) and Zidovudine (ZDV) were the most common drugs in the therapies and resulted in the decreasing the viral loads in most patients.

*Meiya Lin - See Jasmine Carpio*

*Lia Maglione - See Jasmine Carpio*

*Aaron Mathew - See Akarsh Chilakala*

*Andrew McConaghy - See Akarsh Chilakala*

*Nicholas Mendez*

### **Effects of Creatine and Branched-Chain Amino Acids on Planarian Regeneration**

The purpose of this project was to provide planarian regenerative data that could help athletes effectively boost their cell regenerative effects by using supplements creatine and branched-chain amino acids. These are certain muscle recovery and regeneration supplements that are known and proven to speed up recovery from muscle damage. It was hypothesized that if planarians, whose eyespots are removed, are exposed to muscle recovery supplements they will regenerate and recover faster than planarians who sustain identical injuries and are not exposed to any supplements. Four petri dishes were separated and labeled control, BCAA and Creatine, and filled, each petri dish was filled with 10 mL of artificial pond water. The creatine solution was made through mixing 5 grams of creatine with 296 mL of water as per manufacturer's instruction and reducing it to 1:100,000 fold. The same process was done for the BCAA's but instead with a 6g/296 mL mixture. Five planarians were placed into each petri dish. Planarians sat in concentrated solutions for 1 week. After 1 week has passed, using a pipette, planarians were transferred into separate petri dishes, keeping all planaria in their respective groups. The BCAA groups saw no change in regeneration time of the photoreceptors and the creatine planarian experienced mortality before regeneration could take place. The controls were able to survive throughout the experiment and lasted the average 15 days it takes for planarian eyespots to regenerate.

*Daniel Meneses, Nicholas Palmeri, Lucas Vazquez*

### **The Effect of Different Wavelengths of Light on How Darkling Beetles Get Their Food**

Darkling beetles, the most common name for the tenebrionidae species of beetles, pose a threat to plants and grain. They are one of the largest insect families in the world. Classified as scavengers, they feed on both dead and alive plant material, and are seen as pests towards stored grain. Problems have arisen due to infestations and depletion of crops. This dilemma could be solved by observing their behavior under different wavelengths/colors of light. Darkling beetles were placed in a maze under different colors of light. The amount of time it took to reach their food was measured and recorded. It was hypothesized that the darkling beetles would take the longest to reach the food in red light as opposed to yellow, blue, and white light. The data supported the hypothesis. The mean time that it took the beetle in red light was longer than all of the other wavelengths. In order, red, 763 seconds, took the longest, then blue, 202 seconds, yellow with 178 seconds and white, 113 seconds. It is important to note that within all of the data, each color had outliers. More trials are needed to one, further support the hypothesis and two, recommend red light as a way to deter darkling beetles from impacting on agricultural crops.

*Crystal Migliaccio - See Gabriella Kuriakose*

***Shivani Muthukumar***

### **The Effect of *Moringa oleifera* as a Phytoremediator of Copper Sulfate Toxicity**

*Moringa oleifera* is a plant from South Asia that has been used in phytoremediation to decontaminate water and remove heavy metals that are harmful to the environment and human health. It is important to find ways to remove toxins from the environment. The *Moringa oleifera* seeds can absorb and neutralize the positive charges that attract negatively charged metals in water. It was hypothesized that *Moringa oleifera* will be minimally affected by copper sulfate (CuSO<sub>4</sub>) and will uptake it from the soil. The aim of this project was to investigate the effect of *Moringa oleifera* as a phytoremediator of CuSO<sub>4</sub> toxicity by exposing the plant to copper sulfate and recording height and absorbance. Six experimental groups from 0 mol, 0.0625 mol, 0.125 mol, 0.25 mol, 0.5 mol, and 1 mol were watered to their respective pots every four days. Samples were analyzed on a spectrophotometer (650nm), and a standard curve was used to compare the plant samples. Afterwards, a few drops of hydroxide solution were added to test for copper alone. Based on the data, the plants stopped growing when exposed to CuSO<sub>4</sub>. The absorbance graph shows that there was an absorbance increase as the molar concentration increased. The copper reactivity test detected copper in the higher concentrations, but not in the lower concentrations. Therefore, my hypothesis was partially supported by these findings, as the plants were affected by CuSO<sub>4</sub> where the higher concentrations showed a potential CuSO<sub>4</sub> uptake. However, further testing is necessary to conclude findings.

