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."
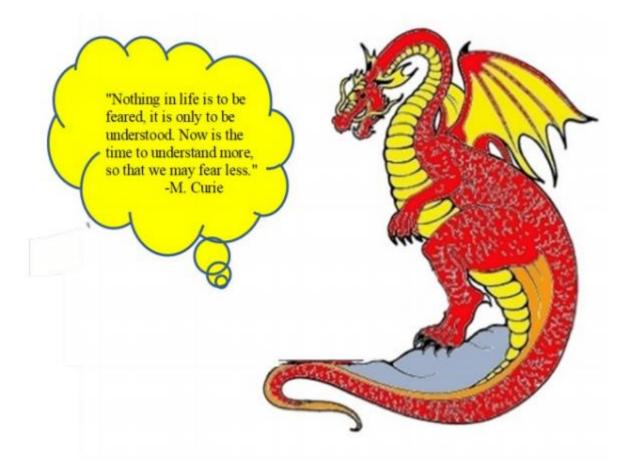-M. Curie

Commack High School's
Research Yearbook

2022-2023

A Celebration of Research at Commack High School
Wednesday, June May 31st, 2023
7:00 pm

Evening Events

Poster Presentation of student projects

Slide Show Presentation… Lia Maglione

Introduction…………..........Ava Glick

Signing of Pledge of Allegiance………..Alexandra Schuval

Opening Remarks……..……Dr. Laura Snell
    Director of Science, K-12

Student Reflections...…..… Saswati Bhattacharya, Nisa Eriskin

Guest Speaker……..…Ms. Deniz Sinar
    CHS Class of 2019
    Biological Engineering, Synthetic Biology Researcher
    Cornell University

Honoring Our Seniors…....Anna Rohring, Jonathan Zhang

Senior Picture Compilation….Alisha Khan

Closing Remarks…..…….Ava Glick

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. Jeanette Collette
Ms. Andrea Beatty
Mr. Alfred Franklin
Mr. Charles Guercia
Dr. Daniel Kramer
Ms. Kelly Moschos-Buonavita
Ms. Jeanne Suttie
Mr. Peter Tine

Ms. Laura Snell, Director of Science, K-12

Science Fair Participation

<u>Regeneron Science Talent Search</u>

Juliette Amram
Brandon Berkoff
Rishin Chatterjee

<u>Junior Science and Humanities Symposium</u>

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

Brandon Berkoff – 5th Place, Physics

<u>Long Island Science and Engineering Fair, Round 1</u>

(Round 1 finalists advance to LISEF 2 for awards)

Juliette Amram
Brandon Berkoff
Rishin Chatterjee
Manya Khatri
Jin Ko
Shivani Muthukumar
Sahaj Pandey
Anna Rohring
Mehek Sawhney
Ishaan Singh
Jonathan Zhang

<u>Long Island Science and Engineering Fair, Round 2</u>

Brandon Berkoff - 3rd Place, Math, Physics and Astronomy
              NASA Earth System Science Award
Jin Ko – Honorable Mention, Animal Science
          US Agency for International Development Award
Anna Rohring – Honorable Mention, Translational Medical Science
               US Metric Award
Jonathan Zhang – 3rd Place, Behavioral and Social Science

<u>Long Island Science and Engineering Fair, JV Division</u>- Cancelled

New York State Science and Engineering Fair, ISEF Division

Juliette Amram
Brandon Berkoff – Honorable Mention, Physics and Astronomy
Rishin Chatterjee
Manya Khatri
Jin Ko – Honorable Mention, Animal Sciences
Shivani Muthukumar – Honorable Mention, Biomedical and Health Sciences
Sahaj Pandey
Anna Rohring
Mehek Sawhney
Ishaan Singh – Honorable Mention, Earth and Environmental Science
               NASA Earth System Science Award
Jonathan Zhang – 2nd Place, Behavioral and Social Sciences
               American Psychological Association Award

New York State Science and Engineering Fair, Andromeda Division- Cancelled

WAC Lighting Foundation Invitational Science Fair

Arda Alptekin – Honorable Mention, General Biology
Juliette Amram
Brandon Berkoff
Jasmine Carpio - Honorable Mention, Medicine and Health
Ishana Chadha
Rishin Chatterjee – 3rd Place, Medicine and Health
Dominick Faini
Danny Fang
Michael Florentino
Amana Gardezy
Mitchel Ghermezian
Ava Glick
Jack Hatcher - Honorable Mention, General Biology
Aareb Jatoi
Manya Khatri
Julia Kim
Abigail Kleinman - Honorable Mention, General Biology
Jin Ko – 2nd Place, General Biology
Gabriella Kuriakose
Emma Li
Meiya Lin - Honorable Mention, Medicine and Health
Shivani Muthukumar
Sahaj Pandey - Honorable Mention, Medicine and Health
Saharsh Peddireddy
Thehan Perera

Amantej Rana
Anna Rohring – Honorable Mention, Medicine and Health
Mehek Sawhney - Honorable Mention, Medicine and Health
Alexandra Schuval - Honorable Mention, General Biology
Max Schweitzer
Ayan Sheikh
Ishaan Singh
DonVeon Tulloch
Jonathan Zhang – 1st Place, Behavioral and Social Science

The Kathy Belton Science Fair at Molloy College

Andrew Davis
Daniel Fang
Kyle Johnson
Julia Kim
Emma Li
Farah Raufi
Brian Suszczynski
Katerina Vrionedes

Long Island Science Congress – Junior Division

Lily Ahmed – Honors
       Lloyd K. Chanin Memorial Award $50
       Long Island Science Congress Award $50
Kenzie Albano – Honors
       Lloyd K. Chanin Memorial Award $50
Zainab Baber – Honors
       Lloyd K. Chanin Memorial Award $50
       LISC Award $50
Saswati Bhattacharya – Honors
       Lloyd K. Chanin Memorial Award $50
Mariam Bibi – Honors
       Lloyd K. Chanin Memorial Award $50
       LISC Award $50
Faye Bley – Highest Honors: Best in Category: Microbiology & Genetics $100
       State Science Congress Nominee
Ornella Bley - Highest Honors: Best in Category: Microbiology & Genetics $100
       State Science Congress Nominee
Ceylin Can - Achievement
Anoush Charkhian - Meritorious
Jaslyn Cloughen - Meritorious
Onyx Devivo

Alyssa Ellwood - Achievement
Jake Gerena - Honors
Jacob Ghermezian - Honors
Kenneth Halvorsen - Meritorious
Ali Hernandez - Meritorious
Max Hsu - Meritorious
Felicity Justich - Highest Honors: Best in Category: Microbiology & Genetics $100
                    State Science Congress Nominee
Joshua Kim - Meritorious
Jerry Lin - Honors
Alexandra Mitnick - Achievement
Krish Mukherjee - Meritorious
Ghufran Mustafa - Meritorious
Madinah Omarkheil - Meritorious
Prezemystaw Pas - Meritorious
Bradley Perry - Honors
Michael Petrizzo - Meritorious
Ava Prestia - Meritorious
Kevin Suszczynski - Meritorious
Joshua Tao - Meritorious
Gianna Tranchina - Honors

Long Island Science Congress – Senior Division

Gabriella Barth – Honorable Mention
Samantha Borre - Meritorious
Jaclyn Clements – High Honors
Nisa Eriskin - Honorable Mention
Ava Glick - Achievement
Chloe Gullo - High Honors
Alisha Khan - Honors
Emily Kraus - Honorable Mention
Ashley Lewis - Honorable Mention
Brianna MacDonald - Honors
Lia Maglione - Honors
Daniel Meneses - Meritorious
Abigail Parisi - High Honors
Kayla Rafft - High Honors

Neurological Surgery P.C. Health Science Competition -Cancelled

SAAWA Fair

Lily Ahmed
Kenzie Albano
Zainab Baber
Saswati Bhattacharya
Mariam Bibi
Faye Bley
Ornella Bley
Akarsh Chilakala
Jaslyn Cloughen
Andrew Davis
Anthony DuBios- $200 Environmental Science Mini-Grant Recipient
Nisa Eriskin
Dominick Faini
Ethan Gordon- $200 Environmental Science Mini-Grant Recipient
Ethan Gullo
Aareb Jatoi
Kyle Johnson
Felicity Justich
Grace Kim
Abigail Kleinman
Aaron Mathew
Brian Ni
Madinah Omarkheil
Thehan Perera
Allie Schuval
Casey Schwartz
Brian Suszczynski
Kevin Suszczynski
Peter Tine Jr.- $200 Environmental Science Mini-Grant Recipient
Alexa Vrionedes
Thomas Voss
Katerina Vrionedes

Supplemental Research Activities

Brookhaven National Lab CSI Spark Program – Ishaan Singh, mentored by Dr. Matthew Carbone

Columbia University Science Honors Program – Sahaj Pandey, Mehek Sawhney

Dormant Biology Lab, Stony Brook University – Akarsh Chilaka, mentored by Dr, Chi-Kho Hu

Harvard Science Research Conference
Lily Ahmed
Kenzie Albano
Juliette Amram
Zainab Barber
Saswati Bhattacharya
Amana Gardezy
Manya Khatri
Abigail Kleiman
Shivani Muthukumar
Sahaj Pandey
Saharsh Peddireddy
Amantej Rana
Anna Rohring
Mehek Sawhney
Ishaan Singh
Jonathan Zhang

Student Summer Research Placements

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

Barnard Pre-College Program
Brookhaven National Lab High School Summer Research Program
Brookhaven National Lab Virtual STEM Prep Summer Institute
Brown University Pre-college Program
Cold Spring Harbor Internship Program
Cold Spring Harbor Laboratory DNA Summer Camp
Cold Spring Harbor Laboratory Partners For The Future Program
Columbia University Pre-College Program
Dr. Bessie F. Lawrence International Summer Science Institute
Luminere Research Scholar Program
Engineering Summer Academy at University of Pennsylvania
Future Doctors Program by Harvard Student Agencies
Genome Science at DNALC
New York University Biology Department
ICaRe Cancer Research Program at SUNY Old Westbury
I-Stem Biotech Scholars Program
iResearch Institute
Independent research laboratory assignments
SUNY Stony Brook Garcia Program
SUNY Stony Brook Simons Summer Research Program
SUNY Stony Brook Laboratories
SUNY Stony Brook Biotechnology Summer Camp

ABSTRACTS

The StanMack Program

Isadora Avery, Matthew Chacon, Tiffany Gracia Suarez, Daniel Kamensky, Jin Ko, Sahaj Pandey, Maheen Waqar

Production and Molecular Characterization of Novel *Drosophila melanogaster* Lines for the StanX-4 P element Integration Site

The *Drosophila* fruit fly is an excellent model organism for studying the role of transposable elements and glucose homeostasis mechanisms, as these traits are shared with humans. Compared to the common rodent model, the fruit fly is a more convenient model for genetic manipulations due to easier access.

