***The Research Dragon***

**

**Commack High School’s**

**Research Yearbook**

**2018 - 2019**

**A Celebration of Research at Commack High School**

**Wednesday, June 12th, 2019**

**6:30 pm**

**Evening Events**

Poster Presentation of student projects

Slide Show Presentation… Gabriel Chan, Pragati Muthukumar

Introduction………….........Ethan Sontarp

Opening Remarks….….…Dr. Alison Offerman-Celentano

Director of Science, K-12

Student Reflections..….….Defne Aktuna, Michael Van Loon

Guest Speaker………….. Ms. Monica Cramer

CHS Class of 2016

Microbiology and Immunology Researcher

Cornell University

Honoring Our Seniors…...Emma Karadenes, SShamtej Rana

Senior Picture Compilation….Kristen Chao, Deniz Sinar

Closing Remarks…..…….Ethan Sontarp

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

Dr. Daniel Kramer

Dr. Stephanie O’Brien

Dr. Lorraine Solomon

Ms. Jeanne Suttie

Ms. Andrea Beatty

Dr. Alison Offerman-Celentano, Director of Science, K-12

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

Carol Barbagallo, Eric Biagi, Anthony Capiral, Diane Cotter,

Dr. Michael Cressy, Lisa DiCicco, Chris DiGangi, Fran Farrell,

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Dolores Godzieba, Camille Horak, Keith Just, Dr. John Kelly,

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Thomas Shea, Victoria Stack, Laura Tramuta, Fern Waxberg, Lois Webster, and Frann Weinstein.

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

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Ms. Boritz, Ms. Shapiro, Mr. Keltos, Ms. Allen, and the administrative staff for their continued support.

Dr. James, Ms. Newman, Ms. Ryan, Ms. Goldberg, Mr. Laub, Dr. Inforna, Mr. Cox, and the members of our Board of Education for their support and recognition of our program.

**Science Fair Participation**

**Regeneron Science Talent Search**

Pragati Muthukumar – National Semifinalist

**INTEL International Science and Engineering Fair**

**Pragati Muthukumar**

**Sean Pak**

**Ethan Sontarp**

***Awards to be Announced***

**Junior Science and Humanities Symposium**

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

Kathy Cao – 1st Place, Earth and Space Science - Advancing to Regional Competition

Delina Levine – 2nd Place, Physics

Pragati Muthukumar – 2nd Place, Biology

Sean Pak- 2nd Place, Computer Science

Yasemin Sahin

Deniz Sinar

**Junior Science and Humanities Symposium, Northeast Regionals**

Kathy Cao

**Toshiba/NSTA Exploravision Program**

Gavin Cressy - National Honorable Mention

Brianna Han - National Honorable Mention

Annabelle Hohne - National Honorable Mention

Tryphena Zareif - National Honorable Mention

*Honorable Mention represents the top 10% of nationwide student participation*

**Medical Marvels Challenge**

Annika Chang

Gavin Cressy

Katerina Efthymiou

Brianna Han

Amy Liu

Tryphena Zarief

**Long Island Science and Engineering Fair, Round 1**

*(Round 1 finalists advance to LISEF 2 for awards)*

Kathy Cao

Kristen Chao

Aria Eghbali

Maheen Khan

Yeil Kim

Christine Kong

Delina Levine

Kimberly Liao

Pragati Muthukumar

Sean Pak

Yasemin Sahin

Ethan Sontarp

Chapin Zerner

**Long Island Science and Engineering Fair, Round 2**

Kathy Cao - 3rd Place, Earth and Environmental Science

The Association for Women Geoscientists Award

Pragati Muthukumar -3rd Place, Cellular and Molecular Biology

Sean Pak – 1st Place, Computer Science

INTEL Excellence in Computer Science Award

Advancing to ISEF

Yasemin Sahin - Honorable Mention, Physics

Yale Science and Engineering Award

Ethan Sontarp - Honorable Mention, Earth and Environmental Science

American Meteorological Society Award

Chapin Zerner - Honorable Mention, Environmental Engineering

NASA EARTH System Science Award

Stockholm Junior Water Prize

**Long Island Science and Engineering Fair, JV Division**

Kevin Chen - 3rd Place, Computer Science

Alyssa Collado

Jodi Claire Consul

Gavin Cressy - 3rd Place, Cellular and Molecular Biology

Brianna Han

Annabelle Hohne

Michael Jang

Nicholas Leahy

Amy Liu - 3rd Place, Cellular and Molecular Biology

Marlee Reiter

Keira Spahn

Rohan Surana - 3rd Place, Computer Science

David Yang

Tryphena Zareif

**New York State Science and Engineering Fair, ISEF Division**

Kathy Cao

Kristen Chao

Aria Eghbali

Maheen Khan

Yeil Kim

Christine Kong

Delina Levine - 1st Place, Physics and Astronomy

Lightning Round Finalist

Kimberly Liao

Pragati Muthukumar - 1st Place, Plant Science

Lightning Round Finalist

Advancing to ISEF

Sean Pak

Yasemin Sahin

Ethan Sontarp - 2nd Place, Earth and Environmental Science

Lightning Round Finalist

Advancing to ISEF

Chapin Zerner - Honorable Mention, Environmental Engineering

**WAC Lighting Foundation Invitational Science Fair**

Candace Arneaud

Kathy Cao – 1st Place, Earth and Environmental Science

The WAC Lighting Foundation Sustainability Award

Michael Chacon – Honorable Mention, General Biology

Gabriel Chan

Kristen Chao – Honorable Mention, General Biology

Kevin Chen

Nathan Cheung – Honorable Mention, General Biology

Alyssa Collado

Jodi Claire Consul

Joseph Cramer – Honorable Mention, General Biology

Gabrielle D’Agostino – Honorable Mention, Prototype Engineering

Adam Dubi – Honorable Mention, Prototype Engineering

Aria Eghbali

John Finnie-Maloney

Nicholas Gembs

Brianna Han

Theresa Haupt – Honorable Mention, General Biology

Amy Held

Annabelle Hohne

Maheen Khan – Honorable Mention, General Biology

Yeil Kim

Christine Kong

Nicholas Leahy

Joshua Lee

Ruth Lee – Honorable Mention, General Biology

Delina Levine – 1st Place, Physics and Astronomy

Kimberly Liao – Honorable Mention, General Biology

Izza Malik

Emma Matz

Paul Moon

Pragati Muthukumar

Sean Pak

Victoria Pensiero

Marlee Reiter

Yasemin Sahin

Deniz Sinar

Ethan Sontarp – 3rd Place, Earth and Environmental Science

Kiera Spahn

Rohan Surana

Carly Tamer

DeVaughna Tulloch

Shawn Uthup – Honorable Mention, Prototype Engineering

Louis Viglietta – 2nd Place, Chemistry

**WAC Lighting Foundation Invitational Science Fair (Continued)**

Jordan Walsh

Mariam Zahran – 3rd Place, General Biology

Tryphena Zareif

**The Kathy Belton Science Fair at Molloy College**

Michael Benin

Jayson Bromberg – Honorable Mention

Michael Chacon

Faith Chi

Joseph Cramer

Grace Cutrone

Ethan Dettman

Erika Fenty

Elena Gnilitskaya

Eric Huang

Juvin Johnson

Jun Ko

George Li

Luke Maciejewski

Jane Maloney

Cole Margarites

Jessica Murrell

Narumichi Nakamura – Honorable Mention

Thomas Parangelo – Honorable Mention

Caitlyn Rothar

Michael VanLoon

Caroline von Hof

**Long Island Science Congress – Junior Division**

*Grand Awards to be Announced*

Defne Aktuna – To Be Announced

Lindsay Cheung - Achievement

Jack Coogan - Meritorious

Mariana Davis - Meritorious

Justin Davitashivili - To Be Announced

Jessica DeYulio – Honorable Mention

onor

Anysia Finkin - Meritorious

Thomas Grgas - Meritorious

Avi Gupta - To Be Announced

Jillian Helmes - Honorable Mention

Ashley Hsu - Achievement

Erica Huang - Achievement

Robin Hwang - To Be Announced

Kylie Iannuzzi - Achievement

Christian Kraus - Achievement

Yashica Kumar - Achievement

Aspen Levine - To Be Announced

Matthew Leyberman - Achievement

Karen Li - To Be Announced

Flora Lin - Achievement

Ashley Moon - To Be Announced

Eshani Mukherjee - Achievement

Angelina Necroto - Achievement

Melina Nicou - Achievement

Olivia Owens - Achievement

Matthew Pace - Meritorious

Abigail Pappachen - Honorable Mention

Denise Phelan - Achievement

Harry Poulose - To Be Announced

Heetak Ra - To Be Announced

Lakxshanna Raveendran - Achievement

Shreya Sriram - To Be Announced

Amber Syed - Achievement

Zeynep Tasoglu - To Be Announced

Brennan Thomann - Achievement

Nicholas Vazquez - To Be Announced

Maryum Waqar - To Be Announced

Kevin Won - To Be Announced

Asmaa Zahran - Achievement

Christopher Zizzadoro - Meritorious

**Long Island Science Congress – Senior Division**

*Grand Awards to be Announced*

Aryam Anand - Meritorious

Nathan Cheung – To Be Announced

Faith Chi - Honorable Mention

Wonjeong Choi - Meritorious

Gavin Cressy - Achievement

Brian Flynn - Honorable Mention

Emily Hartman - Achievement

Emma Hatcher - Achievement

Charlson Kim – Honorable Mention

Erika Kraft - Honorable Mention

Ruth Lee - To Be Announced

Amy Liu - Achievement

Vishwanath Madhavan - Honorable Mention

Alexis Maikowski - Honorable Mention

Evan Ni - Meritorious

Isac Park - Honorable Mention

Faizali Rahim - Meritorious

Caitlyn Rothar - Honorable Mention

Kevin Tuzinowski - Meritorious

Jenny Won - Meritorious

William Yuk - Meritorious

**New York State Science & Engineering Fair - Andromeda Division**

*Awards to be announced*

Ethan Abbe

Gabriel Chan

Annika Chang

Tyler Chipetine

Gabrielle D’Agostino

Ethan Darvin

Elizabeth Demacopoulos

Cathleen Deutsch

Emily DiPrima

Katerina Efthymiou

Mikayla Elferis

Mia Goren

Emma Karadenes

Charlson Kim

Joshua Lang

Matthew Lee

Corey Levy

Jane Maliney

Paul Moon

SShamtej Singh Rana

Funda Sahin

Kyle Spinelli

Joseph Strickland

DeVaughna Tulloch

Louis Viglietta

Mariam Zahran

Michael Zarief

**Neurological Surgery P.C. Health Science Competition**

*Awards to be announced*

Christian Baldi

Maxwell Cantley

Gabriel Chan

Kristen Chao

Nathan Cheung

Alyssa Collado

Gavin Cressy

Cole Darienzo

Elizabeth Demacopoulos

Adam Dubi

Jason Duffe

Gabriella Glickstein

Mia Goren

Annabelle Hohne

Emma Karadenes

Maheen Khan

Charlson Kim

Christine Kong

Joshua Lee

Ruth Lee

Kimberly Liao

Brandon Lim

Amy Liu

Alexis Maikowski

Stephen Mullen

Marlee Reiter

Funda Sahin

Deniz Sinar

Kiera Spahn

Shawn Uthup

Mariam Zahran

Tryphena Zareif

**SAAWA Fair**

Defne Aktuna

Candace Arneaud

Michael Chacon

Kevin Chen – Honorable Mention, Environmental Engineering

Lindsay Chung

Alyssa Collado

Jodi Claire Consul

Joseph Cramer

Gavin Cressy

Elizabeth Demacopoulos

Brianna Han

Annabelle Hohne

Ashley Hsu

Erica Huang

Michael Jang – 3rd Place, Chemistry

Emma Karadenes

Yashica Kumar

Karen Li

Amy Liu

Izza Malik

Melina Nicou

Sean Pak – 1st Place, Physics

Lakxshanna Raveendran

Funda Sahin

Sherya Sririam

Rohan Surana - Honorable Mention, Environmental Engineering

Zeynep Tasoglu – 1st Place, Biology

Jordan Walsh

Maryum Waqar – 1st Place, Biology

David Yang – 3rd Place, Chemistry

Tryphena Zareif

Chapin Zerner

**Student Summer Research Placements**

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

Brookhaven National Lab High School Summer Research Program

Cold Spring Harbor Internship Program

Cold Spring Harbor Laboratory DNA Summer Camp

Cold Spring Harbor Laboratory Partners For The Future Program

Dr. Bessie F. Lawrence International Summer Science Institute

Engineering Summer Academy at University of Pennsylvania

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**

**StanMack Program**

***Nicholas Bitonti, Emma Downey, Matthew Feigenbaum, Nicholas Greco, Marina Khan, Sophia Mastroianni, Sarah O’Connor, Abigail Pace,***