***Nicholas Palmeri - See Daniel Meneses***

*Sahaj Pandey*

### **Prototype of a Desulfurization and Carbon Dioxide Separation and Capture System From Flue Gas with the use of Nanoporous Materials**

Carbon dioxide (CO<sub>2</sub>) and Sulfur Dioxide (SO<sub>2</sub>) emissions from factories have been increasing over the decades, leading to rapid climate change. In order to solve this major problem, many methods such as DAC and flue gas desulphurization have been attempted to lower CO<sub>2</sub> and SO<sub>2</sub> emissions through the capturing of carbon dioxide post-combustion, which all have flaws and downsides such as being highly priced, requiring high energy, and having poor gas selectivity. This CO<sub>2</sub> capture and desulphurization prototype is cost-effective, environmentally friendly, and enhances the porous capabilities of different materials for their intended purposes. The flue gas will be passed through three different porous materials in the order; silica gel, which serves as a desiccant to separate moisture from flue gas, molecular sieve 13x, which will desulfurize and separates polar gasses in the flue gas from carbon dioxide, and activated carbon, which will serve in capturing the carbon dioxide. As expected, due to the silica gel, the average humidity (%rh) decreased from an initial %rh of 36% to a final average of 15.8%. In addition, as a result of the molecular sieve 13x, the sulfur dioxide content of flue gas was found to have sharply decreased, as shown through a qualitative acidified potassium dichromate test. Lastly, the carbon dioxide content of the system decreased due to the porous capabilities of the activated carbon. The initial carbon dioxide concentration reached its maximum at 10013.9 ppm, while the final carbon dioxide concentration reached its maximum at only 2916.8 ppm.

*Samie Park*

### **The Natural Use of Calcium in Concrete to Increase Durability in Sustainable Building Materials**

Seashells, rich in an organic compound called calcium carbonate, are natural resources that can be repurposed into engineering materials rather than disposed of in landfills. Calcium carbonate is a unique substance, due to proteins trapped in its crystal structure, an increase in pressure and force makes it stronger. Concrete, a finite material used for architecture, could benefit from the structure of calcium carbonate in seashells to overall improve its current capabilities. The main purpose of this project was to improve concrete strengths by mixing it with different types of shells, clams and conches, of varying particle sizes. Different shells, clam and conch, were crushed into different sizes then separated based on size, and mixed with concrete. The concrete structures were then tested to determine which mixture could endure the greatest amount of force, as applied by the Vernier structures and material tester. The testing structure had to be custom made so the samples would fit in the Vernier device. Other issues did occur while testing, but current data does support which samples are more durable than others. The purpose for engineering such an experiment is to reuse materials while the best outcome showed that the least shells were the most effective overall.

*Abigail Parisi, Gianna Velasquez*

### **Effects of Lead Nitrate on Planarian Regeneration**

Leading back to 1597, lead nitrate has been involved in man-made production (paint, pipes, et cetera) and continues to contaminate the environment as the years continue. Many organisms are affected negatively by this unnatural chemical, including humans. Because planaria can regenerate, resembling similar processes of human stem cells, they were used to test the effects of lead nitrate on their environment. Three planaria were placed in each petri dish, containing 5 mL of artificial pond water and their respective concentrations of lead nitrate, 0% (control), 0.2%, 0.02%, 0.01%, and 0.005%. There were several trials conducted, each having three experimental groups with different dilutions in each trial. Each planarian was cut at the eyespots, the time of regrowth being recorded to determine the effect of lead nitrate on the rate of regeneration. Due to the lead nitrate exposure, it was hypothesized that the rate of planarian regeneration would either increase dramatically or stop altogether. As a result of the lead nitrate, most of the planaria didn't survive. The planaria that did survive didn't give viable results to base a conclusion on due to possible human error; the hypothesis was not supported. The relative change showed an increase in the rate of regeneration as the concentration amounts increased, underlying a validity to the hypothesis, but not proving it correct. Therefore, due to human error and an insufficient amount of resources, it has not been confidently determined how regenerating planaria respond to an environment containing lead nitrate.