In this research-based course, students used advanced genetic and molecular biology techniques to explore the fruit fly genome. They utilized a P element called StanX-4, which was created by Stanford University and can capture unique enhancers. By mobilizing StanX-4 with Transposase, the students generated P elements inserted at various sites in the *Drosophila* genome, capable of capturing new enhancers. Using inverse PCR, the insertion site was mapped, and the captured enhancer's spatiotemporal expression pattern will be characterized using a LexAop-GFP reporter. Enhancer traps will be visualized using a second P element carrying a green fluorescent protein construct.

The Transposon element was mobilized using a cut-and-paste mechanism from the X chromosome to the second or third chromosomes after multiple crosses. The F3 generation was created, resulting in a stable stock containing flies with the StanX-4 gene on chromosome 2 or 3. Flies from each line were then prepared for inverse PCR, where genomic fly DNA was amplified using select primers to isolate the P-element and the surrounding DNA. Successful amplification was then sent for sequencing and located using online databases. Students designed primers for a missing 5' or 3' end to their insertion site. Successful students completing all class modules may achieve publishable research.

Student findings were presented to peers collaborating in the Stan-X International program in Lawrenceville, NJ, in April of this year.

SENIORS

Juliette Amram

The Effect of Carbon Dioxide Emissions on Abdominal Aortic Aneurysm Prevalence in Global Elderly Populations

An aneurysm is a bulge that forms in a weakened blood vessel due to the pressure on the blood vessel walls. If one bursts, an aneurysm is almost always fatal. Aneurysms are mainly categorized based on location: cranial aneurysms occur in the brain, thoracic aortic aneurysms occur in the part of the aorta in the chest, and abdominal aortic aneurysms (AAA) occur elsewhere in the aorta. Previous studies have demonstrated that higher exposure to particles that trigger inflammation, like air pollutants, may increase the risk of developing an aneurysm due to increased pressure on blood vessel walls. The purpose of this investigation was to find a correlation between carbon dioxide emissions and AAA prevalence among elderly populations throughout various countries. AAA prevalence was gathered through various global studies, and carbon dioxide emissions were obtained from OurWorldInData, an online database. Countries were selected in such a way that many different population ranges and locations were represented. The data demonstrated that there is a positive correlation between AAA prevalence among the elderly and carbon dioxide emissions worldwide, with an R^2-value of 0.622.

Gabriella Barth, Ashley Lewis

The Effect of Lavender Oil affect the Locomotion of Drosophila in a Gaucher's Disease Model

Gaucher's disease is a genetic disorder caused by a deficiency in the enzyme glucocerebrosidase, leading to the accumulation of certain lipids in cells, including those in the brain. Gaucher's is often linked to a high risk for developing Parkinson's disease because the same GBA gene is mutated. One of the most telling symptoms of Parkinson's are tremors, which are shown to affect locomotion. Lavender supplements have been shown to have neuroprotective effects and improve motor function in animal models of neurodegenerative diseases. The use of lavender supplements as a treatment for Gaucher's disease has not been extensively studied in humans. Drosophila, commonly known as fruit flies, have been used as a model organism to study Gaucher's disease due to their genetic similarity to humans and their well-characterized behavior. The active compounds in lavender, such as linalool and linalyl acetate, have been shown to have anxiolytic and sedative effects, which may also contribute to the improved locomotor function in the fruit flies. The purpose of this study is to determine if lavender supplements will increase locomotion of a Gaucher's modeled Drosophila (GBA) in the geotaxis assay. The results show the lavender increased the locomotion of the flies by allowing them to fly higher compared to those receiving no lavender, although there was no significant difference between the GBA group and the control group for the various concentrations of lavender. More research is needed to fully understand any potential benefits and risks of lavender.

Brandon Berkoff

Lunar Water Content as Determined by Crater Feature Analysis

Evidence of water ice in permanently shaded regions of the moon has been seen in previous studies. The aim of this research was to determine which specific regions of the lunar surface are candidates for higher concentrations of both water molecules and water ice using both imagery and topography data from the Lunar Reconnaissance Orbiter (LRO). This is important as water, broken down into its components, can be used to fuel launch vehicles for missions into the deep solar system. Estimating the surface water content was accomplished through crustal analysis by analyzing impact crater features. Prominent features of impact craters that may depend on water content include crater radii, central peaks, ejecta blankets, crater depths, and crater rim uplifts. Four different regions of the moon were selected for analysis based on formation and geographical features. The Lunar Maria region had the highest and most significant central peak diameter:crater diameter ratio when compared to the Lunar North Pole and Lunar Highlands (mean=0.232 p=0.0097, 0.0227) and ejecta blanket radius:crater radius ratio when compared to the three other regions (mean=1.998 p=0.0003, 0.0035, 0.0009). The Maria region also had the strongest relationship between crater diameter and crater rim uplift (slope=21.48 r^2=0.74). The Highlands region had the strongest relationship between crater diameter and crater depth (slope=13.32 r^2=0.65). These results suggest that the Maria region is the best candidate for further hydration studies.

Samantha Borre

The Influence of Race/Ethnicity on Temporal Artery Thermometer Reading Variability

A study by Emory University researchers found temporal artery thermometers had a 26 percent lower chance of detecting fever in black patients than oral thermometers. As a result, fevers went undetected in these patients. It is important to catch fevers early to help doctors with accurate diagnosing and timely treatment of medical illnesses. While studies have been done between two races on the temporal artery thermometer's accuracy, no studies have been done between other races/ethnicities. The purpose of this study was to determine the effect of different races/ethnicities on temporal artery thermometer readings. A colored printer was used with RGB color patterns in ranges of black to yellow, representing various shades associated with races. Readings taken from temporal artery thermometers. This study is important to determine if temporal artery thermometer readings are under-reporting fevers in other racial and ethnic, groups, as this is a primary feature in hospital and medical settings in determining active COVID-19 infections. My hypothesis that each skin tone generated to simulate different races/ethnicities would not have observable differences with the temporal artery thermometers was not correct. There actually was a difference between the different thermometers for the different skin tones, as all p-values were < 0.05. There was also a trend showing the 2 non-medical thermometers had lower temperatures readings on the lighter colors, opposite to the Emory study. This requires further investigation.

Jasmine Carpio, Meiya Lin

The Effectiveness of Supplements on *C. albicans* as a possible Treatment for Estrogen-Induced Yeast Infections

Birth control pills are a method to prevent pregnancy through a hormonal imbalance in estrogen. This interference increases *Candida* yeast infection frequencies, because estrogen promotes glycogen production nourishing the yeast. However, supplements provide the necessary remedies to hinder estrogen-induced yeast infections. *Lactobacillus*, a bacterium found in fermented products, harbors the potential to protect a vaginal ecosystem through interfering with pathogens via vaginal receptors. Coconut oil can help rupture the cell walls in yeast, hindering the growth. Similarly, tea tree oil has shown properties to interfere with the synthesis of yeast cell walls. In addition, oregano oil has been integral in destroying the biofilms of *Candida* causing the cell membrane to dehydrate. The purpose of this study was to determine if these supplements can be a natural remedy with a cost-effective benefit, specifically for those who lack health insurance. In order to test the efficacy against yeast infections, the different supplements were added to filter disks and introduced to *C. albicans* with or without estrogen in the media and the zone of inhibition was measured. Both the supplements of coconut oil and *Lactobacillus* yielded no results. Meanwhile, the supplements of oregano and tea tree oil yielded the largest zones of inhibition. Further results indicated that the presence of estrogen did not have any effect. In addition, after 24 hours of incubation, the tea tree oil was overall more effective than oregano oil at inhibiting yeast growth.

Rishin Chatterjee

The Effect of Curcumin and Curcumin Derivatives on the Decidualization and Cell Proliferation of Endometrial Stromal Cells

Endometriosis is a disease that causes inflammation of the uterine lining, resulting in chronic pain. Decidualization is a complex process which involves the differentiation of Endometrial Stromal Cells from rectangular shaped cells to rounded shaped cells followed by their proliferation in preparation for blastocyst implantation. Complications with decidualization can result in the onset of ovarian endometriosis. This process requires the regulation of cyclic adenosine monophosphate (cAMP) and progesterone. Decidualization can also produce senescent cells, which are cells that stop dividing but have the ability to secrete molecules which trigger inflammation. Endometrial senescent cells do not respond to progesterone and estrogen, hindering decidualization. Natural senolytics such as quercetin and curcumin have been shown to induce senescent cell death. The purpose of this study is to investigate the effect of curcumin and its derivatives on senescent cell death, through decidualization and cell proliferation measurements. The ELISA Sandwich Assay measures decidualization by the IGFBP-1 biomarker and the CyQUANT Assay measures cell proliferation. A sample of primary endometrial stromal cells was tested with eight derivatives of curcumin. All the curcumin derivatives inhibited cell proliferation, and all but one derivative inhibited decidualization. Although quercetin has been shown to increase decidualization, and curcumin has anti-inflammatory properties similar to quercetin, this study demonstrates that curcumin and many curcumin derivatives actually decrease decidualization. One exception was the curcumin derivative $C_{19}H_{14}F_2O_4$ which increased decidualization. This might be due to the presence of fluorine, although further investigation needs to be done to determine why this derivative behaved differently than others.