***Caitlin Tolentino***

**Exploring the Function and Development of Insulin-producing cells in**

***Drosophila melanogaster* with the Goal to Improve**

**Diagnosis and Treatment of Diabetes.**

*Drosophila* are highly suitable for research since they serve as a model for studying the role of the transposable element. Mechanisms of glucose homeostasis are conserved between flies and humans, and the fruit fly allows for easier access for conducting genetic manipulations when compared to the common rodent model.

The goal of this project is to create a stable stock of *Drosophila* with a gene analogous to the human gene. By the end of this project, s unique line of fruit flies could be used to study insulin-producing cells in Drosophila, comparable to the human gene. The Transposon are sequences of DNA that move from one location in the genome to another using a cut and paste mechanism. This transposable element would migrate from the X chromosome to the second or third chromosomes. This project began by creating an F0 cross using females from the Bloomington *Drosophila* Stock Center (BDSC) fly stock line (StanEx1) and males with the gene for transposase, this cuts out the transposable element and allows it to jump into another part of the genome. From this cross, jump starter males were found based on phenotypic attributes that carried the StanEx1 gene and crossed with Double Balancer virgin females. From the F1 cross, males with the StanEx1 gene transposed from the X chromosome to another were found. These males were crossed with virgin Double Balancer females. Afterwards, a brother-sister cross was performed using the same phenotypic offspring from the F2 generation to create the F3, where the stock would then become stable and only contain flies who have the StanEx1 gene either on chromosome 2 or 3.

After stable stocks were achieved, flies from each line were then picked and prepared for a process known as inverse PCR, by first digesting and ligating the fly DNA. Inverse PCR is a process that amplifies the genomic fly DNA. By using select primers, the P-element and the DNA around it can be isolated and then sent out to be sequenced. Afterwards the DNA can then be located using online databases. Once the P-element has been located, it can then be sent to Stanford for use in their ongoing research. Successful students have the opportunity to achieve publishable research.

**SENIORS**

***Kathy Cao***

**The Development of a Machine Learning Model to Predict Tropical Cyclone Genesis from Mesoscale Convective Systems**

Tropical cyclones (TCs) are destructive storms that may evolve from mesoscale convective systems (MCSs). The ability to predict if a particular MCS develops into a TC would allow for more preparation, saving lives and property. Hence, the goal of this study was to develop a robust machine learning model to make the aforementioned predictions with an optimal predictive ability when generalizing to new data. To do so, models were trained on data pertaining to environmental features of MCSs that both did and did not develop into TCs from around the globe. Predictions were also made for the Western North Pacific (WNP) and the North Atlantic (NA) basins. Models were developed using three classification algorithms: K-Nearest Neighbors (KNN), Random Forest (RF), and AdaBoost (ADA). Nine models were created (three regions, three algorithms) and compared to each other and the traditional method of the genesis potential index (GPI). The models were assessed using the F1 score, which quantified their predictive abilities from 0 (least able) to 1 (most able). Results showed that the models using ADA had the highest F1 scores 6 hours before TC genesis: 0.98, 0.94, and 0.96 for the global scale, the WNP, and the NA, respectively. Additionally, ADA models that were trained on only the five most important features out of thirteen original features achieved F1 scores just as high. For all the cases studied, the machine learning models outperformed the conventional method of the GPI, which consistently yielded F1 scores less than 0.70.

***Gabriel Chan***

**An Exploration of Dynamics of Population Neural Activity**

**In Neural Cortex During Spatial Attention**

Recent studies have demonstrated that cortical state can be modelled by wave propagation. These complex dynamics are driven by intricate networks of microscopic interactions between hundreds thousands neurons and thus are only vaguely glimpsed in spike-trains of single neurons. By taking advantage of new recording techniques that enable us to monitor the activity of large neural populations in behaving animals, we initially investigated these interactions across the whole region of the Frontal Eye Fields (FEFs). Using multichannel local field potential recordings obtained from 2 monkeys, we calculated receptive fields of the FEF neurons for these monkeys. The second part of the analysis focused on studying how the physical distance between the neurons in the V4 and the FEF affect neural spiking patterns. Code was written to separate the neural data from the V4 and the FEF based on the shape of their receptive fields and the physical orientations of the fields. We then fit a Hidden Markov Model to the segregated neural data, and monitored how the HMM state synchronized and desynchronized based on the physical distance between the receptive fields. Subsequently, we looked for spatial patterns based on receptive field data (local field potential data and the segregated Ozzy receptive field data). Preliminary results indicate that there is evidence of correlation between receptive field location and neural spiking in the FEF.

***Kristen Chao, Maheen Khan, Kimberly Liao***

**An Improved Formula for Renal Parenchymal Area and Total Kidney Volume for Increased Accuracy in Renal Dimensions**

With conditions such as chronic kidney disease (CKD) and polycystic kidney disease (PKD) on the rise, it is critical to accurately measure renal area in these patients. Measurement of renal dimensions and identifying changes inform physicians about the presence and progression of renal diseases. Currently, there is an existing elliptical formula utilized in clinical setting, but it grossly underestimates kidney volume. Modification of this formula has been demonstrated to provide a better estimation of the renal parenchymal area in a model of murine kidney disease. While treating the kidney as an ellipse with the major axis the polar distance, this technique involves extending the minor axis past the hilum into the renal pelvis to obtain a new minor axis. The study sought to determine whether this modified formula is applicable to additional models of kidney diseases. Left and right kidneys were sourced from different strains of male and female rats with tubulointerstitial disease or glomerulosclerosis as well as from healthy animals. In each model examined the use of the existing methodology underestimated renal parenchymal area whereas the use of the modified elliptical formula yielded a calculated renal parenchymal area similar to the true parenchymal area. Since the use of this modified elliptical formula provides a better estimate of renal dimensions, the extent of renal scarring can now be easily computed by making just two axial measurements. Therefore, this technique provides a more accurate, noninvasive method of monitoring kidney disease.

***Gabrielle D’Agostino***

**Non-Newtonian Vehicle Side Impact Damage Reduction System**

Although the car industry continues to make technological advances in safety systems, and the number of fatalities from head-on collisions decrease, deaths from side impact crashes remains the same.  Current side impact protection systems do not adequately address side impact safety. Due to the minimal distance of the occupant’s seat to the point of side impact, there is almost no crumple zone on the sides of the vehicle, thereby causing the occupants to be more vulnerable during this type of collision.  The goal of this project was to create a novel impact curtain made from a non-Newtonian fluid in order to significantly reduce the risk of injury and fatality upon side impacts. To do so, non-Newtonian fluids were studied. A non-Newtonian fluid is a fluid that does not follow Newton’s laws of viscosity. In non-Newtonian fluids, viscosity can change under an applied force to either more liquid like or more solid like.  Shear thickening fluids become more solid on impact and shear thinning fluids become more liquid on impact. A non-Newtonian fluid has the capability to significantly reduce the effect of an impact. A non-Newtonian shear thickening material consisting of water and cornstarch was placed in an 8-millimeter polyurethane bag which was placed between the inner and outer sides of the door.  Different thicknesses (0.5 to 4 inches) of shear thinning materials consisting of a viscoelastic foam were also used to absorb the impact at the time of the crash and were placed underneath the polyurethane bag inside a wooden box that held the materials in place during the tests. The effect of the materials was tested using the high velocity impact of an anvil drop, and an accelerometer attached to the anvil recorded the G-force upon impact. The 2-inch-thick shear-thinning foam reduced the G-force from 506 G’s to 92.5 G’s in the tests.

***Cathleen Deutsch***

**Hong Kong Land Valuation Analysis Over the Past 14 Years**

Land and housing prices on Hong Kong Island have drastically increased, causing many to find themselves without a home. Housing shortages has led to a new wave of housing similar to tenement housing in the early 1890s; these new houses are called cage homes. A cage home is a living quarter that has room for one bed and then is caged in with a wire frame. These homes break apart regular studio apartments into a living quarter to as many as ten people. The price/square foot of these cage homes is higher than the price per square foot of luxurious apartments. Taking into consideration that the luxurious apartments have more amenities and are in more favorable locations, it has led to some questions as to why they are cheaper per square foot than the smaller apartments. It is rumored that the high prices of land for housing may be impart due to developers having large land banks but providing low housing supply. These developers control the supply in their favor by holding on to land driving prices higher, in turn making more substantial profits for themselves. The purpose of this investigation was to determine how the price per square foot of land in Hong Kong has changed within the past fifteen years in response to the apparent land shortage facing the city. Housing prices per square foot for the past 14 years were collected by using LINK RIET database. And the Prices per square feet were compared with their respected Cap Rate to determine the price relation to the valuation of the property. The Data was compared for 14 years.

***Aria Eghbali, Yeil Kim***

**Reinforcement Learning for Optimization of Traffic Light Control Using Multiple Light Nodes as Inputs**

The optimization of traffic light control systems can increase overall mobility and productivity, while decreasing emissions. Over 6.9 billion hours of productivity are lost in the U.S. every year as a result of traffic congestion according to a Texas A&M study. An intelligent solution would be able to mitigate traffic congestion through an optimal and adaptive light control system which requires minimal additional infrastructure, therefore having low costs. Commonly employed electro-mechanical systems utilize a fixed time method, which is not responsive to variations in traffic flow. More efficient sensor-based methods exist, however, their implementation is costly and impractical. We propose a Multi-Agent Reinforcement Learning (RL) model which implements Q-Learning through a Convolutional Neural Network (CNN) to determine the optimal traffic light pattern at a given time. Our model was evaluated using Simulation of Urban Mobility (SUMO) to replicate varying traffic conditions with the RL model as the traffic light control system. Implemented internodal communication between independent traffic lights can additionally optimize traffic management. The success of the RL model is defined as decreased average delay time through a network of three or more nodes with internodal communication as compared to the optimization of a single node. After 1200 episodes, the single node RL model decreased delay times by approximately 22% When internodal communication was implemented in a three and four node RL model, delay times were reduced by an additional 3.8% and 4.2% respectively.