*Saharsh Peddireddy - See Edward Liao*

*Kayla Rafft - See Julia Kim*

*Amantej Rana, Ishaan Singh, Jonathan Zhang*

**Suicide/Depression Rates and Mental Health Facilities/Health Professionals :  
A Retrospective Study**

Depression is a common illness impacting millions of people worldwide. Oftentimes, depression can lead to an individual committing suicide, or intentional self-harm leading to mortality. Suicide is one of the leading causes of death in both teens and adults worldwide. In 2017, a reported 47,173 people in the U.S. died from suicide, with 6,241 coming from young adults between the ages of 15 and 24. The purpose of this study was to determine if a correlation existed between crude suicide/depression rates and the amount of mental health facilities/professionals. Using data previously collected from the WHO and IHME, the correlation between countries' mental health rates and mental health facilities/professionals was determined using linear regression. It was hypothesized that there would be a recognizable moderate to strong negative correlation between the amount of mental health facilities/health professionals and crude suicide and depression rates. Intuitively, more mental health professionals and facilities should cause a lower suicide rate and depression count. However, it was expected that some countries will have a positive correlation between mental health facilities/health professionals and crude suicide rates, meaning that as the amount of facilities/health professionals increase, the suicide rate also increases. This type of correlation may exist in certain countries due to detrimental facilities/health professionals that may increase the suicide rate. Our results exhibited weak/no correlation between any of the types of mental health facilities/health professionals and crude suicide and depression rates.

*Farah Raufi - See Manya Khatri*

*Mehek Sawhney - See Ishana Chadha*

*Ayan Sheikh - See Arda Alptekin*

*Alexandra Schuval - See Naomi Amram*

*Lilly Schwan - See Tiffany Gracia Suarez*

*Ishaan Singh - See Amantej Rana*



*Anna Rohring*

**Effect of Freeze-thaw Cycles in Cryopreservation on the Survival Rate and Glucose Levels of Radish Plants**

Alaskan wood frogs are organisms that undergo freeze and thaw cycles, with help from glucose as a cryoprotectant, prior to being fully frozen for winter; their glucose levels are higher the more freeze-thaw cycles they endure. These sugars are extracellular cryoprotectant agents and aid in their survival rate. Plant glucose levels have also been shown to increase in colder temperatures when acclimated to cold. The relationship between the change in levels of carbohydrates of the Alaskan wood frogs and kidney bean plants was assumed to be the result of a similar biological mechanism; however, the basis of this mechanism is still unknown. The purpose of this experiment was to determine the optimal temperature for the highest concentration of carbohydrates in radish plants and on the plant's overall survival with use of similar procedures with the frog research. As many plants are sensitive to the cold and with climate change, bringing the possibility of unpredictable weather patterns resulting in extreme temperatures, it is necessary to find the optimal temperature of freeze-thaw cycles that will benefit a plant's survival rate. After being frozen and thawed, the carbohydrates were extracted and quantified with the use of a carbohydrate assay standard curve. It was hypothesized that as the number of freeze-thaw cycles increased, the plant's production of carbohydrates would also increase. This would happen because there is an observed relation between cold acclimation in plants and sugar accumulation. This was seen with the gradual increase of glucose over the freeze-thaw cycles; room temperature, 22°C, had an increase of 0.0002 µg/µl, 4°C had an increase of 0.0002 µg/µl, and 18°C had an increase of 0.0010 µg/µl.

*Peter Tine Jr. - See Jin Ko*

*Lucas Vazquez - See Daniel Meneses*

*DonVeon Tulloch*

### **The Effects of Temperature on Ants Behavior and Survival when Foraging for Food**

In the age we live in, climate change is a growing issue, where weather events like heat waves are more common through increasing global mean temperatures. As a result, the effects of climatic factors on animals and insects has attracted interest in the scientific community. The rising climate changes could very well alter insects' general behaviors and responses to the environment. In terrestrial communities, ants are dominant members and have large ecological effects in the ecosystem. The purpose of this study was to investigate the effects of temperature on ants foraging behavior and survival. Two ant chambers were built, one with a heat lamp to simulate global warming and one without to serve as the control. Both chambers required the ants to climb up for food. Five ants were placed in each chamber, and their behavior was recorded. The survivability (number of ants still alive) and the amount of food eaten was then recorded after several days. It was found that the ants exposed to heat had a less percent change in food consumption (57.1%) than the ants not exposed (62.6%), showing ants eat less with heat. Furthermore, the survivability of ants exposed to heat had a higher percent change (73.3%) than the ants not exposed (66.7%), meaning the ants exposed to heat survived less. This experiment supports that climate changes can affect the ants foraging and survivability, giving further insight of what we can expect to happen to other insects under the increasing climatic conditions.

*Gianna Velasquez - See Abigail Parisi*

*Alexa Vrionedes - See Jillian Cestaro*

*Maheen Waqar - See Maryum Waqar (upperclassman)*

*James Yu - See Jin Ko*

*Jonathan Zhang - See Amantej Rana*

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