Dominick Faini, Aareb Jatoi, Thehan Perera

Effects of Different Gases on the on Darkling Beetle larvae Appetite

Populations found in higher altitudes have been shown to be healthier and able to maintain an active lifestyle, due to decreased appetites when in low oxygen environments (hypoxic). This has been found to be due to an increase in leptin, an appetite suppressant, which increases in hypoxic environments. However, a decreased appetite might be an issue for people suffering from eating disorders since it already hinders them from eating much at all. Several studies have suggested that populations living in lower altitudes have the opposite effect of increased appetites, and in turn, can struggle with obesity. In this experiment, darkling beetle populations were exposed to different oxygen environments by adding carbon dioxide and nitrogen to change the oxygen levels. Their appetite was measured by recording the mass of the food before and after. We found that the data did not support our hypothesis, meaning that there was no difference in consumption when there is a difference in air content. Our data may have been skewed due to the carrots absorbing the water moisture, causing an increase in size and negated the amount eaten. This happened mostly in the control. This study requires further investigation.

Ethan Gullo, Thomas Voss

The Optimization of Phage Therapy on E. coli-infected Planaria

Antibiotic resistant bacteria have been getting increasingly more dangerous each year. An alternative medicine known as phage therapy is a promising solution to solving this problem. Phage therapy is the process where bacteriophages (viruses that only attack bacteria) are used to target and kill pathogens. Similar in purpose to antibiotics, phages alleviate and eliminate bacterial infections. Phages attack specific bacteria (some attack a single genus or family), while antibiotics do not discriminate in what they attack. Therefore, phage therapy can be more effective than antibiotics in healing planaria's wounds. The purpose of this experiment was to test the effectiveness of phage therapy compared to antibiotics. Planaria were cut in half, and the eyeless half were placed in various *E. coli* cultures containing differing concentrations of the T-7 bacteriophage. The time for eyes to grow back in each dilution was determined. Planaria treated with phages showed a faster healing rate, although there was no difference observed among different phage concentrations. This research supports using phages as an alternative when antibiotic treatment is not an option in wound healing of bacterial infections.

Aareb Jatoi - See Dominick Faini

Alisha Khan, Lia Maglione, Brianna MacDonald

Azadirachta indica extracts and turmeric as traditional medicine for treating skin ulcers in a planarian model

Skin ulcers are defined as an open wound that develops on the skin as a result of an injury, poor circulation, or pressure. An ulcer is considered to be chronic, if it persists six weeks after the initial infection. Studies have shown that 9 to 12 million Americans suffer from skin ulcers. *Azadirachta indica* (neem) is a tree native to the Indian subcontinent, and various parts of this plant have often been utilized in traditional Asian medicine. *Azadirachta indica* contains numerous active compounds, of which several have pharmacological potential which give it numerous antioxidants and anti-inflammatory effects. Turmeric is a widely known spice that has the active compound, curcumin, which has been shown to be a potent anti-inflammatory and antioxidant. The purpose of this study was to determine if the neem, turmeric, or a synergist of the two compounds is most effective in treating skin ulcers by using a planarian model. Ten planarians were cut in half and the half without eyes were put into each solution. Data was recorded to see how many days it takes for the planaria to regenerate their eyes. Results indicate that the concentration of neem caused regeneration of eyes faster than just turmeric and the synergist. Further research needs to be done with concentrations of neem less than 0.1% in order to evaluate the ideal concentration without killing the planaria. Conducting research on turmeric powder and *Azadirachta indica* powder can contribute to a more effective, natural, and cost-effective treatment option for skin conditions.

Grace Kim

Impact of Flooding in Malarial Prone Regions

Increasing global temperature causes more water to evaporate and heavier precipitation. This affects the size and frequency of flooding. After a flooding event, the humidity rises. Mosquitoes thrive in higher humidity conditions because of the higher temperatures. This increases the habitat availability, leading to an increase in the population of mosquitoes within that area and raising a health concern because mosquitoes carry malaria. India is one of the countries that has high-flooding prevalence. Its geographical location makes India prone to flooding and monsoons. Research has suggested that there's a significant increase in malaria transmission post-flooding in a rural, highland area of Western Uganda in Africa; therefore, it was hypothesized that there would be a direct relationship between malaria transmission and post-flooding in India. Rainfall data was collected before, after, and during a monsoon from the Climate Data Service Portal and the malaria transmission data for India was collected from the World Bank. The purpose of the investigation was to determine the relationship between flooding and the incidence of malaria to understand the implications for climate change and disease control. The correlation coefficients that were generated from the data show that there is no relationship between the two variables—all of the values were extremely close to zero. The results are most likely due to the limitation of access to annual incidence of malaria data in peninsular and central areas of India. However, this doesn't reduce the value of the project.

Ashley Lewis - See Gabriella Barth

Meiya Lin – See Jasmine Carpio

Brianna MacDonald – See Alisha Khan

Lia Maglione – See Alisha Khan

Thehan Perera - See Dominick Faini

Max Schweitzer

Creating an Entirely 3D Printed and Customizable Putter

Golf requires a lot of accuracy to get a ball in a hole, so there is a demand for precision equipment. According to a study by Pan et.al., outcomes of tournaments for professional golfers come down to their putting skills. Therefore, golfers strive to improve their putting success. This puts an emphasis on understanding the putter design. By understanding putter design, even higher handicap players will be able to build a putter that would best fit their own needs. Different weighting and design of putters have different outputs such as forgiveness, feel, and power. Having the ability to print out a putter and then customize it will allow for any player to improve their game in the quickest and simplest way possible. Prototype designs were made on Autodesk Inventor Professional software using an Ender Plus 5 3-D printer. The design was customizable and allowed for the player to change at will. A mix of PLA+ and standard PLA filament were used for the body and either PLA or a more elastic filament was used for the face and other detachable parts. Joints were added on the face and back of the club head so easy alterations could be made for increasing weight, changing the softness of the face, or eye appeal. Slots were added where magnets can be added to adjust the putter's weight depending on the type of put. For testing, the path of the printed club was compared to that of a retail putter comparing the difference in accuracy. Since the public libraries have printers capable of 3-D printing, it is easily accessible for anyone to make their own customizable putter.

Thomas Voss – See Ethan Gullo

UNDERCLASSMEN

Lily Ahmed, Zainab Baber, Mariam Bibi

Heterogeneous Anodes Rapidly Perused for Oxygen Overpotential Neutralization

Fossil fuel combustion is currently used for energy generation. However, fossil fuels are limited and release greenhouse gasses into the atmosphere, which leads to global warming. This has led to many studies on solar fuel as an alternative source. Previous studies aimed at identifying cheap, earth-abundant catalysts for the solar-driven electrolysis of water into fuel have found that adding in small amounts of lanthanides increases catalyst activity in the oxygen evolving reaction. In this study, neodymium was explored as a possible lanthanide additive. Various combinations of mixed-metal oxides (including iron, cobalt, nickel, zinc, and neodymium) were tested as catalysts for oxygen formation for splitting water. Initial results show that addition of neodymium enhances catalytic activity. The catalyst activity for our best performing, which is composed of 25% neodymium, had a higher catalyst activity than our reference solution, which was composed of Ni:Fe:Co 20:40:40 (relative efficiency 1.747). As such, this study has shown that neodymium has promise as a potential component of a catalyst for splitting water into hydrogen and oxygen.

Kenzie Albano, Saswati Bhattacharya

The Effect of Negative Pressure on Bacterial Growth

Aerobic respiration is known to produce more energy (in form of ATP) than anaerobic respiration. It is common knowledge that by exercising, you keep yourself healthier. While exercising an athletes' muscle cells tend to have more mitochondria as they require more energy to keep up with the amount of physical activity they do. The more energy an organism can produce, the more efficiently that organism can carry out its metabolic processes. Since we had no actual way to measure the amount of energy an organism produces, we decided to do use the indirect measurement of growth as an indication of ATP production. By using a spectrophotometer to measure the absorbance of light, we were able to determine the amount of growth of an *E. coli* culture in both an aerobic and anaerobic (negative pressure) environment. The more growth that the bacteria had, the higher the absorbance of light. After collecting all of our data, we have found that the total mean was much higher for each trial in the aerobic group than the anaerobic test. Overall, the absorbance in the aerobic environment was up to 2.5x higher than the anaerobic environment. This research is important as it validated the impacts of oxygenated environments on growth. If people understand how exercising impacts energy supply, it can motivate them stay healthy and possibly maintain a better immune system to be more resistant to diseases.

Arda Alptekin, Jack Hatcher

The Effects of CBD oil on Termite Trail following Behavior

Termites are small invasive insects that cause detrimental damage to infrastructures of houses and wood furnishings. The backbone of termite societies are pheromones, chemical substances produced and released into the environment. Pheromone exchanges are vital in order to build a prosperous termite society and to effectively balance life functions in addition to specific roles within a colony. Cannabidiol is a naturally occurring chemical compound found in the cannabis plant. It was shown to have therapeutic effects over a wide range of disorders and also shown to reduce growth and increase mortality within an insect colony. The purpose of this experiment was to explore whether CBD can function as a natural insecticide in a termite colony. A figure-eight was drawn with a red ink pen. CBD oil was then infused into another red pen and an additional figure-eight was drawn. The time it took for the termites to stay on the path was measured. The average time the termite stayed on the trail without CBD was 121.59 seconds, while the average time the termite stayed on the trail with 0.0001% CBD was 155.14 seconds. Our hypothesis was supported that the introduction of CBD oil into a trail affected the termites' ability to follow the trail (unpaired t-test p-value: 0.0208), however, we anticipated the results would be worse with the CBD but it was actually better. This surprised us as it appears the CBD oil helped focus the termites more, and therefore, would not be a good insecticide.