***Brian Flynn***

**The Effect of Different Antacids on Reducing Stomach pH**

Heartburn is caused by stomach acid regurgitating back into the esophagus. It causes a burning sensation in the chest and left untreated can lead to a precancerous condition known as Barret’s Esophagus. Treatment for heartburn includes prescription and over-the-counter (OTC) drugs. These drugs include histamine blockers (H2 blockers) and proton-pump-inhibitors (PPI’s); which cause the stomach to reduce acid production. Another, more common form of treatment are antacids which neutralize stomach acid by converting it into water and a salt. The purpose of this experiment was to determine which over-the-counter antacid is the fastest acting at neutralizing stomach acid. A hydrochloric acid solution was created to mimic a stomach acid environment and a Vernier Lab Pro pH probe was used to record the system’s pH. An antacid is poured into the acid solution to measure the pH change in the stomach acid solution. It was hypothesized that the liquid Milk of Magnesia would be the quickest antacid due to its concentration of solute per unit of solvent, a liquid with pre-dissolved antacid should be quicker than any solid due to this. Results show that Milk of Magnesia (8.7E-01 pH\*min-1)followed by Pepcid (6.7E-01 pH\*min-1), and Tums (4.9E-01 pH\*min-1) were the most effective at neutralizing stomach acid. Whereas Gaviscon (8.05E-02 pH\*min-1) and Pepto-Bismol (3.1E-02 pH\*min-1 for liquid, and 3.21E-02 pH\*min-1 for solid) were the least effective as they failed to neutralize stomach acid in any capacity. Gaviscon due to its low dosage of aluminum hydroxide and calcium carbonate and Pepto-Bismol due to its active ingredient of Bismuth Subsalicylate being organically bonded, rather than using ionic bonding like the other antacids active ingredients.

***Maheen Khan – See Kristen Chao***

***Yeil Kim – See Aria Eghbali***

***Joshua Lee***

**A Deep Learning System Approach to Probe the Genetic Links Between Schizophrenia and 22q11.2 Deletion Syndrome**

22q1102 deletion syndrome is a genetic syndrome caused by a deletion in the q11.2 arm of chromosome 22. There are multiple phenotypes that are caused by this deletion which include cognitive impairment, low IQ, and intellectual disability. A 22q11.2 deletion syndrome patient is ten to twenty times more likely to develop schizophrenia, a psychosis disorder. Therefore, 22q11.2 deletion syndrome is considered to be a strong risk factor for schizophrenia. Consequently, it is hypothesized that there is a gene protein common to the expression of both disorders. In this research, the gene proteins within gene coexpression networks vital to the expression of schizophrenia and 22q11.2 deletion syndrome were identified. To do so, first FASTA sequences of those gene proteins were collected from online databases. To then analyze coexpression, a deep learning system was created in Python in the NetBeans IDE with the FASTA sequences of the gene protein sequences in schizophrenia and 22q11.2 deletion syndrome as input into the deep learning system. The gene proteins were compared in terms of the number of letter differences between their FASTA sequences. The prediction algorithm in the deep learning system will be based on that input of FASTA sequences as training data. Results will reveal which gene proteins are common to schizophrenia and 22q11.2 deletion syndrome.

***Delina Levine***

**Proof of Principle: Machine Learning to Analyze Phase Transitions**

The analysis of phase transitions, including the critical points at which these transitions occur, can give insight to important properties of the material under study. However, the computational methods currently used to determine these critical points have been shown to fail under certain conditions. Machine learning has recently been introduced in the field as a potential method of circumventing these limitations and has been proven useful in analysis of large datasets. In this study, the method of supervised machine learning is used to identify the critical temperature (Tc) of a magnetic phase transition using a 2-dimensional Ising model. First, a neural network was trained on a 2-dimensional square lattice at extremely high and low temperatures to identify non-magnetic (paramagnetic) and magnetic (ferromagnetic) spin configurations. After training on square lattice configurations, the trained network was tested on data both below and above the known Tc to determine an estimated Tc. In the square lattice, the estimated Tc and the known Tc value differed by 0.04%. The network can also accurately predict the Tc for a 2-dimensional honeycomb lattice, where the estimated Tc and the known Tc differed by 0.72%. The success of this method indicates potential use in analyzing more complex scenarios, including magnetic phase transitions with a higher-dimensional Ising model or the transition between an antiferromagnetic phase and a superconducting phase.

***Emma Matz, Carly Tamer***

**Analyzing the Growth of *TatA2, HSLJ*, and *AlgW* Mutants Of *Acinetobacter baylyi* Under Different Temperatures.**

Due to bacteria’s ability to rapidly evolve due to their short generation time, antibiotics are deemed ineffective after a strain of the pathogenic species develops resistance. Studying bacteria's transportation mechanisms may uncover new targets for antibiotics, allowing for longer periods of functionality. In this experiment, three transportation mechanisms are investigated. The twin-arginine translocation (Tat) Pathway is responsible for transporting folded proteins across the inner

membrane to the periplasm in certain gram-negative bacteria, including *Acineobater baylyi,* which is unique in that it possesses two Tat pathways: one essential (TatA1B1C1) and one non-essential (TatA2B2C2). In the Lol pathway, if the Lnt enzyme is mutated, the biogenesis of lipoproteins is altered and the HslJ gene is upregulated. A membrane protease responsible for cleaving proteins and peptides as well as producing biofilm, AlgW, is also studied. By mutating the non-essential *TatA2, HSL J,*and*AlgW* proteins and subjecting *A. baylyi*to temperatures from 30°C to 40°C, the functions of these proteins are studied. Measurements of Optical Density (OD), growth curves, and antibiotic disk assays will be utilized. Antibiotics that target key components of bacterial structure linked to these proteins were utilized in an antibiotic disk assay (erythromycin, vancomycin, bacitracin, rifampin, and novobiocin). Thus far, results show that mutant strains, especially the *TatA2* strain, experienced a more drastic increase in OD and colony forming units (CFU) in the growth curve experiment than WT when temperature was increased within the given range. In addition, *Acinetobacter baylyi*exposed toErythromycin showed a significantly larger zone of inhibition as compared to the other antibiotics used in the disk assay across all strains tested.

***Paul Moon***

**Growth of Iron Aluminide Crystals**

In this experiment I studied the growth and the intrinsic properties of an iron aluminide crystal, which was chosen because of its potential as a low phonon thermal conductor. (Tobito, 2016) The crystal was grown through a flux, binary mixture, consisting of tin (flux), iron, and aluminum. For Iron, iron ingots were used, and for aluminum, small shots of aluminum were used. A conventional furnace was used, and a program ran for the temperature profile. The temperature profile was determined through phase diagrams, and a eutectic temperature was determined. A temperature of 850 °C was the lowest temperature which maintained the atomic percentages. (Goldbeck, 1982) With this method, one sample produced successful results, and the crystals were then analyzed in an X-Ray diffractometer (XRD). Using the XRD, the bandwidth and the general structure of the iron aluminide crystal was determined. Despite using such equipment, problems throughout the growth period may have given rise to impurities. The iron aluminide crystals that were grown were tested for thermal conductance, but due to time and lack of additional samples, the data set proved null.

***Pragati Muthukumar***

**Identifying Differential and Conserved Alternative Splicing (AS) Events in *Zea mays***

*Zea mays* is a staple crop worldwide known for extensive genetic diversity, making it a worthy plant model to study. Alternative splicing (AS) is a post-transcriptional regulatory mechanism in many eukaryotes and can generate multiple transcript isoforms for a single gene through the splicing of mRNA. Studies show that AS contributes greatly to transcriptome diversity in humans and animals. Preliminary studies in Arabidopsisshow that AS plays a significant role in a plant’s response to stress and can be induced by various abiotic stress conditions, but little is known on how this regulatory process affects staple crops like maize. The purpose of my study was to (1) develop a maize-specific computational workflow to predict differentialAS variants, where the events either negatively or positively affect the plant, and (2) to see if these AS events are conserved. To do this, public RNA-seq data was aligned to a reference genome. Stringtie was used to predict transcripts, these were quantified by expression, and filtered through custom-made Python scripts to identify the AS events most likely to encode for a functional protein. SUPPA2 detected differential splicing events across multiple conditions. Based on transcriptional-expression levels, Ballgown was used to determine differentially expressed genes. An evolutionary analysis was used to determine if a particular AS event was conserved between multiple maize inbreds and sorghum. This study will give scientists a better understanding of complexity of AS events in maize and identify candidate genes that may be tolerant to various abiotic stressors. Since climate change is a serious agricultural issue affecting crop production, understanding how AS contributes to gene function could help foster resilient crop varieties.

***Sean Pak***

**Artificial Neural Network Based Target Localization Method for Multi-Static Passive Radar Systems**

The rise in terrorism has increased concerns regarding aerial security. Major geographical areas are currently safeguarded by specialized active radar systems that detect, locate, and track both foreign and domestic aircraft. However, coverage is limited due to the high-cost and low-covertness of the said system. With current approaches, passive radar systems reduce the cost and increase covertness by utilizing available broadcast signals. However, passive systems fail to accurately locate and track targets, so an artificial neural network based target localization method is proposed for a multi-static passive radar system consisting of multiple illuminators, a radar receiver, and a single target. Assuming a multi-frequency network, the time-difference-of-arrival (TDOA) of signals coming from each illuminator via the target path and the direct path was estimated from the cross-ambiguity function. The training data consisted of estimated TDOAs corresponding to each illuminator and each assumed target location. These estimated TDOAs were then used to train a feedforward neural network. The network’s performance was evaluated with the test data, wherein 10% of the total data was randomly chosen as test data. Simulation results showed that the machine learning method achieved a low mean squared error value even at low signal-to-noise ratios. This success at target detection and localization indicates potential applications in aerial surveillance and security upon large-scale deployment.

***Isac Park***

**Modeling the concentration of EDTA Y4- ions at decimal pH levels**

Complexometric titration is an analytical technique used to determine the unknown amount of an identified metal in a liquid solution. In fields of research involving metal production or sample analysis, complexometric titration is particularly useful in determining numeric constants for the tendency of the formation of a molecule or the abundance of a metal. Ethylenediaminetetraacetic acid, or EDTA, is a weak acid standardly used for this technique. EDTA forms 1:1 molecular ratios with metals in their fully deprotonated form, usually abbreviated as Y4-. However, complexometric titration using EDTA is less effective at lower pH levels because the formation of protonated forms, such as HY3- or H6Y2+, of EDTA are more favored, decreasing the amount of EDTA available in the Y4- form, thus increasing the amount of total EDTA solution required to fully complex the metal analyte. Therefore, experiments have been conducted to determine the concentration of EDTA Y4- ions at various pH levels. Current literature only details required concentrations at integer pH levels and do not include the necessary data needed to predict the concentration of Y4- ions at exact pH levels. Increasing the pH level of a sample to achieve an ideal Y4- concentration may adversely affect other elements in a field sample where the metal cannot be reliably extracted, so a model detailing the concentration of EDTA Y4- ions at an exact pH may have applications in field sample analyses sensitive to pH. The purpose of this experiment was to determine EDTA Y4- concentrations at exact pH levels. It was hypothesized that the concentration of EDTA Y4- ions will increase proportionally as pH level increases because when the pH level of a solution increases, its concentration of H+ ions decreases, causing more EDTA molecules to favor deprotonation by Le Chatelier’s Principle. Solutions of aqueous CaCl2 were prepared at various pH levels. Several drops of Eriochrome black T indicator were added to each beaker. A burette was filled with EDTA aqueous solution and titrated into the CaCl2 solutions until an endpoint. A growth equation should have been determined using the experimental data.

***Victoria Pensiero***

**Powering Dual Chamber Pacemakers Using Biofuel Components**

An artificial pacemaker is a device that can be implanted in the cardiac tissue of a patient (Parsonnet, et al., 1981). Pacemakers use electrical impulses to stimulate muscular heart contractions in patients who are diagnosed with abnormally paced heartbeats(Bleeker, Kakkar, 2018). One side effect that occurs in patients who have had pacemakers installed for approximately 10 years or longer is called Pacemaker Syndrome (Wish, et al., 1987). This is when the contractions of the atria and ventricles become desynchronized as a result of prolonged pacemaker usage, resulting in less blood being pumped from the heart with each beat (Witte, et al., 2006). This forces the heart to work harder to circulate blood, increasing the patient's risk of heart attack (Lazarus, 2007), and encourages the development of a pacemaker which can control atrial and ventricular contractions separately in a patient's heart. In order to do this, two standard pacing components, each obtained from separate single-chamber pacemakers, were used. One was programmed to deliver electrical impulses to the left atrium. One delivered an impulse to the right atrium approximately 500 milliseconds before the second one delivered electrical impulses to the left ventricle(Bleeker, Kakkar, 2018). This trial pacemaker was attached to a preserved sheep heart and blood flow was measured for 10 minutes and compared to a single-chamber pacemaker. The trial pacemaker with dual controls caused the sheep heart to pump out approximately 17% more blood (20.3ml) more blood after a 10 minute time period as opposed to heart with the regular single-chamber pacemaker. Thus, the trial pacemaker was able to increase blood volume output, and would be a more effective pacemaker to use in patients prevent the development of Pacemaker Syndrome.

***Yasemin Sahin (with Samuel Kim, Ward Melville HS)***

**Steering Magnet Research and Development for the Electron-Ion Collider**

The Relativistic Heavy Ion Collider (RHIC) is a particle accelerator at a National Laboratory. The laboratory plans to build a cost-effective Electron-Ion Collider (EIC) by adding an electron ring and polarized electron source to RHIC. To reduce gas ionization problems in the EIC, several additional dipole magnets are needed. The purpose of our research was to build three different prototypes of air-core dipole steering magnets– a cosine-theta coil, a saddle coil, and a double-helix. These three magnet designs have been used in iron-dominated designs, but are not typically used in air-core applications in accelerators. In this research, several versions of these three air-core dipole magnet were hand wound, and peak field, field uniformity, and points of thermal runaway were measured. We wound each magnet on 4-inch stainless steel beampipes using tape adhesive. For testing, field strength measurements were made with a Hall probe that was moved manually in the axial and horizontal directions, relative to the center of the beampipe. We used a constant-current power supply, and were able to determine the point of thermal runaway, where the voltage increases rapidly due to increased coil temperature. For the double-helix dipole magnets, gold elastomeric connectors were used to enable the magnet to be removed from the beam pipe. Our magnetic field measurements showed that our saddle coils’ field were more spatially uniform than the cosine-theta. For the double-helix, both the unaltered and elastomeric prototypes yielded field strengths which met the required specification of field strength and field quality.

***Deniz Sinar***

**DNA Damage Repair: The Correlation Between Dicer and Replication Protein A1**

Double-strand breaks (DSBs) in DNA jeopardize genome stability and can lead to mutations or cell death. Thus, it is essential that DSBs are efficiently repaired in order to ensure the health of a cell. One method of DNA repair is homologous recombination (HR). Replication Protein A1 (RPA1) binds to single stranded DNA (ssDNA) which is produced near DSB sites, and it allows for HR to proceed. Thus, when DNA damage occurs, there would be a buildup of RPA1 since this damage must be repaired. The purpose of this investigation was to determine if the presence of RPA1 is correlated to the presence of Dicer near sites of DNA double-strand breaks, since previous research shows that Dicer plays a role in the DNA damage response. Thus, it is possible to hypothesize that Dicer and RPA1 interact during DNA repair, and that the presence of RPA1 is correlated to the presence of the Dicer protein. To test this, myc-tagged RPA1 strains were transformed into *Schizosaccharomyces pombe* using a standard bacterial transformation protocol, with one strain in the presence of Dicer and one in the absence of Dicer. Western blotting was used to confirm protein presence in each strain. Then, chromatin immunoprecipitation (ChIP) was performed which included binding the RPA1 protein to DNA, fragmenting the DNA, selectively immunoprecipitating the DNA using antibodies that bind to RPA1, then separating the DNA from the protein-antibody complex. Lastly, qPCR was performed to quantify the relative levels of RPA1 binding from the ChIP product in the presence and absence of Dicer. The results thus far show that in the absence of Dicer, there was an increase in RPA1 indicated by a buildup of ssDNA, suggesting that the presence of Dicer and RPA1 are correlated.

***Kyle Spinelli***

**Development of an Efficient Method of LFSR for the**

**Encryption of DNA Data Stores**

Data storage is becoming an increasing necessity and a challenge for computer chip manufacturers to keep up with demand. Moore’s law states that computer chip size double approximately every year. Soon, however, semiconductor chips will not be able to meet the demands of the growing need for storage capacity. In efforts to solve this problem, computer hardware engineers are looking to the biological. One gram of DNA can store over 455 exabytes of data for billions of years. That’s as much as 1 million cds. Other factors such as the ability to work in base 4 ( instead of binary) and energy efficiency make DNA data storage an attractive choice for modern computer data research. The technology to easily encode and read this data remains in the developmental stage for now, but the next step after reliable data storage is facilitated will be the encoding of this data to ensure the secure transfer of information between users. The purpose of this research was the development and analysis of LFSR applied to data encoding by retrovirus in non-transcribed mRNA. The method was developed and analyzed based upon previous LFSR developments and gene coding techniques and a nuanced DNA data encryption scheme was created. Further research potential is discussed regarding potential for the translation of other encryption techniques.

***Carly Tamer – See Emma Matz***

**UNDERCLASSMEN**

***Ethan Abbe***

**Looking at the Expression of the Dsup Gene in Tardigrades Upon Exposure to**

**UV Radiation with Ascorbic Acid Supplements.**

Dsup is a gene found in the animal family of Tardigrada. This gene has been shown to provide tardigrades with their resistance to extreme conditions and survivability in environments. Dsup helps suppress radiation damage, helping to repair damaged genes. Ascorbic Acid, also known as vitamin C, is known to help protect DNA against free agents, using its powerful antioxidants to defend DNA from damage. Antioxidants are also thought to repair radiation damage to cells. The purpose of this project is to see the effect the radiation and ascorbic acid has on the Dsup gene expression of the tardigrades. We would compare the expression of Dsup in non-irradiated samples to the expressed and irradiated samples both with and without ascorbic acid. This was done to measure the comparative expression. Our hypothesis is that the Dsup will less expressed in the irradiated samples with ascorbic acid than the ones without. To test for this, we first made three groups: a control group, which would be unirradated, one exposed to UV radiation, and one exposed to UV radiation and ascorbic acid. after this, we verified that we had our DNA using Instagene matrix protocol, then extracted RNA using Qiagen RNA mini kit. From there we prepared cDNA using the Qiagen RT-PCR kit protocol, running the PCR three times, increasing each trial by 5 cycles. Finally, we analyzed the DNA using gel electrophoresis

***Defne Aktuna, Karen Li, Shreya Sriram***

**The Impact of Nicotine on the Cognitive Function of Memory on**

**Future Generations of *Drosophila melanogaster***

The addictive properties of nicotine release dopamine in the brain, over time causing the development of a tolerance to this chemical. Studies have shown that children of smokers are more likely to suffer from mental and physical defects, for example asthma, mental disabilities, and growth restrictions. The purpose of this experiment was to test the impact and the extent that the nicotine had on the cognitive function of memory on the second and third generations of *Drosophila melanogaster*. *Drosophila* were used because they bred quickly and had a strong genetic resemblance to humans, therefore the results can be applied humans. The first generation of fruit flies were exposed to different levels nicotine, 0, 100, 200, and 300 µL in their food. The second and third generations were exposed to banana and almond oils. When exposed to banana oil, the flies were simultaneously exposed to an electric shock. The objective was for the flies to couple the banana oil with the negative experience of the electric shock. They were then run through a choice chamber testing their ability to associate and recall aversion scents. The flies had a choice between the scent of almond oil and banana oil in two paths. It was hypothesized that if the first-generation parents were exposed to nicotine, then the offspring would show less of an ability to recall which scent had the shock and which one didn’t, and therefore take several more tries to choose the scent without the electric shock than the fruit flies exposed to less or no nicotine, showing a decrease in mental abilities.

***Ryan Alves, Victor Bua***

**The Effect of Temperature on the Burying Behavior in Hermit Crabs (Pagarus longicarpus)**

The *Pagurus longicarpus* otherwise known as the long-clawed hermit crab is one of the most common ocean organisms of the East Coast. They’re often in the temperature threshold of 15° and 25° Celsius and are very social animals. Due to their wide range, they seem to have multiple reactions to various conditions. Hermit crabs react to cooler temperature, less than 15°C, by burying themselves. In warmer water, based upon other researchers, crabs show increased activity, or other odd behavior. The interest in this particular species is how do they behavior in warming ocean temperatures. The information gathered in the experiment is important due to the effect of climate changing and increasing water temperatures. As many cold-blooded animals are sluggish when cold and more energetic when warm. So, if we expose these animals to higher temperatures, they will likely become more active. The plan was to place one of the hermit crabs in a floating container that had 3cm of sand. The container was placed in 10 gallon tank. The initial temperature of the tank water was 24°C. We raised the temperature 2°C and left them in the container for 30 minutes, observed their behavior, then removed them. Since there were two hermit crabs, every other day we tested each one in that tank at the same temperature while the other one stays in a control container in a control tank which had a temperature of 23°C. We kept raising the temperature by 2°C each testing day until we reached 35°C. In the actual experiment when we started testing, no odd behaviors were recorded until 29°C. One of the hermit crabs became very jittery and acted strange but no burying was observed. At 31°C, one of the hermit crabs showed burying habits, while it didn’t bury itself in the time allotted, it made a decent size hole. At 33°C and 35°C, both hermit crabs showed this behavior. The only difference between the 33°C and 35° tests was that both hermit crabs started to dig earlier and thus made more progress by the end of 30 minutes. The only thing we didn’t answer really is if they were trying to bury themselves or simply dig. We felt if we had more time leave the crabs in the container we may have witnessed this full burial.

***Deborah An, Paul Kang***

**The Effect of Different Background Colors on Readability and Test Performance**

The effect of digital colored backgrounds on a user’s ability to comprehend a reading passage was tested. This experiment is important to daily life because it can help improve future website design. When conducting this experiment, 16 participants, all in high school, took a variety of different reading exam sections with 4 questions each. The background of the exams varied in 3 colors: blue, black, and red, with the text color as the complementary color of the background color. The last background color, white, was tested as a control group. All exams were given in a different sequence in which taken, depending on the subject group. Based on previous studies, it was hypothesized that the blue background would lead to better readability and focus. Based on the results, the red background color helped the participants perform the best on the exam. Black had an impairing effect on the test performance. In future studies, we can test the effects of different colors, effect on different age groups, and the effect of background colors on colorblind people versus non-colorblind people.