Zainab Baber – See Lily Ahmed

Saswati Bhattacharya – See Kenzie Albano

Mariam Bibi – See Lily Ahmed

Faye Bley, Ornella Bley, Felicity Justich

The Effect of Ampicillin and Elderberry on *Streptococcus* Infections

Streptococcus is a gram-positive bacterium that causes strep throat. Strep throat is when a person's throat is inflamed causing it to be sore, one can also experience a fever and runny nose. Antibiotics are prescribed to treat bacterial infections, and ampicillin is known to kill *Streptococcus*, however elderberry is a natural substance with antibacterial properties. Many vitamins are supplemented with elderberry, because it is believed to be a remedy to boost the immune system and treat inflammation. It was hypothesized that elderberry would succeed in killing *Streptococcus*, making it a natural and cost-effective substitute for ampicillin. We tested ampicillin, elderberry syrup, and both combined on *Streptococcus mutans* grown in tryptic soy media. We used ampicillin disks and sterile disks, then measured the zone of inhibition for each. Based on our experiment we determined whether elderberry can be a successful natural substitute for ampicillin in killing *Streptococcus* infections. With antibiotic resistance being an arising issue because of the overuse of certain antibiotics, this may be an alternative solution.

Ornella Bley – See Faye Bley

Ceylin Can, Alyssa Ellwood, Alexandra Mitnick

The Influence of a Smartphone Proximity on Task Perseverance

As the advancement of technology increases, people have become more reliant on their phones. Research has shown that smartphones affect the attention span of teens; the presence of a cell phone alone can be a distraction. One important predictor of academic success is grit, which is strength of character, and it is possible that cell phone use affects student persistence, which in turn impacts academic performance. In fact, grit has been found to mediate the relationship between social media addiction and academic performance. We conducted a behavioral experiment to test the effect of smartphone presence on the persistence of solving a puzzle. Two groups of IB Physics students, one with access to their phones (Group A) and one without (Group B), were given 6 minutes to solve an unsolvable tangram puzzle. We recorded the time each participant stopped working and compared the average of the two groups. We hypothesized that the group with access to their phones will give up faster than the group that wasn't allowed access. The results displayed that smartphones did not have a significant effect on the time spent on the tangram puzzle based on a p-value result of p= 0.5489. Future research should include more time given to students to complete the puzzle and using a sample of participants in standard level classes.

Anoush Charkhian, Krish Mukherjee, Ghufran Mustafa

The Effects of Earthworms on Plant Growth

Earthworms are terrestrial invertebrates that increase nutrient availability in the soil. They assist the plants around it by providing the soil with a more stable structure. Earthworms can also enhance the decaying of plastics in the soil. We added varying amounts of earthworms to the soil (0, 1, 3, and 6) and grew kidney beans recording the plant height over time. We hypothesized the more earthworms you add the more plants will grow, but too many can be detrimental. Based on the data, the pots with one and three earthworms both grew to 42cm after 7 days, however, the pot with three earthworms had the fastest rate of growth. The group with six earthworms grew to 39cm, while the control grew to 33cm. Our hypothesis was not supported based on our results, and all pots with the earthworms grew better than the control. This research is important because it showed earthworms are beneficial to plant growth. These findings may help farmer's grow crops faster.

Jaclyn Clements, Kayla Rafft

The Effect of a High Prebiotic vs. Probiotic Diet on Parkinson's Disease Modeled in
Drosophila melanogaster

Parkinson's disease is a neurodegenerative disorder that is caused by the impairment or death of nerve cells in the basal ganglia. These nerve cells are responsible for the production of dopamine. Parkinson's disease affects almost 1 million Americans and there is no effective treatment for symptoms. The purpose of this investigation was to observe the effect of prebiotics and a postbiotic, *Lactobacillus plantarum,* on the symptoms of Parkinson's disease. Data was collected by performing a negative geotaxis test on Parkinson's *Drosophila* after administering various concentrations of probiotics. We hypothesized the diet of *Lactobacillus plantarum* will slow the progression of Parkinson's disease symptoms to a greater extent, compared to the prebiotic supplement. This is due to the fact that prebiotics act as food for microflora whereas probiotics replenish gut bacteria, therefore creating a more diverse microbiome. *Lactobacillus plantarum* has also been shown to increase dopamine production levels. Our hypothesis was not supported, as there was no difference between the prebiotic and probiotic different concentrations in the Climbing Assay, as seen by the overlapping error bars. However, there was a statistical difference between the control group and each of the different prebiotic and postbiotic groups, in that the flies were able to climb to the top of the chamber more quickly. This suggests both prebiotic and postbiotics are effective at improving the cognitive ability of Parkinson's disease *Drosophila melanogaster*, and could potentially assist in reducing symptoms. Further testing needs to be done to see if this is applicable to humans.

Ishana Chadha

Social Media and Political Polarization:

As more and more people use social media; many people have also begun to question how it is affecting society and the world. One such way that social media impacts society is through political polarization. Political polarization is when political ideas diverge from the center, and become increasingly more extreme. Since many people turn to social media for political information, it contributes to a person's political beliefs. People who do so are generally less aware/knowledgeable about a wide range of events and issues, and more likely to have heard and believed about a number of false or unproven claims. This contributes to polarization. This study aimed to quantify the level of polarization on social media. A point scale based on Pew research's substantive topics was developed for classifying social media posts which represents the level of polarized content. Two separate Tik Tok accounts, one that I used the algorithm to push extreme leftist content, and the other that pushed extreme rightist content. I tracked how many posts it took to get content that was skewed towards one political party using my point scale to evaluate how polarized it was. This process was repeated for 20 posts. I expected that social media would have a large impact on political polarization, but the data was statistically evaluated and found no difference between political polarization of Democratic (left) vs. Republican (right) social media accounts.

Akarsh Chilakala, Aaron Mathew

Supplementation of Probiotic *Bifidobacterium breve* to Increase Cognitive Ability of Alzheimer's Disease Modeled *Drosophila melanogaster*

Alzheimer's Disease is a neurodegenerative disorder which greatly impairs cognitive ability and usually occurs in people over the age of 65. One of the main causes of Alzheimer's Disease is a mutation that results in a buildup of beta-amyloids in the brain ultimately disrupting cognitive function. The probiotic *Bifidobacterium breve* has shown to reduce beta-amyloid production, therefore leading to improved cognitive function. In this study four generations of mutant Alzheimer's and wildtype *Drosophila melanogaster* were split into 2 groups. One group received food supplemented with probiotics (0%, 25%, 50%, 75%) and the others received non-supplemented food. Different tests such as geotaxis assay and aversive phototaxis assay were used to measure and observe the cognitive ability of the *Drosophila* for all four generations. Overall it was found that on average the fourth generation of flies with supplementation of *Bifidobacterium breve* did the best on both the aversive phototaxis assay and geotaxis assay. There was a progressive increase throughout the generations. Therefore, it was concluded, the use of *Bifidobacterium breve* can improve the cognitive ability of the *Drosophila.*

Jaslyn Cloughen, Madinah Omarkheil, Kevin Suszczynski

Simulating Plant Growth in Outer Space

Plants are the basis of our food web, and essential to our lives. They make life on Earth viable by producing oxygen and removing carbon dioxide, a greenhouse gas. If we need to survive on another planet, we need to determine which food source can grow in which environmental conditions. One way to test if plants will survive in space would be to evaluate the composition of different celestial bodies. If it is discovered that they can survive in certain soil conditions, these can be used to grow plants on the soil of other planets. Three different soils: organic (Earth), inorganic (Moon), and organic autoclaved (Mars) were used to simulate the soils of other planets. Radish seeds were grown in the different soils and plant height was measured after 14 days. Our hypothesis was supported in that the predominance of metallic elements that make up regolith soil, which contains less organic material, caused the plants to grow at a slower rate than the plants grown in organic soil. However, we were unable to get any growth with the Lunar Mare soil. The importance of our experiment was to see if we could grow plants on other celestial bodies for future survival needs.

Andrew Davis, Kyle Johnson, Brian Suszczynski

The Effects of Nitrates on Radish Plants

Nitrates are an essential nutrient used by plants for growth and development. If additional nitrates are added to plants then said plants growth will be accelerated. Radish plants (*Raphanus sativus*) were grown in separate plastic pots with 3 different nitrate solutions added daily with water: KNO_3 (1.01g/100ml), $Ca(NO_3)_2$ (1.6g/100ml), MgN_2O_6 (2.56g/100ml) respectively. A fourth pot, the control group, had no nitrates. Plant height was recorded for 37 days for each group and averaged, and the rates were calculated. It hypothesized that potassium nitrate would increase growth rate significantly, while calcium nitrate would increase growth rate at a small rate, and magnesium nitrate would not impact the growth rate in a positive manner. Results showed that plants treated with nitrates had a higher growth rate and higher final height. Plants treated with KNO_3 solution had a growth rate of 0.29cm per day and a final height of 10.72cm. Plants treated with MgN2O6 had the best growth rate of 0.30cm per day and final height of 11.28cm. Plants treated with $Ca(NO_3)_2$ solution had a final growth rate of 0.27cm and a final height of 10.04cm. The control group had the lowest growth rate of 0.25cm and a final plant height of 9.18cm. All plants treated with the nitrate solution were positively affected. This research can be used to improve plant productivity and yield.

Onyx DeVivo

The Effect of Fertilizers on the Eating Habits and Mobility of *Callosobruchus maculatus*

The bean beetle, *Callosobruchus maculatus*, feeds on mung bean plants, Vigna radiata. However, many factors affect the growth and internal makeup of this plant, with fertilizers being a particularly important variable. As such, the growth and subsequent behavior of the bean beetle may be affected by the mung bean plants. It is proposed that future studies will show impacts on the bean beetles due to the health and biochemical makeup of their mung bean plant-based diet.

Anthony DuBois, Ethan Gordon, Peter Tine Jr.

Optimizing Algal Biomass Production with Fertilizer Runoff for the Synthesis of Biofuel

Although efficient and inexpensive, fossil fuels have been shown to cause irreversible damage on a multitude of ecosystems. Algal biofuel is an alternative, sustainable energy source. Current algae-producing methods and technologies have limitations in regard to cultivation, resources, and cost that prevent necessary applications such as biofuel use. Polluted runoff having rapid growth of algae in the form of harmful algal blooms in aquatic systems, was used in this situation. Utilizing a synthetic fertilizer runoff recipe, algal biomass was measured with a spectrophotometer for concentrations containing sodium nitrate, ammonium chloride, glycine, and disodium phosphate. Additionally, four separate experimental groups doubled amounts of each respective chemical were tested to deduce an optimal combination of these pollutants. Results show that sodium nitrate had the greatest effect on algal growth rate, with an average increase of 0.17µg/mL. Additionally, the artificial runoff water had the second greatest, with an average increase of 0.115µg/mL. It is believed that this was due to the fact that fertilizers may already contain an optimal concentration for plant growth. These are in comparison to the control, which had a negative effect, decreasing biomass by 0.04µg/mL. This was likely because of the lacking nutrients being supplied to the algae. Regarding the other three experimental groups, negligible biomass growth was observed. Therefore, it can be deduced that an increase in sodium nitrate may contribute to expediting the growth process. Algae is a promising source of fuel and can be cultivated rapidly under the correct conditions.

Alyssa Ellwood – See Ceylin Can

Nisa Eriskin

Fluoride Toxicity and Dental Fluorosis

Several regions worldwide don't have access to safe drinking water because of geographical disadvantages, and economic drawbacks. The severity of fluoride toxicity depends on the amount of exposure, where higher levels of exposure can eventually lead to more severe damage. Regions with poor water quality lead to serious health problems, like fluorosis. Fluoride toxicity on tooth enamel is a subject of much debate in the field of dentistry. While fluoride is an essential mineral that can help prevent tooth decay and promote healthy enamel, unfortunately, excessive exposure to fluoride can have a significant negative effect on the structure and stability of the tooth. This study investigated the impact of an individual's specific factors like gender, age, and where they're located can affect how their body reacts to fluorosis and fluoride intake. I found fluorosis persists and continues in several regions even with all the advancements in research. The data showed the fluoride intake in children aged from less than 12 years old to 15 years old did increase dramatically during 1950-2004. Before 1970, there were significantly less numbers of tooth decay but ever since the increase in fluoride intake in different locations, the amount of tooth decay has exponentially increased. Overall, it can be concluded that massive amounts of fluoride intake lead to fluorosis affecting the enamel and permanent teeth thus impacting oral health. While fluoride can be an effective tool in promoting oral health, it is mainly important to use it responsibly to avoid future damages to tooth enamel.

Danny Fang

The Effect of *Persicaria hydropiper* on Wound Healing

Persicaria hydropiper is an aquatic plant that belongs to the Polygonaceae family and grows in shallow waters in damp areas. Aside from its use as a spice it has also demonstrated medicinal properties such as having anti-inflammatory, antioxidant, and antibacterial effects. This experiment investigated the effect of *Persicaria hydropiper* on planarian regeneration. Planarians were cut in half on a sagittal plane and the eyeless half of the planarian was studied for regeneration time. The experimental group was allowed to regenerate in a solution of artificial pond water (APW) with *Persicaria hydropiper,* while the control group had APW only. The time to regrow eyes was measured. Average of all trials showed that planaria exposed to the water pepper extract regenerated 20% faster than those without. This was supported by a p-value of 0.008. The results of this experiment could potentially provide a new understanding of the role of plant extract in wound healing.

Michael Florentino, Ayan Sheikh, DonVeon Tulloch

Effect of Rhizobium leguminosarum on the Growth of a Mung Bean Plants whilst exposed to Bean Beetles

Rhizobium leguminosarum is a soil bacterium, with the capability to improve the growth rate of a plant, by forming symbiotic relationships involving nitrogen fixation of the root modules. This study serves to assess the impact of the bean beetle (*Callosobruchus maculates*) being exposed to the plant while the growth is being aided by the bacteria inoculant. The Mung bean plant was used because research has shown its compatibility with both the *Rhizobium leguminosarum* and *Callosobruchus maculates*. Four groups of plants were compared against each other, each being affected by a different variable (control, beetle + bacterium, bacterium, beetle). The hypothesis stated that the Mung bean plants being treated with the Rhizobium Leguminosarum inoculant will show less of a change in growth, being that the primary nitrogen fixation function of *Rhizobium leguminosarum* has been shown to increase plant growth, and studies have shown links between bacterium in the rhizosphere mediating plant-insect relationships as well as inducing systemic resistance within a plant. The percent change in volume of the plant was calculated to determine the change in growth, using the ImageJ software. Data acquired indicates that plants with inoculant and bean beetles exhibited the largest decrease in area of the leaves. Plants without inoculant or bean beetles indicated the greatest positive volume change. This rejects our hypothesis. It was apparent that the rhizobium did not aid the plants in a net crop yield and instead may have hindered it. However due to a smaller sample size this requires further investigation.

Amana Gardezy

The Effect of Curcumin and Luteolin on Neurofibromatosis Development in a *Drosophila melanogaster* Model

Neurofibromatosis is a primarily pediatric genetic disorder causing tumors to form on nerve tissues. Neurofibromatosis is associated with neurocognitive impairments, like learning disabilities and behavioral issues. Curcumin and luteolin are two compounds found in plants that have been known to have a wide range of medicinal and therapeutic effects. These flavonoids have been studied for its anti-inflammatory and antioxidant properties, as well as its potential to improve brain function. The goal of the project is to determine if the combination of curcumin and luteolin can act synergistically to slow the development of neurofibromatosis cognitive symptoms. Neurofibromatosis modeled and wild-type *Drosophila melanogaster, the* fruit flies, were exposed effective dose of curcumin (1/10-gram ratio) and luteolin (4/10-gram ratio) based on previous research, and their effects were monitored over the course of ten days for changes in behavior. The wildtype flies fed curcumin and luteolin had no effect on cognitive behavior. The neurofibromatosis flies showed a decrease in average time to fly to the top mark when the flavonoids were added to the food. This was supported by a p-value of 0.0033. This research shows that flavonoids can act as a form of an inexpensive, effective, and non-toxic treatment of cognitive symptoms of neurofibromatosis and provides valuable insight into the potential of curcumin and luteolin to act as effective therapeutic agents in neurofibromatosis treatment.

Jake Gerna, Jacob Ghermezian, Bradley Perry

The Effect of Different Detergents on the Growth of *E. coli*

E. coli is a bacterium that is commonly found in the small intestines in many animals. Certain strains can sometimes cause illness like food poisoning. *E. coli* is often excreted with feces and ends up in waste products which can sometimes end up on soiled clothes. We wanted to investigate detergents, and see if one would be more effective in inhibiting the *E. coli* growth to potentially treat soiled clothing. To test our experiment, we chose three different detergents, Ultra oxi, Original, and Hygienic Clean. We made an overnight culture of *E. coli* and added it to each detergent respectively. The cultures were incubated for 48 hours at 37 °C and the zone of inhibition was measured. Detergents work when water-shunning tails of the soap molecules wedge themselves into the lipid membrane and pry it apart. The more soap molecules in the detergent, the more efficiently it should be at killing the *E. coli*, therefore, we hypothesized Ultra oxi would be the most effective. Our results did not support our hypothesis, as the Original had the greatest zone of inhibition of 2.46cm, followed by 1.88cm for the Hygienic Clean, and 1.26cm for the Ultra oxi. All detergents showed a reduction of *E. coli*, further research can be done to quantify how much was actually killed.

Jacob Ghermezian – See Jake Gerna

Mitchell Ghermezian

The Effects of Fluid Viscosity on Aqueous Single Bubble Sonoluminescence

Sonoluminescence is a phenomenon in which a gas-filled cavity rapidly compresses and decompresses, producing electromagnetic radiation. As the commercial applications of sonochemistry began to be understood and researched, sonoluminescence began to be researched by some chemists. However, sonoluminescence garnered more attention after single bubble sonoluminescence was discovered. Currently, the exact mechanism through which sonoluminescence occurs is unknown, although many theories have been proposed. This research looked at if changing the viscosity of fluids had an effect on the temperature of single bubble sonoluminescence. It was hypothesized that as fluid viscosity increases, the temperature of the bubbles would decrease, because the higher viscosity would prevent the bubbles from compressing as quickly, lessening the amount of plasma formed and lowering the temperature.

Ava Glick

The Effect of Sulforaphane and Metformin on the Development and Survival of a Skin Cancer Model of *Caenorhabditis elegans*

Melanoma, a type of skin cancer, causes more deaths than any other skin cancer. Current treatment includes chemotherapy and radiation, which can be expensive, so less expensive treatment options are needed. Sulforaphane and metformin are compounds that are both found to have anti-cancer properties and may be used in cancer treatments or as preventatives. Sulforaphane is found in cruciferous vegetables and is also used to treat asthma, hay fever, and sunburns. Metformin is a drug that is used to decrease inflammation, protect against cardiovascular disease, and cognitive impairment in non-diabetics. A synergistic use of these compounds may be an effective treatment for skin cancer, specifically melanoma by decreasing cell growth due to their anti-cancer benefits. The wild type of the model organism *C. elegans* was used in this experiment. The worms were placed in plates with no compound, sulforaphane alone, metformin alone, and both sulforaphane and metformin, where their body lengths were recorded before and after a two-day period. On average, the length of the worms in the metformin group had increased by 11.7%, and the sulforaphane group had increased by 8.4%, yet the length of the sulforaphane combination group decreased by 30.7% on average compared to the worms in the control group which decreased by 17.5%. These results support my hypothesis that the synergy of metformin and sulforaphane may help as an alternative treatment for melanoma.

Ethan Gordon- See Anthony DuBois

Chloe Gullo, Abigail Parisi

The Effects of Mycelia on Planarian Regeneration

Formaldehyde is an organic, colorless compound and is classified as a carcinogen because of its link to lymphatic, hematopoietic, and nasal cancers due to the inhalation of formaldehyde vapor from tobacco smoke, automobile emissions, and unvented gas stoves. Formaldehyde risks the development of cancer cells through the alteration of DNA and uncontrollable growth of cells. Mycelium is the fleshy network under a fungus that allows for the decomposition of organic substances. Because mycelium's ability to stimulate cell growth through the modulation of cytokines, it could be used for the treatment of some cancers. This experiment tested the effects of 50µL and100 µL of mycelium on planarian regeneration, which was accelerated by the formaldehyde. Three planaria were placed in each petri dish, containing 10 mL of the mixture of formaldehyde and artificial pond water and their respective mycelium concentrations. There were five trials conducted with mycelium, both concentrations killing the planaria, and five trials with the formaldehyde solution of 38 and 3.8 ppb, both concentrations yielding similar results. Each planarian was cut in half, and the eyeless half was placed into a concentration. The formaldehyde increased the regeneration rate of the planaria, but as mycelium was added to each solution, the rate of planarian regeneration decreased. The mycelium alone interrupted the development of the planaria. The T-test indicates a p-value of 0.0037, demonstrating a significant difference in cell growth with mycelium than without. The hypothesis is accepted, as the regulation in regeneration underlines a validity to the hypothesis.