***Aryaram Anand, Evan Ni***

**The Effects of Cinnamaldehyde and Ultraviolet Water Purification on the Reduction of Algal Bloom Development**

Algal blooms are colonies of algae that grow at an uncontrolled rate. They are located throughout the world and found near shorelines. These harmful blooms pollute aquatic environments and can negatively affect marine life by upsetting food webs and ecosystems. Therefore, it is critical to find a solution that can reduce the growth of these algal blooms. The purpose of this investigation was to determine the most effective treatment using either UV light or cinnamaldehyde in the reduction of algal bloom. The algae, *Chlorella*, was placed in beakers and grown under a Grow-Lux light. After several days, some of the algae was exposed to ultraviolet (UV) light for several seconds or cinnamaldehyde. This was to allow for efficient treatment exposure time. A control sample had no exposure to either. Using a spectrophotometer, the absorption at 580nm was recorded for each sample. It was hypothesized that UV light exposure would be the most effective in limiting and reducing algal bloom development because it effectively penetrates the algae and damages the DNA. Results have shown an increase in the amount of algae after the application of cinnamaldehyde, and there was no significant difference found between the absorbance of the control and UV groups.

***Victor Angielczyk, Liam Whitewolfe***

**Improving Current Facial Recognition Programs**

In today’s world, security is an imperative part of everyday life, whether in schools to prevent events like the Parkland school shooting, or on streets to catch criminals who are a threat of endangering the lives of others. The technology that allows us to do this is facial recognition. All that is required is a camera, a computer that is connected to the camera can determine whether a person belongs in a school or help police officers in identifying and ultimately catching criminals. But recently, there has been some controversy about the accuracy of these programs. Companies like Google have pulled their Open-Source facial recognition programs, because of some racial bias. The software had a hard time recognizing minorities, even going as far to label people as animals. Currently the fix is to take out animals that have some human resemblance in the data set which is used to detect faces of humans and animals and keep humans only. Python scripts were used with a library Open-CV, facial images were gathered and transferred to a Linux machine to train it in facial recognition. Afterwards the script was used to determine the recognition value had any measurable change. Our goal is to improve the current issues, allowing for the software to be more mainstream. At this point the code is scripted but due to limitation with our school’s network security, we were unable to complete the task.

***Candace Arneaud, Izza Malik***

**The Comparison of Natural (*Fallopia japonica)* of Commercial (Glyphosate) HHerbicides on White Clover Feed Growth**

*Fallopia japonica*, an invasive species, prominent in North America and Asia. It can colonize quickly over new regions thus eradicating native species. This property is due to natural chemical compounds known as stilbenes, that are produced in many plants, however these invasive plants have a relatively high concentration of this chemical. This allows *japonica* to imitate the role of an herbicide, as it decreases the growth of native populations. Homeowners typically use RoundUp®, a natural herbicide containing the active ingredient glyphosate to eliminate unwanted weeds and plants. This is supposed to be safe and blocks an enzymatic pathway only found in plants. The purpose of this experiment is to determine whether a natural herbicide, *Fallopia japonica*, could be just as effective as a commercial herbicide, RoundUp®, at eradicating a population of White Dutch Clover plants. To test this inquiry, we grew 12 pots, with 5-6 seeds of White Dutch Clover. Once the plants were steadily grown, we sprayed 4 pots each with the natural herbicide, 4 pots with commercial herbicide, and 4 pots used as a control. We hypothesized that the natural herbicide would be just as effective since it possesses strong allelopathic qualities, allowing the species to secrete chemicals and hormones to influence the growth of neighboring plants. Thus far results show that *Fallopia japonica* has the capability of eradicating weeds but at a much slower rate than Glyphosate. Although *F. japonica* didn’t eradicate all the plants as quickly as hypothesized, it showed physical weaknesses such as bendy or thin stems. The physical appearance of the plants supports the fact the *Fallopia japonica* has a detrimental impact on weeds.

***Daniel Baek, Jackson Rubin, Zeshan Cheema***

**Nutrient Effectiveness on the Regeneration of Flatworms**

This project uses flatworms that have a specific trait that is valuable to the experiment. These flatworms have special cells called stem cells, they’re large undifferentiated cells of annelid worms that participate in regeneration of lost parts. Using this type of cell, we tested 3 different nutrients: calcium, protein and vitamin C. Calcium benefits the organism by blood clotting, cell signaling, muscle contraction and nerve function. Protein help regulate body tissue and organs. Vitamin C help protect cells from compounds formed when bodies convert food into energy. The nutrients were tested on can they accelerate healing in an organism. The purpose of this experiment is to see the acceleration of regeneration in flatworms. This could help future research on this topic about cell growth. If the stem cells could be accelerated in flatworms, the stem cells in humans could be used to fully develop missing organs. The experiment will contain 4 groups, one control, protein group, calcium group and vitamin C group. Each group will in total have 10.0 mLof solution. The solution will be 9.75 mL of artificial pond water and .25 grams of each nutrient, higher of lower depending on how to flatworms react to the solution. The control group will get 10 mL of artificial pond water. This will test the administration of nutrients will accelerate flatworm regeneration. We cut the heads off the planaria and waited to see if the different nutrients affected the rate of regeneration. If we administer different foods of high concentrations of specific nutrients to flatworms such as calcium, protein and vitamin D we can isolate which nutrients result in the most efficient way of healing because we can correlate specifically what added nutrient to the diet results the shortest time of regeneration. In conclusion, the protein and vitamin c group died. Calcium regenerated the fastest in eighteen days. The control group then finished two days after.

***Christian Baldi, Maxwell Cantley***

**Frequency of NBA Injuries Per Inch of Height**

Injuries in the National Basketball Association (NBA) occur frequently. However some players are more at risk for injury than others and may need to wait longer before playing again. This experiment dealt with one factor that affects injury risk- height. The goal of this study was to investigate the likelihood that taller players are more vulnerable to injury. Data was taken from NBA, Google, and Kaggle databases that recorded how many players were in the NBA each season and all the injuries from those players. The data was used to find a percentage that gave the approximate frequency of injuries an NBA player could expect in the first two months of the season. The numbers were calculated in height intervals of an inch and were done for the 2010-2011 season and the 2017-2018 season. In the first two months of the 2010-2011 season, there was an average of a 35% injury rate for players 7 feet or taller, whereas only about a 28% injury rate for players 6 feet 6 inches to 6 feet 11 inches. The computations showed that generally, the taller a player is, the higher chance that person has to be injured. Athletes can benefit from this project to better understand how prone they are to injury and be able to plan time to rest.

***Michael Benin, Michael Van Loon***

**Clean Green Hydroelectric Machines: Utilizing Wastewater to Power Hydroelectric Turbines for Energy Recovery System**

Hydroelectricity is 90% efficient when converting potential energy into electricity, as compared to fossil fuels, which are only 50% efficient. This makes hydroelectricity a more attractive source of energy both economically and environmentally. The most well-known hydroelectric turbines are associated with large dams; however, these dams have consequential impacts on the environment. By using “run of river” hydroelectricity, capitalizing on the potential of water used in a home, the ecological impact of energy production will be even less, with no carbon emissions. The purpose of the project is to find the ideal funnel diameter to generate the most electricity, optimizing turbine performance. When the optimal funnel diameter is determined, it will be possible to compare different turbines to see which is truly the most efficient. The model we hope to achieve will maximize the greywater flow to generate energy through kinetics.

***Jayson Bromberg, Narumuchi Nakamura, Thomas Parangelo***

**Comparing the Effectiveness of Drones to Ambulances**

**In Terms of Transporting Blood**

The purpose of this experiment was to determine whether drones are more time and cost effective than ambulances in terms of transporting blood from a hospital to an emergency scene. John Holcomb, MD, a former trauma surgeon in the US Army, estimates that 35% of all trauma deaths can be prevented simply by implementing the universal policy of prehospital blood transfusions. Drones have been present in everyday life from delivering packages to being used as a surveillance tool for the military. For medical emergencies, drones would have to go a shorter distance to reach a scene than an ambulance because drones can go to a scene in a straight path while ambulances must follow roads. The path a drone takes to get to an emergency scene is on average 21% shorter than an ambulance’s. Using travel ambulance records and specs of drones based off manufacturer’s websites, it was possible to simulate the times it would take for a drone and an ambulance to go specified distances (3 miles, 7 miles and 12 miles). The costs were compared by using the price of an ambulance and their required maintenance each year against the average cost of drones and their maintenance. It was hypothesized that drones would be more time and cost-effective than ambulances in transporting blood in pre-hospital transfusions because drones are less expensive than ambulances and are not restricted to roadways. Results show that drones are more cost and time effective than ambulances. Drones are cheaper than ambulances and reach the scene on average 4 minutes faster than ambulances. Yearly maintenance of an ambulance costs $10,000, while drones on average cost $9,439 with negligible maintenance costs. However, the data doesn’t show if drones can be applied to other emergencies requiring different medical treatment than blood transfusions.

***Victor Bua – See Ryan Alves***

***Maxwell Cantley – See Christian Baldi***

***Michael Chacon, Joseph Cramer***

**The Migration Patterns of the Great White Shark *(Carcharodon carcharias)***

The Great White Shark is a species of shark that can be seen off the coast of every continent except Antarctica. Great Whites average about 2000 pounds and have a bite force 4000 PSI, they also have the ability to dive to depths of 980 meters and can tolerate water temperatures of 3.4 degrees Celsius. Ocearch is a research program that began tagging white sharks in 2012, by placing satellite linked radio telemetry (S.P.O.T.) tags on the shark's dorsal fin. Every time the fin broke the surface the Ocearch websites receives a “ping” that show the sharks GPS location. This tagging showed a common pattern of migration down the east coast, ending near the Bahamas or continuing into the Gulf of Mexico. The purpose of this experiment was to determine the reason for the Great White Sharks migration pattern. We believe water temperature as well as the Atlantic Tuna migration maybe the cause. We used data points from Ocearch.com and compared them to the locations average water temperature during that time of year from ndbc.noaa.gov. We hypothesize that if the Great White Shark originates in Nova Scotia, then, they will migrate to Southern Florida because of the warmer water and the migration of pelagic fish. Our results showed that all sharks traveled south towards Florida and North and South Carolina. Males and younger females swam into the Gulf Of Mexico while larger adult females swam offshore towards the Bahamas.

***Isaar Chadha, Jonathan Mitra***

**Superstructure vs. Substructure in a Bridge Design**

Over time mankind has developed many unique ways to design different bridge structures. The superstructure of a bridge is the structure above the surface. The substructure is the part of the bridge design below the surface. It was hypothesized that the superstructure and substructure have an equal importance on a bridge design. This is likely because if they are both there to keep the bridge together, then the side of the surface the beams are on should not impact the bridge stability. A variety of bridge structures was designed and tested in the West Point Bridge Builder software, while varying beam sizes, beam material and beam density. Beams and joints were used to create five analogous designs. The bridges were tested by seeing whether they would pass or fail when a truck load went across. These designs were then retested after changing the deck thickness from medium-strength concrete which is .23 meters thick to high-strength concrete which .15 meters thick. The data supports substructure being more important because there were substructure designs that were able to support the bridge whose analogous superstructure designs failed. This study could improve the way engineers design bridges and help make decisions on which way a bridge should be built for the most stability.

***Annika Chang, Katerina Efthymiou***

**The Effect of Heavy Metals on the Seaweed *Caulerpa prolifera***

Heavy metal contamination in agricultural crops is a significant problem as bioaccumulation can cause negative effects to plants, animals and humans. They can interfere with many plant processes such as growth, photosynthesis, respiration and nutrient absorption. Heavy metal concentration in the ocean has increased due to contaminated runoff from industrial activity. Seaweeds play a vital role in marine biomes and their population is declining. Seaweeds provide a habitat for small organisms, filter the water, and prevent erosion from ocean currents. The purpose of this project was to determine if the heavy metals, lead, copper, and zinc have an effect on the photosynthesis of the seaweed, *Caulerpa prolifera*. The seaweed was grown in four different environments, three with equal concentrations (10 ppm) of each heavy metal and one control group. Their photosynthetic activity was measured using a PAR (Photosynthetically Active Radiation) sensor every 2 days, for 25 days, and compared to the control to determine if there was a significant difference between the plants grown with a heavy metal and the control. It was hypothesized that the tanks with the heavy metals, would have a lower PPFD (photosynthetic photon flux density) than the control tank because heavy metals, especially lead, can inhibit several enzymes in the Calvin cycle, especially Rubisco which is a catalyst for carbon fixation by RuBP. T-tests comparing the photosynthesis of the heavy metals tanks to the control had a p-value greater than 0.05 so there was no statistical difference. However, the control appeared healthier with greener and more numerous blades of seaweed. Additionally, the seaweed in the control tank had the greatest increase in average mass. The heavy metals caused chlorosis and necrosis.