Jack Hatcher – See Arda Alptekin

Kenneth Halvorsen, Prezemystaw Pas

The Role of Magnetism on *Lumbriculus variegatus* (California Blackworms)

Magnetic fields are common in outer space, they are found in planets, stars, and galaxies. Magnetism is of great importance as it is responsible for keeping the shape of our solar system. Without magnetism the Earth's atmosphere would be stripped away by the solar winds. Blackworms are model organisms for understanding biological systems, as they are sensitive to a variety of environmental conditions through distinct segmental shortening. Since magnetism is everywhere, it is essential that we study magnetism to uncover more about how the solar system supports life, in the event Earth is unsustainable and we must find life on other planets. We believe that the higher magnetism exposure would hasten the regeneration of the blackworms, having a negative effect from long term exposure. Blackworms were placed in the center of a container where one side had magnets and the other side did not. After minutes, the blackworm's location was recorded. Black worms were also cut in half and placed in one container with magnets, and one container without magnets. The results show our hypothesis was supported, as the blackworms regrew segments slower after injury when exposed to the Neodymium magnets that were surrounding their environment, as determined by the slope of the line. Also, we found the blackworms not exposed to magnets grew more segments than the blackworms exposed to magnets. Therefore, magnets were found detrimental to health, and is something we should be concerned with in the event we had to inhabit other planets.

Allison Hernandez, Ava Prestia

The Effect of Superoxide Dismutase (SOD) on Reactive Oxygen Species (ROS) Injuries in *Escherichia coli*

Many researchers use *Escherichia coli* as a model organism to investigate human health-related conditions. Reactive Oxygen Species (ROS) are naturally occurring free radicals in the body that can cause oxidative stress when produced excessively due to environmental factors, leading to tissue damage and potential cell death by damaging proteins or DNA. Alzheimer's disease is a prevalent condition, particularly in individuals over 65, characterized by neuronal changes that result in memory loss due to lost connections. Scientists are investigating the manipulation of ROS levels within the body to develop treatments for Alzheimer's and various cancers. Antioxidants, such as Vitamin C, can neutralize free radicals, reducing the surplus of ROS. Additionally, the enzyme Superoxide Dismutase can prevent harmful oxygen levels from arising in a cell caused by oxidative stress. Both Vitamin C and Superoxide Dismutase are antioxidants. To determine their effects on bacterial growth, we conducted an experiment using spectrophotometry to measure the absorbance of light in *Escherichia coli* cultures treated with solutions of Vitamin C and Superoxide Dismutase. Our results support the hypothesis that the addition of Superoxide Dismutase and Vitamin C promotes bacterial growth, with the SOD sample showing the greatest absorbance.

Max Hsu, Joshua Kim, Michael Petrizzo

Herbal Substitute to Lessen the Effect of Eczema

Eczema is a skin condition caused by dry, itchy, and inflamed skin that negatively affects the quality of life for those afflicted. Eczema has a very limited array of available treatments, of which are very expensive. It would be helpful for eczema sufferers to develop a treatment which is both affordable and effective. Herbal medicines are often used to improve one's health. *Chrysanthemum indicum Linne* and *Asparagus cochinchinensis Merrill* were tested on their effectiveness in wound healing on planaria, where planaria received varying doses of the medicinal herbs and their regenerative properties were examined. Planaria were cut in half and the number of days for eye regrowth on the eyeless half was recorded. We found that our original hypothesis that *Chrysanthemum indicum Linne* and *Asparagus cochinchinensis* would have minimal effect was supported, however, we could not conclude whether the planaria exposed to Chinese Herbal Medicine regenerated at a faster rate over planaria not exposed to Chinese Herbal Medicine because of the time increments we used. In the future, we will change our time increments. This research can help eczema rash sufferers.

Kyle Johnson – See Andrew Davis

Felicity Justich – See Faye Bley

Manya Khatri

A.I. Recognition Software for a Wearable Device Measuring Individual Physical Biomarkers

According to the World Health Organization, 1 in 10 adults suffer consequences from unawareness and undiagnosed mental and physical diseases. Additionally, a recent study from the Centers for Disease Control & Prevention found 85% of Americans do not visit their medical professional in a calendar year. My project aims to help people effectively manage, monitor, and track their physical biomarkers for quick identification & monitoring of their health, in addition to preventative mental & physical disease, by developing a machine learning model that identifies and updates a personalized baseline of biomarkers and uses trained layers of comparative analysis models to develop an output. For my procedures, the biomarkers of heart rate, blood pressure, body temperature, and oxygen levels were used, and trained a model within Google's TensorFlow A.I. to run various statistical tests on biomarker data to derive a personalized baseline of mean, standard deviations, variance, range, interquartile ranges, and z-score. The model was then trained to take in semi-continuous biomarker inputs and compared them to a user's baseline. The model identified the extent of variability in accordance with the measures of spread depicting internal bodily processes. Once the model identifies periods of variation within a specific biomarker, the model would output a warning. Post-training the model updated the baseline biweekly. Basic usage with simple multi-input Keras models and Model analyzer API was used for directed acyclic-graphing of layers to clearly identify comparisons of input to baselines and residual connections, within the layer graphs efficiently to clearly show variation.

Joshua Kim – See Max Hsu

Julia Kim, Emma Li

Metal Compounds on Tau Protein Aggregation and Memory Function in Alzheimer's mutant *Drosophila melanogaster*

Alzheimer's Disease (AD) is a common type of dementia, impairing memory function. Alzheimer's Disease typically occurs among older patients, and in 2022 about 6 million Americans over 65 were found to be living with Alzheimer's. Metals such as zinc and copper play significant roles in tau proteins, as they are metal-binding proteins that regulate metabolism, stability, and bodily functions. Drosophila melanogaster, the fruit fly, shares similar biological pathways with humans, making them viable candidates to study cognitive neurofunction. The purpose of this study was to determine the effect of metals on the AD brain. Solutions of different concentrations of zinc nitrate and copper sulfate were created based on LD50s and added to the food of both wild type and tau mutant Drosophila. A climbing assay was conducted for each concentration of metal on each type of fly, and rates were recorded and averaged. Results showed that tau mutant flies exposed to $Zn(NO_3)_2$ concentrations of 0.078% and 0.039% had a statistically significant difference in results compared to the control group, with a p-value of 0.000 and 0.008 respectively, as well as tau mutants fed CuSO4.5H2O concentrations 0.05% and 0.029% with p-values of 0.000 and 0.020 respectively. Results were statistically significant when CuSO4.5H2O concentrations 0.117% and 0.029% were compared in tau mutant and wild-type flies. This study contributes to understanding the benefits of these metals as an indirect method of studying tau protein aggregation in the brain.

Abigail Kleiman, Alexandra Schuval

The Effect of Water Hardness on the Cardiovascular Health of Daphnia magna

As the issue over water pollution prevails, small aquatic organisms become targets to its consequences. To protect these organisms, water hardness needs to be researched to ensure it is not damaging their cardiovascular health. The mineral calcium carbonate can be used to help organisms with their health, and we can change the levels of this mineral to affect water hardness levels. This research is important as it will help us create ideal cardiovascular health for microorganisms and protect them against harm. Daphnia were separated into four separate tanks with varying hardness levels: 25ppm (control), 50ppm, 250ppm, and 300ppm. There were three Daphnia in each container. After they lived in this water for two days, the heartbeat was observed under a microscope. We counted the number of beats per minute using a clicker. It was hypothesized that the higher the water hardness, the more notable the differences in heart rates. Our hypothesis was supported, in that the 300ppm group had the largest and a significant difference in heart rates when compared to the control group. This means that in general, the harder the water, the higher the heart rate will be. This is important as it shows how water hardness has a significant impact on the heart rate of Daphnia and can affect other aquatic microorganisms as well.

Jin Ko

Behavioral Analysis of Circadian Rhythms of PerL, PerO & w1118 strains in
Drosophila melanogaster

There exist several fallacies in maintaining a proper circadian rhythm. As the magnitude of exposure to sunlight or darkness varies across age groups, constant exposure to 12 hours of daylight and 12 hours of nighttime is nearly impossible. As a result, people are in a perpetual cycle of an unbalanced circadian rhythm, which can lead to conditions like mood disorders, cardiovascular dysfunction, and metabolic syndrome. This study was performed to measure the consequences of a disrupted circadian rhythm over age ranges, the effects of an arrhythmic cycle, and compare artificially disrupted circadian cycles vs naturally born arrhythmic cycles. *Drosophila melanogaster* was used as a model organism because it possesses similar circadian rhythms and mutations to these rhythms, allowing for their viability for studies in horology. The PerL mutation (Longer circadian rhythm), PerO (Arrhythmic circadian rhythm), and the w1118 (Wildtype) strains were utilized as each possessed different circadian rhythms. Various age groups of these three strains were entrained to a 3 LD (Light-Dark) cycle (10:10, 8:8, 4:4, 2:2) and then exposed to a CO_2 anesthesia assay. When comparing results to their control group, it was discovered that although the w1118 and PerO strains were not similar in locomotor activity, the trend of their variability was found to be greater in younger age groups than older counterparts. This essentially supported that, regardless of strain, *Drosophila* that are younger tend to be more greatly affected by entrainment cycles, pushing the importance of children to maintain a healthy circadian rhythm.

Emily Kraus

Effects of Water-soluble Vitamins on Planarian Regeneration

Cell regrowth is very important for our bodies to survive. The mechanisms by which various metabolites are produced, transported, and utilized to promote cellular regeneration are not well understood. The effects of vitamins on cell regeneration is important because knowing what vitamins help cell regeneration can tell us possible ways to heal wounds faster or know which vitamins people with vitamin deficiencies should take when they are injured. Vitamin C and Vitamin B are water soluble vitamins that are readily absorbed by the body. Planaria are model organisms for wound healing because of their regenerative properties. Their regeneration rate would be a good assessment of the effects of the vitamins. Planarians were cut in half and the time for their eyes to grow back were measured. They were placed in a 1:3200-part solution and were measured in days it took to grow back eyes. It was hypothesized that a mix of Vitamin C and Vitamin B-complex will result in the greatest amount of regrowth. Also, the B-complex specimen and Vitamin C specimen would grow faster than the control specimen. The Planaria in the Vitamin b-complex solution took 5 days to grow eyes. The planaria in the Vitamin C and B/C mixture did not survive. It can be concluded that high concentrations of Vitamin C are not good for cell regeneration.

Gabriela Kuriakose

COVID-19 and Diabetes Prevalence

Diabetes is a long-lasting disease that affects the body's ability to turn food into energy. People that are most prone to getting diabetes are obese, inactive, or take recreational drugs. Over the years, there has been an increase in diabetes cases. When COVID-19 hit the world in 2019, many people were fearful of the disease since little was known about it. Researchers found people with autoimmune diseases are more prone to getting COVID-19. Another study found the numbers of immune cells in the circulation of a COVID-19 patient declines and the functionality of the remaining cells is impaired. It was believed this is why people are more susceptible to secondary infections during, and right after recovery from a COVID-19 infection. The aim of this study was to determine if the COVID-19 pandemic caused an increased prevalence of diabetes. This research focused on rates of diabetes in the states Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, Delaware, Maryland, New Jersey, New York, Pennsylvania, Virginia, and West Virginia pre (2017, 2018, 2019) and post (2021) the COVID pandemic. The rate between the prevalence of diabetes before and after COVID was compared for various states. The results of this research were that diabetes rates had an increased rate of prevalence after the outbreak of COVID-19. With lowering and leveling rates in the years before, the year 2020 experienced a great increase in prevalence in most states. This research can help understand the impact of COVID on people with secondary illnesses.

Emma Li – See Julia Kim

Jerry Lin, **Gianna Tranchina**

The Effects of Caffeine on Aggregation of *Lumbriculus variegatus*

Across a majority of organisms, there are many diverse and unique characteristics to each of them, but one commonality, besides basic characteristics of life, include sleep. Observing how sleep impacts an organism's survival mechanism, such as aggregation, could help us get a better understanding of the world around us, and the organisms in it. Due to this, discovering if sleep insomnolence has an impact on the aggregation of California Blackworms could show beneficial advancements in the fields of biology and ethology. In our experiment, we explored the stimulant, caffeine, that is known for decreasing fatigue and increasing alertness, and recorded observations, regarding how their aggregation is impacted. California Blackworms, or *Lumbriculus variegatus*, are a species of aquatic worm, which, under stressful conditions aggregate as a means of protection. After exposing the blackworms to caffeine, we discovered that caffeine's effects did significantly impact the aggregation of the worms, as the average amount of time it took for the worms to complete aggregation decreased by about 3.1 seconds. This is supported by a p-value < 0.05. Blackworms affinity for aggregation may be linked to their sleep cycle but further research is needed to support this.

Aaron Mathew – See Akarsh Chilakala

Daniel Meneses

The Effect of *Zingiber officinale* Treatment on Concussed *Drosophila melanogaster*

Concussions are a common form of traumatic brain injury that can have long-lasting effects on cognitive function and motor coordination. *Zingiber officinale*, commonly known as ginger, has been shown to have anti-inflammatory and neuroprotective effects in animal models of brain injury. *Drosophila melanogaster,* or the fruit fly, has been used as a model organism to study the effects of concussions on the brain. In this study, I investigated the effects of ginger on concussed flies using a locomotive climbing assay. One group of concussed flies were fed regular food while another group was fed food containing ginger. A high impact trauma (HIT) device was used to concuss the flies. The amount of time taken for the flies to reach the top of a testing tube was measured. This study was aimed to find an immediate remedy to assist in cognitive impairments caused by brain injury. The results showed that ginger treatment improved the locomotive function of concussed fruit flies, as these flies recovered faster than the concussed flies not fed ginger. Though it is evident that ginger is very beneficial in aiding fruit flies through concussion recovery, further research is needed to fully understand the potential benefits and risks of using ginger as a treatment for concussions in humans.

Alexandra Mitnick - See Ceylin Can

Krish Mukherjee - See Anoush Charkhian

Ghufran Mustafa - See Anoush Charkhian

Shivani Muthukumar

Identification of MicroRNA (OncomiRs) That May Inform Increased Risk for Progression of GERD and *H. pylori* to Gastric Cancer

Gastric cancer is a leading cause of cancer-related mortality worldwide. Gastroesophageal reflux disease (GERD) is an illness where stomach acids reflux back to the esophagus. An infection caused by the bacteria *Helicobacter pylori (H. pylori)*, causes chronic inflammation in the stomach. Both GERD and *H. pylori* are risk factors for gastric cancer. MicroRNA (miR) are single-stranded, non-coding RNA molecules that control gene expression. MicroRNA dysregulation plays a critical role in the development of many diseases. This study aimed to find a set of common microRNAs between gastric cancer, GERD, and the *H. pylori* infection. Identification of a set of oncomiRs linked with these three diseases can spur the development of strategies to neutralize them and potentially reduce the incidence of GERD- and *H. pylori*-associated gastric cancer. A search of the miRNet database showed miR-148a, miR-210, and miR-143 to all be associated with all three diseases. MicroRNA expression data for gastric cancer and *H. pylori* patients were analyzed to find dysregulated microRNA. MiR-148 were both found to be downregulated in the gastric cancer and *H. pylori* patient datasets. MiR-148 was identified as a potential marker of GERD and *H. pylori* associated gastric cancer. It controls mRNA that are associated with many cancers including p27, and it could serve as a prognostic marker of chronic inflammatory disorders, which both GERD and *H. pylori* are, and many cancers.

Brian Ni, Casey Schwartz

Measuring the Concentration of Fertilizer on Rate of Algae Growth Using Light Sensors

It has been shown that algal blooms can lead to the destruction and annihilation of marine ecosystems around the world. Algal blooms preventing sunlight from reaching the bottom of these habitats, cause many organisms to perish, which produces harmful chemicals and breaks in the food chain. By using different amounts of fertilizer in three simulated ponds, the rates of growth of algae were tested based on amounts of nutrients given. With a flashlight on one side and a detector on the other, the amount of light energy (lux) passing through the pond was recorded. We went through this ten-minute process for two weeks, five days a week. The average percent rate of change of absorption of the heavily fertilized tank, which has 3x the amount of recommended fertilizer was 26.55%, whereby the tenth day of data collecting, no light went through. In the control tank with no added chemicals, the average percent rate of change was 0.55%. Finally, in the regularly 1x fertilized pond, where we added a normal amount of nutrients, the average percent rate of change for light intensity was 5.76%. This research supports how much fertilizer truly plays a part in growing algae and causing algal blooms can be elucidated.

Madinah Omarkheil – See Jaslyn Cloughen

Sahaj Pandey, Mehek Sawhney

Effect of MAPK1 gene in combination with KRAS gene and/or Tp53 gene expression on Lung Adenocarcinoma patient survival

Lung Adenocarcinoma is a type of non-small cell lung cancer, with a survival rate of roughly 12%. Mitogen-activated protein kinase 1 (MAPK1) is an assimilation point for various biochemical signals and is involved in many biochemical processes and is part of the MAPK signaling pathway. KRAS is a gene that is responsible for cell signaling pathways that facilitate cell growth, maturation, and apoptosis. The impact of KRAS on lung adenocarcinoma prognosis is currently subject to debate. The Tp53 gene produces the tumor-suppressor protein p53, which can inhibit the overactivation of the MAPK pathway and is commonly mutated in cancers. In this study, we explored the role of the KRAS and the Tp53 genes by looking at their effect on MAPK1 gene expression and overall patient survival time. To carry out this study we used raw data from the Cancer Genome Atlas, containing patients with varying levels of expressions of the genes, and then analyzed this data. Those with low expression of the KRAS gene had lower expression of the MAPK1 gene and higher overall survival time. Those with low expression of the Tp53 gene had lower expression of the MAPK1 gene and thus a higher overall survival time. Lastly, patients with low KRAS expression in combination with high Tp53 expression had lowered MAPK1 expression and higher overall survival time. Therefore, it is ideal to have low KRAS whether individually or in combination with Tp53, as high levels of KRAS may lead to the inhibition of p53 protein activity.

Abigail Parisi – See Chloe Gullo

Prezemystaw Pas – See Kenneth Halvorsen

Saharsh Peddireddy

Unique Computational Approach for Early Detection and Diagnosis of Cardiovascular Diseases

Heart disease is the leading cause of death in the United States, with around 700,000 people killed every year in just the US alone and the rapidly increasing disease is costing both developed and undeveloped countries more than 200 billion dollars. The extreme effects and damage caused by coronary heart disease (CAD) and cardiovascular disease (CVD), the most common forms of heart disease, are mostly due to late detection and diagnosis of the disease. Current methods of heart disease detection are invasive based techniques such as angiography, but these techniques have their limitations such as technological knowledge necessary, long process due to human-error, and high-end tools required. Machine learning models using computational methods are rising technologies that have proven to be precise and trustworthy in numerous applications. Using two datasets from separate countries from the UC Irvine Machine Learning Repository, multiple feature selection techniques were tested to preprocess the data, and then the new data was implemented by various computational algorithms. The performance of the models was analyzed using ROC curves, accuracy, precision, and more by using the metrics that resulted from confusion matrices that were generated. After testing and evaluating all the classifiers, in terms of accuracy, sensitivity, and specificity, the ET (ExtraTrees) classifier performed the best with all feature selection techniques.