***Zeshan Cheema – See Daniel Baek***

***Kevin Chen, Rohan Surana***

**An Analysis of the Relationship Between Shifts in Cyclone Location and Variable Temperature Gradients**

Due to extensive damage caused by cyclones, we need to further investigate the relationship between cyclones and climate to better prepare for and minimize future destruction. Though the occurrence of cyclones has persisted in select regions over the past century, current research suggests that the concentration of cyclone activity is shifting in the Pacific Basin due to large scale changes in climate. The objective of this project was to understand changes in cyclone patterns over a period of 20 years and to make correlations with the possible causes like temperature, gravitational pressure and vorticity. We recognized that there was a significant shift in cyclone patterns over the past 20 years and hypothesized that the primary cause for this shift is the change in location of high temperature gradients. To test our hypothesis, we developed a statistical method that used t-tests to analyze the difference between cyclone locations (latitude and longitude values), grouped by region, in the years 1998 and 2018. We believed that the utilization of a simpler statistical method would further facilitate the replication of prediction methods. Our results suggested that there was a significant shift primarily in cyclone locations of the Pacific over the 20-year period. To determine whether this shift was dependent on changes in the location of high temperature gradients, thermal maps of the Pacific Ocean from 1998 and 2018 were extracted. The thermal maps suggested that over the 20-year period, regions of high temperature gradients in the sea migrated in patterns that coincided with the westward shift of cyclones in the Pacific.

***Nathan Cheung, Ruth Lee***

**The Effect of Cerebrospinal Fluid Hemoglobin Levels on the Progression of Parkinson's Disease**

Parkinson’s disease (PD) is one of many neurodegenerative diseases where the cause is still unclear. PD is a progressive disorder of the central nervous system, which impairs movement leading to tremors. The primary hypothesized cause of PD is dropping dopamine levels or death of dopaminergic neurons due to an undetermined cause of Iron being deposited in the brain. Hemoglobin (Hgb) contains iron and as the dopaminergic neurons die, hemoglobin levels in the cerebrospinal fluid (CSF) may drop along with iron levels.Previous studies have shown that a decrease of hemoglobin levels in the blood can be correlated to the progression of PD. The purpose of this study was to determine whether there is a similar correlation between the concentration of hemoglobin in the CSF and the progression of Parkinson's disease. Data was obtained from the Parkinson’s Progression Markers Initiative, utilizing the Movement Disorder System - Unified Parkinson’s Disease Rating Scale. Patients were separated based on gender, clinical event and diagnosis. After tests were done it was concluded that there is general decrease in CSF hemoglobin concentrations for males as severity increases/clinical event progresses. However, in PD females, there appears to be only a moderate negative correlation. In PD males, there appears to be a strong negative correlation of – 0.7673, meaning that as PD severity increases as the values of CSF hemoglobin concentration decreases which confirms our hypothesis.

***Faith Chi, Caitlyn Rothar***

**Which Insecticide, Bifenthrin (pyrethroid) or *Azadirachta* *indica* (organic), Will Have the Greatest Horizontal Transfer Within an Ant Colony?**

Harvester ants are from the southwestern United States and play a large role in the ecosystem. They aerate the soil by digging tunnels and letting water flow to plant roots and distribute seeds in their tunnels. Their niche in the environment made it significant to study the effect that insecticides have on ants. The purpose of this experiment was to see which insecticide, organic or non-organic, caused the most horizontal transfer resulting in the greatest mortality rates. Horizontal transfer is when part of an ant colony is exposed to an insecticide, then spreads the chemical to the rest of the colony, causing more deaths. The insecticides studied were Bifenthrin and neem seed oil. Bifenthrin, a non-organic insecticide that is very potent, affects the ant’s nervous system by halting the communication and control of its body, killing the ant immediately. Neem seed oil *(Azadirachta indica)* affects an ant’s ability to synthesize the molting hormone, ecdysteroids, and causes the insect to die when it attempts to molt which is approximately every two weeks. It was hypothesized that Bifenthrin and neem seed oil would cause a similar amount of mortalities; however, it would result in greater mortality rates due to its high toxicity level, resulting in greater harm to the ant. The ants were exposed to the pesticide for one day and then were placed with the rest of the colony. This was done by creating a nesting chamber with the insecticides mixed into sand to contaminate the ants when exposed. When the ants came into direct contact with the insecticide, it contaminated its body and spread the chemical to the rest by crossing over the bridge connecting the foraging area to the nesting chamber. The mortalities were counted after seven days. As a result of this experiment, our data proved our hypothesis correct since the mortality rates of the ants exposed to bifenthrin were in greater numbers than *Azadirachta indica*.

***Tyler Chipetine***

**Precision Incision: A Study on the Retention of Memory After the**

**Regeneration of *Dugesia trigrina***

*Dugesia trigrina*, known as brown planaria, can regenerate their entire body after being cut to a minimum of 1/279 of its original size, with all major organs and body parts being regenerated to full functionality. One interesting characteristic of brown planaria is the ability to retain memory, even if the brain is regenerated. This is known due to the fact that planaria can relearn a task in a shorter time after regeneration than before regeneration. The purpose of this experiment was to test the retention of memory in brown planaria regenerated from 3 sections, the neck, the torso, and the tail. The results would show which region, if any, is most vital in the retention of memory and would help to learn the extent of stem cells in the regeneration process. This experiment was done in three phases, the initial learning stage, the division/regeneration stage, and the re-learning stage. First, the planaria were trained to be less sensitive to light over an 8-day period, and then cut so either the neck, the torso, or the tail was remaining. They were left to regenerate for 14 days and then were retaught the task, ith time for relearning recorded. It was hypothesized that the group containing the nerve cords (neck region) would relearn the task in the quickest amount of time. This hypothesis was made due to the theory that the nerve cords retain memory of environmental stimuli, specifically light. In the training stage, the average distance traveled increased for almost every five-minute training period, with a minimum of 1.1 boxes on the first day and 4.2 boxes on the seventh day. For the negative control group, the retraining stage took longer than expected, where it took 4 days for the planaria to relearn their comfort with light. For an unknown reason, the planaria would not regenerate and were unable to be retrained in some trials.

***Wonjeong Choi***

**Gene Expression of Dpy-10 in Ultraviolet (UV) Radiation *Caenorhabditis elegans* Both With and Without Tretinoin**

Human skin is exposed to ultraviolet radiation (UV) on a daily basis. To repair the damaged skin cells, skin treatments are used to increase the mitotic reproduction of skin cells. Retin-A is a skin treatment used for acne and wrinkles. It contains Vitamin A which is a group of unsaturated nutritional organic compounds that includes retinol, tretinoin (retinoic acid), and several provitamin A carotenoids. Vitamin A is important for cell growth and development, therefore it is also important for repairing damaged skin cells. Since dpy-10 is a protein, that codes for increased production of cuticle collagen proteins, this study looked at changes in gene expression of dpy-10 in *C. elegans* with exposure to radiation and to tretinoin. The experimental groups were a) with radiation exposure and without tretinoin and b) with radiation exposure and with tretinoin, the control was neither treatments. The RNA of all groups of *C. elegans* were isolated using a Qiagen RNA extraction kit. Next, a Qiagen RT-PCR Kit was used to convert the RNA to DNA for PCR. AFterwards, the samples were run through a 0.8% agarose gel with a mass DNA ladder. It was hypothesized that the gene, dpy-10, would be expressed more in *C. elegans* with radiation exposure and without tretinoin compared to with radiation exposure and with tretinoin. Thus far no results were obtained. The technique was repeated several times, once under complete sterile ethanol conditions, again as one step without freezing in between the RNA to DNA step, and finally by changing the annealing temperature. My next step is to order primers to a different location on the dpy-10 gene.

***Lindsey Chung, Flora Lin, Amber Syed***

**Alternative Materials for Feminine Hygiene Products for Underprivileged Women**

A momentous issue for many underprivileged women is the risk of getting infections from not being able to afford proper products to care for themselves during menstruation. This could lead to use of unsanitary materials such as leaves, twigs, and other homemade materials which could cause severe health problems. Some infections that could result from this are yeast infections, trichomoniasis, and scabies infections. Another complication with many sanitary napkins is the negative effect they have on the environment since they use materials like polypropylene, polyethylene, and adhesives. Cellulose is an abundant resource in nature, and is biodegradable, non-toxic, low cost, and renewable. Cellulose-based superabsorbent hydrogels can absorb and retain aqueous solutions up to hundreds of times their own weight. Cellulose has a negative charge and attracts water molecules resulting in efficient absorption of liquids. Other commonly used materials used in pads are hemp fabric, cotton, and synthetic rayon. We soaked 5 grams of each material in 100 mL of synthetic blood for 2 minutes each before straining any excess blood that did not get absorbed. A strainer was used to hold the material while draining synthetic blood that the material could not retain. 100 mL of the synthetic blood was used so the amount held by the material could be found by subtracting 5 grams from the product weight. Our hypothesis was that the cellulose will be the most beneficial as it is highly absorbent and biodegradable. Price wise, cellulose is low-cost, since it is copious in the environment. The cellulose used in our experiment was $10.99 for 1 lb. of the material. In our experiment, results indicate incorporating cellulose based superabsorbent hydrogels could help many women worldwide with menstruation since the average absorbency for the hydrogels was 87.9 mL. compared to cotton, which was a close second, with an average absorbency of 87.4 mL. There was a big difference between these two and the rayon, with an average absorbency of 23.3 mL, and the hemp fabric with 24.0 mL.

***Christopher Citera, James Haupt, Matthew Strogach***

**Testing the Time it Takes for Hermit Crabs to Detect their Food Preferences**

Hermit crabs, *Pagarus Longicorpus*, live underwater in varying depths of saltwater from shallow reefs and shorelines to deep sea bottoms. The *Pagarus Longicorpus* are found locally in New York State. The Hermit Crabs have an increase in smelling abilities when underwater. Hermit Crabs have a great olfactory and they can smell from great distances. We tested the olfactory system of the *Paganus Longicorpus* species of hermit crabs. The purpose of this research project was to determine which foods hermit crabs prefer. The foods we tested were strawberries, coconut flakes, almonds, and Tetra Faun Hermit Crab Meal. Their favorite are the coconut flakes, which trigger the hermit crabs olfactory by their chemical attraction. The coconut flakes contain volatile compounds that cause a distinct odor for the crabs. Hermit crabs are a vital part of the benthic community and are scavengers who have helped to recycle energy back into the ecosystem. This project can help us understand that the food they eat affects this ability. We placed one gram of each food in every corner of the 4-cornered maze. The time the hermit crabs took to detect the food was taken. Thus far results show that the hermit crabs went for their favorite food, coconut flakes, first, and almond was a close second.