Bradley Perry – See Jake Gerna

Michael Petrizzo – See Max Hsu

Ava Prestia See Allison Hernandez

Kayla Rafft – See Jaclyn Clements

Amantej Rana

A Study on the Optimization of N-gram models through interpolation

Language modeling is known as predicting the probability of a word in a sentence. The most common kind of language model is the n-gram model, which is a model trained on text. It predicts the next most probable word that might follow a sequence of words, given how often a certain word has been seen. Combining n-grams may result in a lower perplexity, which means the accuracy would increase. The way to do this is through Katz Backoff Smoothing. This is a n-gram interpolation technique that consists of using the next lower n-gram model when the current one provides a high perplexity. This means that if a three-word n-gram has a lower probability of being accurate when given a text, then using a two-word n-gram may have a higher probability. To do this, first a basic n-gram model was coded, along with a perplexity function. Then a valid smoothing function was found and implemented into the same language as the n-gram model. The two functions were combined in order to test the perplexity of the improved function. It is currently predicted that by combining certain weights of a uniform n-gram (or a n-gram where each possibility has the same probability of being the word needed) and a regular n-gram (where the greater the number, the greater possibility there is of the n-gram guessing the word) one can figure out the certain combinations which will improve the accuracy of the overall model.

Farah Raufi

The Effect of Rhizofiltration by Common Plants on Dye-Polluted Water

As the world becomes more industrialized, textile industries have grown immensely over the centuries. With this growth, industries release more pollution than ever before, specifically dye pollution. Dye pollution in water can cause many diseases in humans and is extremely dangerous. An effective, cost-efficient method to combat this is phytoremediation, or, specifically, rhizofiltration- a form of phytoremediation that occurs in water. Different plant species including *Spinacia oleracea, Helianthus annuus*, *Lactuca sativa*, and *Tropaeolum nanum* were used in this experiment to remediate the dye from the water sample. *Helianthus annuus* was hypothesized to be the best remediator of dye due to its thick root system. Thirteen samples of water were "polluted" with red Rit Dye, allotting three samples per plant species- with an additional negative control and positive control. UV-Vis Spectroscopy was used on the samples of water to determine the concentration of light passage in each of the samples. Supporting the hypothesis, *Helianthus annuus* was shown to be the best remediator, allowing, on average, more light to pass through than the other plants, indicating that it absorbed more dye. With these results, polluted water found in home gardens can be easily and quickly cleaned by *Helianthus annuus*, a common garden plant, relinquishing the risk of contracting disease.

Anna Rohring

ssPERG Parameters Associated with Visual Field Global Indices and OCT Thickness Measurements in Glaucoma Suspects

This study investigated the relationship between steady-state pattern electroretinogram (ssPERG), visual field (VF), and optical coherence tomography (OCT) parameters in glaucoma suspects with intraocular pressure (IOP), VF, and OCT measurements within clinically healthy ranges. While OCT and VF are clinically used to assess optic nerve structure and function, ssPERG assesses the health of retinal ganglion cells. ssPERG parameters, when compared to VF and OCT measurements, may support that some measurements are not truly within healthy ranges if correlated with cell dysfunction. Past research established a relationship between the listed parameters in patients with diagnosed glaucoma, but the purpose of this research is to support that reclassification of healthy ranges of OCT and VF is necessary to better categorize a patient's physiological changes. Tested VF parameters were mean deviation and pattern standard deviation. Tested OCT regions were the retinal nerve fiber layer (RNFL), ganglion cell layer and inner plexiform layer thicknesses (GCLIPL), and ganglion cell complex. Partial correlations were performed comparing PERG parameters with OCT and VF parameters while controlling for known risk factors of age, sex, spherical equivalent, IOP, and central corneal thickness. Magnitude had a high correlation with RNFL thickness in the superior sector (r=0.622) and magnitudeD with the GCLIPL minimum measurements (r=0.613). MagnitudeD had moderate correlations with other GCLIPL sectors and the average thickness measurements. Magnitude and MagnitudeD had moderate correlations with VF 10-2, r=0.539 and r=0.531 respectively. The VF 10-2 test was slightly more correlated with MagnitudeD than 24-2.

Ishaan Singh

Forecasting Sea Levels on the US East Coast with Respect to the Strength and Location of Centers of Action

The Azores High is a large subtropical semi-permanent center of high atmospheric pressure typically found south of the Azores in the Atlantic Ocean. The Icelandic low is a similar region experiencing especially low pressures. These centers of action (CoA) can have significant short term and long-term effects on sea level. Known as the inverse barometer effect, high pressure makes the sea level go down while low pressure makes the sea level go up. If the CoA changes lead to longer term changes in ocean circulation, this can cause the amount of heat transported from place to place in the ocean to change. This could lead to a gradual warming or cooling of the ocean, which would affect sea level by making seawater expand or contract. This study calculates intraseason correlations (i.e. sea level in Winters in Miami correlated with pressure, longitude, or latitude in the Azores High summers) as well as interseason correlations (i.e. sea levels in Montauk correlated with pressure, longitude, or latitude in the Icelandic Low with a lag of 2 seasons). With the significant correlations found, multiple linear regression was utilized to create a model forecasting the sea levels at the tide gauges using the values at the centers of action.

Joshua Tao
Effect of Triclopyr on Planarian *(Dugesia tigrina)*

Triclopyr ($C_7H_4C_{13}NO_3$) is an organic compound in the pyridine group that is used as both a herbicide and fungicide. Herbicides containing Triclopyr are often used for plants such as Eurasian Watermilfoil that grow in or around water. As a result, triclopyr can end up in freshwater bodies of water. In these bodies of water, marine life like planaria are exposed to triclopyr which is known to irritate certain parts of humans. Data was collected by putting varying amounts of triclopyr (1.5 ml - 0.01ml) in a petri dish with 200 ml of water. The dish was maintained by swapping the water out every week and feeding the planaria every ~5 days. My research found that triclopyr is lethal to planaria in the concentrations of $5.0E^{-5}$ water to 0.0075 ml of triclopyr. This study is important because the use of triclopyr isn't uncommon in locations nearby freshwater sources meaning that other aquatic animals may be harmed from the usage of triclopyr.

Gianna Tranchina – See Jerry Lin

DonVeon Tulloch – See Michael Florentino

Alexa Vrionedes

Chemical Leaching from Polyethylene Terephthalate (PET) containers used as Storage for Acidic Food or Beverages on *Daphnia magna* Reproduction

Polyethylene terephthalate (PET) plastics are commonly used in food and beverage containers for consumer usage. There is evidence showing PETs, when subjected to higher temperatures, tend to leach endocrine-disrupting chemicals (EDCs) causing hormone-related health issues in humans. An experiment was conducted to determine if the high acidity of soda stored in PET plastic affects the reproduction of *Daphnia magna,* as there is little research in the United States showing the impact of acid leaching at high temperatures. PET bottles containing Coca-Cola® were left to sit in a high temperature water bath for varying amounts of time. After sitting, the bottles were emptied, and their contents were tested for antimony as it is one of the EDCs known to leach from PET containers under high temperature conditions. *Daphnia magna* were grown in these containers to determine how the EDC leaching would affect their process of reproduction. The male to female sex ratio of the *Daphnia magna* offspring was also measured as EDCs are known to alter the reproductive ratio. All bottles filled with Coca-Cola® were found to contain antimony. The only bottle filled with water to contain antimony was the one that sat the longest in the water bath. Most of the *Daphnia magna* had died before they could reproduce, possibly due to the EDCs that had leached. The offspring that did survive were only males and exhibited an unusual spinning behavior. This research supports the harmful effects that could arise from heat and acidity on leaching in plastic water bottles.

Katerina Vrionedes

Effects of Amylase and Fluoride on Dental Decay-causing bacteria:
Streptococcus mutans & Lactobacillus

Dental decay occurs from the breakdown of tooth enamel caused by the aciduricity of *Streptococcus mutans* and *Lactobacillus*, which leads to build up dental plaque. This buildup can be reduced with fluoride, though there are risks associated with excess amounts, such as thyroid issues, impaired brain development, bone disease, and more. An alternative to fluoride can be found in the salivary enzyme of amylase. Various concentrations of amylase were compared to and with fluoride solutions to determine which combination was the most effective in limiting bacterial growth. The absorbance of light concentration within each tube was measured with a spectrophotometer to determine bacterial growth. Since amylase is known to protect dental enamel against bacteria, it was hypothesized that the solution with the highest concentration of the enzyme added to fluoride would be most effective at limiting the growth of the *Streptococcus and Lactobacillus*. Results show that addition of amylase to fluoride was more effective in restricting growth of both types of bacteria than fluoride or amylase alone. However, this only partially supported my hypothesis as *Streptococcus* growth was restricted more with a lower concentration of amylase than originally predicted. This research will be beneficial in providing further knowledge to limit bacterial growth in dental cavities.

Jonathan Zhang

Differential Diagnosis of Sleep Disorder Subtypes with Neural Aperiodic Components

Polysomnography is a frequently used tool for diagnosing disorders like sleep-related hypermotor epilepsy (SHE) and rapid-eye-movement sleep behavior disorder (RBD). It is highly inefficient because often-infrequent seizure events are required to reach a diagnosis. Also, SHE and RBD are difficult to differentiate due to the overlap in symptoms and presence of ictal (during seizure) and interictal (between seizure) abnormalities in electroencephalographic (EEG) data. Therefore, it is important to ascertain whether non-seizure EEG data can be used to distinguish between SHE and RBD with new methods. The FOOOF package was used to calculate the EEG aperiodic components (exponent, offset)—historically ignored by clinicians— for polysomnographic recordings of 62 subjects during non-seizure sleep, and t-tests and effect size calculations to determine significance and quantify differences between disorders. Both the aperiodic exponent and offset proved to be able to distinguish between SHE, RBD, and healthy subjects in S2 and S3 sleep ($\alpha = 0.05$). In addition, effect size calculations showed that the aperiodic exponent was better at differentiating than the offset in all cases, and that the frontal electrode was most effective. Using aperiodic components in polysomnography may yield improvements in efficiency, accuracy, and patient affordability.

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