***Alyssa Collado, Annabelle Hohne, Tryphena Zareif***

**The Effect of Neurotransmitters on Regeneration in Planarian (*Dugesia tigrina)***

Regenerative medicine is a growing field due to its applications in the creation of treatments for spinal cord injury, Parkinson’s, and Alzheimer’s in people. This field uses neural regulators known as neurotrophic factors, to regulate neural cell functions and increase signaling between the cells’ synapses. Likewise, there are also neural inhibitors, which work to neutralize the effects of the neurotrophic factors. Thus, in this experiment neurotrophic factors were tested against neuroinhibitor GABA on *Dugesia tigrina*, commonly referred to as planarians. Planaria are known for their similarity to the human nervous system regarding their regenerative properties. They are made of stem cells known as neoblasts, which can differentiate into any cell in the body, and are responsible for the regeneration of eyespots, a marker for their regeneration rate. In this experiment, planarians were placed in neurotrophic factors phosphatidylserine and citicoline solutions. To test these neurotrophic factors, planarians were cut; tails were placed in Artificial Pond Water (APW), a GABA solution, a GABA with citicoline solution, and GABA with phosphatidylserine solution; and the time for growth of the eyespots was recorded. It was hypothesized that cut planarians placed in a solution with a neuroinhibitor (GABA) and either phosphatidylserine or citicoline, the planarians in the citicoline solution would regenerate eyespots first because citicoline is a producer of acetyl-choline which is an important neurotransmitter whereas phosphatidylserine just works to insulate synaptic transmissions. If one neurotrophic factor showed significantly better results than the other did, it could help create new medical treatments. The results show that planarian in the citicoline solution regenerated at a slightly faster rate, about 22.57% per day, than those in the phosphatidylserine solution, 22.29%. Overall, supporting our hypothesis that the citicoline solution will all the planarian to regenerate at a quicker

***Jodi Consul, Brianna Han, Nicholas Leahy***

**The Effect of Nanoparticular Ingredients Found in Sunscreens on Phytoplankton**

Many modern-day sunscreens contain chemicals that can disrupt various marine organisms and ecosystems. Zinc oxide (ZnO) and titanium dioxide (TiO2) nanoparticles can be found in certain sunscreens. A study has shown that the photoexcitation of these nanoparticles under solar radiation produces significant amounts of hydrogen peroxide (H2O2), which is a bleaching agent known to cause oxidative stress on marine organisms. Phytoplankton are significant to the food web, as they are producers and feed various organisms in aquatic systems. The decrease of phytoplankton would create an imbalance and affect other marine life. The purpose of this experiment is to determine if ZnO and TiO2 decrease the survival rate of phytoplankton, and it was hypothesized that ZnO and TiO2 will decrease the survivability of the phytoplankton organisms, but not to the extent of H2O2. To test this hypothesis, a *Nannochlorapsis* phytoplankton culture was created with saline water and nutrients. The culture was divided into four parts. The first culture was treated with ZnO, the second with TiO2, the third with H2O2 (positive control), and the fourth was left untreated (negative control). The cultures were placed under a UV light to grow. The population densities of each culture were calculated once a week using a hemocytometer for seven weeks. T-tests were conducted and resulted in P-values of 0.00231 (negative control vs. ZnO) and 0.00331 (negative control vs. TiO2). The null was rejected, and the alternative was accepted. Therefore, there is a statistical difference, and nanoparticular ZnO and TiO2 have negative effects on the survivability of phytoplankton. In addition, T-tests resulted in P-values of 0.98466 (positive control vs. ZnO) and 0.83170 (positive control vs. TiO2). In this case, the null was accepted. Therefore, there is no statistical difference, so the negative effects of nanoparticular ZnO and TiO2 on phytoplankton are of equal extent as those of H2O2.

***Jack Coogan, Thomas Grgas, Christopher Zizzadoro***

**Planarian Movement in Different Temperatures Before and After Transverse Cut**

Traumatic injury affects organisms long term. Planarians can recover from a traumatic injury such as being cut in half, in about two weeks.  Planarians are very adaptable and can live in both saltwater and freshwater ponds.  Unlike many other organisms, planarian flatworms can fully regenerate after being cut either horizontally or transversely.  In this study three planarians were placed in separate petri dishes at room temperature.  A line crossing assay was performed which showed how many lines on a piece of graph paper a planarian crossed in 1 minute (five trials for each planarian).  This procedure was repeated for 3 planarians at 9°C and 3 planarians at 40°C measuring the planarians mobility.  The same procedure occurred after about two weeks when all the planarians recovered from a transverse cut.  The planarians moved a little slower after they were cut in half at 9°C but there was no significant difference *(p=*0.286254).  The planarians moved significantly faster before they were cut than after they were cut in room temperature water *(p=*0.041461).  The planarians that were in 40°C water moved a little slower after they were cut but not that significantly (*p=*0.490758).   It appeared that the planarians moved the fastest before they were cut in room temperature water. The planarians have shown to move slower after their transverse cut in each group. This supports the idea that planarian mobility is not the same after being cut even after the two weeks of regeneration.

***Joseph Cramer – See Michael Chacon***

***Gavin Cressy, Amy Liu***

**The Antibacterial Effects of Hydrogen Peroxide with Ampicillin**

**On *Escherichia coli* Decay**

*Escherichia coli* (*E. coli*)is a bacterium that naturally resides in the intestines of animals and is integral in maintaining a balanced gut microbiome. However, harmful foreign strains of *E. coli* have negative effects on the body. Antibiotics fight off harmful bacteria by inhibiting cell wall growth or stopping protein production. Hydrogen peroxide is a compound with antibacterial properties and is the primary component in antiseptics. However, it kills helpful bacteria in the process because it destroys their cell walls. This project was designed to determine if administering ampicillin with hydrogen peroxide would kill more *E. coli* than ampicillin alone and determine the smallest concentration of hydrogen peroxide that would do so. It was hypothesized that it would be the 2.5% hydrogen peroxide sample because higher concentrations would be excessiveand lower concentrations would allow the bacteria to grow.To test this hypothesis, 500 μl of *E. coli* and 50 μl of ampicillin were placed in test tubes with 500 μl of a different concentration of hydrogen peroxide in each test tube except for one, which only contained *E. coli* and ampicillin and acted as the control. The absorbance of each sample was measured twice a day for 3 days using a biospectrometer. A higher absorbance meant there was more bacteria present in the sample. The turbidities of each sample were compared to determine differences in bacterial growth or decay. Results reveal that administering hydrogen peroxide with ampicillin is more effective at killing *E. coli* than ampicillin alone, but the concentration of hydrogen peroxide does not have a significant effect on *E. coli* decay.

***Grace Cutrone, Caroline von Hof***

**The Effects of Altering pH on the Behavior of *Palaemonetes paludosus***

The rise in acidity levels of the ocean, which is caused by a phenomenon called ocean acidification, affects the organisms of the ocean as well as the organisms living in connected bodies of water negatively and can lead to death. In this experiment, Ghost shrimp, were studied to determine the effects of a change in pH on their life functions and ability to survive. In the experiment, we preformed two behavioral test that show how pH affects the ghost shrimp. These tests were used to observe the distance that the ghost shrimp swim away after being touched by a simulated predator and the time it takes them to retrieve their food at the top of the tank. It was hypothesized that the change in pH will negatively affect the ghost shrimp and cause their behavioral abilities to decline. Results thus far showed that the normal behavior of a shrimp in the control tank respond quickly to a net by swimming away from it. Shrimp in the control tank have a transparent appearance and eat regularly. In pH 5 tank the shrimp took on an opaquer color after living in the tank for about one week. While food is made available in all three tanks, none of the shrimp seems to be molting at the regular rate (once every two weeks). In the first two control tests, the first shrimp moved 165 boxes and then moved 160 boxes in the second test. The second shrimp moved 47 boxes and 50 boxes in the second test. Due to our water quality complications and the shrimp dying in the tanks with higher acidity levels, we were unable to collect data for the experimental tests.

***Cole Darienzo, Stephen Mullen***

**An Improved Adrenaline Auto Injector: A Potential Fix for First Responders**

One of the more serious issues that a portion of people come across in their lives today is the life-threatening allergic reaction known as anaphylaxis, which is a severe multi-system allergic reaction. However, there is a counter to this allergic reaction, and that is an Adrenaline Auto Injector (AAI). Several models exist, such as MYLAN©’s EpiPen®, but most modern AAIs contain flaws in their design, which can lead to anywhere from minor to severe injuries to the person operating the AAI, with a high percentage of these injuries in the fingers. Therefore, the goal of this research project was to design an improved model of modern AAIs using Autodesk Inventor, and basing our design on responses that we received from first responders and consumers of AAIs. Our AAI prototype included recommendations based on the responses received by first responders. These modifications included but were not limited to the following: a smaller size for more concealability and easier to hold, a larger gauge needle (preferably a 16-gauge needle) and more for the AAI prototype and results have been gathered with their experienced and personal opinions. Additionally, the prototype was printed on an FDM 3-D printer. In conclusion, the aim was to produce an improved AAI prototype with the help of First Responders to increase the overall safety of AAIs. Additionally, First Responders will then look at the prototype and provide feedback for additional improvements.

***Ethan Darvin, Corey Levy***

**The Effect of Climate Change on Weather Severity From 2000-2015**

Climate change has been known to cause increasing severity of various climatic extremes. The existence of climate change has been proven and recognized by scientists and governments, alike, worldwide. The effect of climate change is hypothesized to be colder, harsher winters with more snowfall as well as increasingly warmer summers that consist of a more severe and an increasing number of droughts and heat waves. It was hypothesized that an there will be an increase in severity correlated with an increase in the number of heat waves, droughts and winter storms as time progresses from 2000-2015. This is justified by the Nation Climate Assessment in 2014 which stated that climate change and the earth warming will lead to an increasing number of heat waves, droughts, increase in Atlantic hurricane activity and winter storm frequency and intensity.  The purpose of this research was to determine the trend by which this weather severity changes over time and that can be expected in the future if climate change continues to follow the expected rate in New York. In order to see if weather events correlated with increased severity from 2000-2015 in New York, data was found on average and peak temperature (℃), and number of events that resulted in deaths, injuries, and estimated damages (USD) from heat events and hurricanes in summer and winter storms in winter. Data was obtained from the Storm Events Database, National Snow and Ice Data Center and Climate.gov. The results didn’t display a clear correlation between an increase in severity and frequency as the years progressed making the hypothesis incorrect. This is most likely because the scope of this research was only New York, a narrow sample size, which mean that the results could be different if data and display a correlation if a larger sample size was analyzed.

***Mariana Davis, Anysia Finkin, Matthew Pace***

**Effects of Artificial Sweeteners on Termite Mortality**

Artificial sweeteners are used as sugar substitutes in different foods such as candy and can be added to drinks such as coffee, tea and soda. Artificial sweeteners such as Equal are thought to be better to use in place of refined sugar because of the possibility that it has less of a negative effect on blood sugar, but this is not the case. Artificial sweeteners have been linked to many cases of different cancers, liver inflammation and diabetes. Termites have unique gut microbiota which enable the organisms to eat wood, soil and other material generally not considered as food sources by other animals. Their complex microbiota can be negatively impacted when exposed to artificial sweeteners, causing health problems that could lead to a shortened lifespan. Equal, Splenda and Sweet-n-low are the sweeteners that we tested in this study. We tested the effects of these artificial sweeteners on termite mortality. We predicted that the Equal will have the most significant impact on the termite’s health out of the three sweeteners, causing the Equal-fed termites to live the shortest amount of time. This hypothesis was based upon that Equal is made from Aspartame, which has been known to cause health problems in human microbiota. Aspartame is made from the feces of genetically modified E. coli bacteria, and this bacterium can make the microbiota unhealthy. Claims have been made linking Aspartame to health problems from headaches to cancer as well as altering of gut microbiota activity. Results showed that the control groups lived longer than the groups fed the sweeteners. The Splenda group lived an average of 3 days and we found termite larvae in the wood and the soil. The Sweet n’ low group lived an average of 3 days. The Equal group lived an average of 3 days. Our results showed that the Sweet n’ low group had the greatest mortality.

***Justin Davitashvili, Aspen Levine, Nicholas Vazquez***

**pH and its Effects on Termites Eating Preferences**

Termites are detritivores, animals that eat dead plants, and eat foods that have a neutral pH. Termites sense their food using their antennas, which have receptors on them that sense the volume and shape of the food, which helped us understand how they distinguished their food. The purpose was to learn what termites would do if they were in an environment without their natural food source of wood and dead plants and pH limits. This is an important project because it helps people understand termites’ preferences and could even help draw termites out of certain unwanted places. We hypothesized that if we present food such as potatoes (pH6.1), oranges (pH3.1), asparagus (pH6.5) and papaya (pH5.1) to the termites with similar pH as their natural food source (pH of 6.5-7), then they will go to the potatoes and asparagus, because they have a similar pH to food in their normal diet. Termites were placed in a decision tray and had a choice between two foods (acidic or neutral). The choice of food was recorded. Our results were that, in the three trials we did per food group, the termites liked the acidic food more. The data does not support our hypothesis because we thought that the termites would eat the neutral food, since it is closer to the pH of their regular food. This shows how pH does not affect what foods termites would eat if they were forced to eat foods that are not like their normal food.

***Krish Dayal, Siyang Ma***

**The Effect of Population around the World**

**On the Amount of Air Pollutants**

Particulate matter can lead to negative health effects on the human body. Global population increases have contributed to global warming and may lead to the increase in particulate matter. The goal of this research was to examine a possibility of a direct relationship between population and pollution. For this research, a WHO database was used to find approximately 3000 cities and particulate matter (10 µm and 2.5 µm) data. PM10 is particulate matter measured less than 10 micrometers. PM2.5 is particulate matter measured less than 2.5 micrometers. Population was found through Google searches. Based on this data collected, we constructed two graphs to find the best fit correlation. The results showed that high population does not necessarily mean high PM10 pollution. The line of best fit showed a lack of correlation (r2 = 0.07). Use of a logarithmic fit showed a better, but still weak correlation (r2 = 0.23). There was a similar correlation with PM 2.5 data. The line of best fit showed a lack of correlation (r2 = 0.06). Use of a logarithmic fit showed a better, but still weak correlation (r2= 0.23). This study has shown that pollution is an issue which affects many areas, irrespective of population.

***Elizabeth Demacopoulos, Emma Karadenes, Funda Sahin***

**The Effects of Hydroxychloroquine Sulfate (Hydroxychloroquine) on the**

**Offspring of Drosophila Melanogaster**

Hydroxychloroquine, like many other drugs on the market, can treat multiple conditions. Classified as an immunosuppressive and anti-parasitic drug, it is used to treat certain autoimmune diseases, including lupus and rheumatoid arthritis. Hydroxychloroquine has recently been used as treatment for pregnant women diagnosed with antiphospholipid syndrome (APS), a medical condition that leads the immune system to attack normal proteins in the blood, causing frequent miscarriages in women. A recent study concluded that the use of hydroxychloroquine when treating APS is associated with an increased live birth rate and a reduced need for induced labor. However, the effect of the drug on the unborn child remains unknown. The purpose of this experiment was to determine the effects of hydroxychloroquine on Drosophila melanogaster offspring. Specific concentrations of Hydroxychloroquine were added to Drosophila melanogaster food and the flies were bred. The resulting larvae were obtained, tested with a larvae crawl assay, and compared to larvae whose parents were not exposed to hydroxychloroquine. When chloroquine, a derivative of hydroxychloroquine is given in high doses, it is associated with teratogenic effects, or, birth defects. Due to this finding, we hypothesized that flies exposed to the hydroxychloroquine would have a shorter average distance traveled than the control for the crawl assay.

***Ethan Dettmann***

**Smelling the Difference: Terrestrial Snails Odor Response to Turmeric & Alcohol Infused Food**

Terrestrial snails have a well-developed olfactory system which plays an important role in locating food, homing ability, communication and assessment of a predator risk. Their olfactory organs are located at the tip of the upper tentacles and allow the snail to orient towards distant food odors and identify the odors. If an odor is stimulating the tentacle protracts but if it is adverse it retracts, making the terrestrial snail an excellent model for studying olfactory processing and odor learning behaviors. Studies have shown that snail can learn to associate the odor of food with noxious experiences following the ingestion of the food and learn to avoid that food. The purpose of this study was to determine if manipulation of the snail’s dietary experience coupled with hunger influences its food preference. Understanding food preference is important because snails can be destructive agricultural pests which cause economic damage to a wide variety of plants. Snails were feed either turmeric-infused lettuce or regular lettuce for several weeks. After conditioning to their particular food, they were placed into a choice chamber that had turmeric-infused food with and without ethanol, and regular lettuce with and without ethanol. Snails were starved for 4-6 days before entering the chamber and the type of food choice was recorded. It was hypothesized that snails that had turmeric-infused food would be de-sensitized to the choices and would not have a food preference while those without turmeric would avoid both turmeric and alcohol-infused food. T These results do not support my hypothesis in that the lettuce only fed snail “tended” more towards the turmeric only, while the turmeric-infused lettuce fed snail “tended” more towards the turmeric with alcohol lettuce. In both cases, the snails preferred turmeric. The Chi Test showed there was a significant difference in the food preference as the p-value = 0.0411.

***Jessica DeYulio, Jillian Helmes, Abigail Pappachen***

**Using Salt to Prevent Browning in Bananas**

Catecholase is an enzyme that causes the darkening in bananas. This is caused by the enzyme’s chemical reaction to oxygen. This reaction causes a release of melanin, which is responsible for the brown color. The purpose of the experiment is to elongate the banana shelf life and prevent food waste of bananas. Thirty to forty percent of food is wasted, bananas being half of it. The experiment was done by applying different salt solutions to banana peels and analyzing the browning in the banana, over a ten day period. Using the United Fruit Sales Corp. Banana Ripening Scale, we observed the color of the bananas and converted it to numerical data. We hypothesized that the table salt would prevent browning on the bananas the most. Table salt is composed 99% of sodium chloride, which is known as an inhibitor to Polyphenol Oxidase (PPO), which is the browning factor in bananas. Pink Himalayan salt and Kosher salt contain less sodium chloride. The results show that salt has little to no impact on the action of catecholase. Throughout the ten day period, the bananas browned at the same rate, regardless of if it was sprayed with a salt solution.

***Emily DiPrima, Mikayla Elferis***

**A Qualitative Comparison of the Oxygen Produced by Illuminated Metal Nitrate**

Natural energy resources are being consumed to produce electricity, resulting in an increase of greenhouse gases released to the atmosphere.  As the amount of greenhouse gases increases, the rate of global warming also increases.  Thus, we need to find alternative, eco-friendly ways to reduce the use of CO₂ generating electricity.  One possibility for generating electricity is fuel cells, which workoff the electrolysis of H₂O.  The HARPOON  (Heterogeneous Anodes Rapidly Perused for Oxygen Overpotential Neutralization) Project investigates the oxygen production of of various metal nitrate electrodes in water electrolysis.  Metal nitrates can catalyze the lethargic half reaction of water into oxygen and hydrogen.  This water splitting, provides the hydrogen and oxygen for the fuel cell. The result of this process is the production of renewable  electricity, similar to photovoltaic solar panels. In this experiment sodium, ammonium, and zinc nitrates will be tested in order to determine their relative abilities to produce oxygen from H₂O.  Mixed-metal combinations of these nitrates were deposited onto fluorine-doped tin oxide (FTO) conductive glass plates, which serve as the working electrodes in the experiment.  Once dry, the electrodes are fired in a kiln.  The electrodes were then observed under ultraviolet light and the levels of produced oxygen produced by these solutions are analyzed using the computer program, JMAP.  This program measures “brightness values”, which represent the amount of oxygen produced.

***Jordan DiPrima , Daphne Koutsoukos***

**How do Different Concentrations of Cross-linker**

**Affect the Amount of Water Absorbed by a Hydrogel?**

Hydrogels are water insoluble, cross-linked, three-dimensional networks of polymer chains where water fills the voids between them. Hydrogels are made by a process called photolithography. This is a process where a photo initiator, or a molecule that forms bonds when exposed to radiation, is added to the polymer chains and the mixture is put under a UV light. The UV light irradiates the mixture, which is a crucial step in making a hydrogel, because without irradiation, it cannot hold any water. Hydrogels also contain cross-linkers, or molecules that connects the polymer chains that let it absorb water. In this experiment, the concentration of cross-linker was varied across five different hydrogels to test the absorbency of hydrogels with different amounts of cross-linker. With further research, hydrogels can be specifically made for future medical situations, such as to dress wounds and develop artificial organs. As more research for this application is done in the medical field, hydrogels will become higher in demand. In this experiment, five hydrogels were made, each with a different concentration of cross-linker. The hydrogels are made with a mixture of DMPAP, HEMA, TEDGMA, and EG. These substances were mixed in a vortexer and cured with a 365nm wavelength UV light. The hydrogels were submerged in deionized water for 30 minutes to measure absorbency. It is hypothesized that if 5 mole percent of the solution is cross-linker, the hydrogel will absorb the optimum amount of water. If the mole percent of the cross-linker is higher than five, there won’t be enough bonds to be connected by the cross-linker. If the mol percent of the cross-linker is lower than five, the bonds between polymer chains will be too weak to absorb much water. The investigation is still in progress, so thus far, the results are being collected. The photolithography using the UV light has not been successful due to the strength of the light and an ineffective mold. There is very few existing information on a hydrogel made of the same materials.

***Adam Dubi, Shawn Uthup***

**The Design of a Device to Automate the Application of Sterile Gloves**

Sanitation is very important, particularly in a doctor’s office. When greeting their patients, doctors typically shake hands. In doing this, germs are transferred between the doctor and patient (Mohney, 2017). Studies have shown that washing your hands with soap and drying them on a paper towel reduces the bacterial count by about 24-77% (Gupta, n.d.). During examinations, doctors wear latex gloves to prevent the transfer of bodily fluids, infectious diseases, and germs and bacteria (Exam Gloves vs. Surgical Gloves, n.d.). When doctors put on their gloves, however, they must touch the outside of the glove itself in order to fit it onto their hand. This allows for the germs from their hands get onto the outside of the glove, where it can then transfer to the patient. This can be detrimental during examination, as it can lead to the spread of disease or worsen the condition of the patient due to the exposure to bacteria. This is one of the reasons we have decided to create this device. The purpose of this project is to create a device that will enable the doctor to put on gloves without touching the outside of the glove in order to prevent the transfer of germs to the glove exterior. To carry out this project, we are using PVC pipes of different lengths in order to construct a pathway for air to flow from an air source to the gloves. The gloves will be inflated by the air so that the doctor can place their hand inside of it. We will measure the success of the device by timing selected subjects as they put on gloves without the use of the device, as well as with the device. Results concluded that the device reduced the time it took to put on the sterile gloves by about an average of about 16.54 seconds. The next step of this project is to make it self-dispensing. Future research will be conducted into the bacteria presence on the gloves resulting from this technique.

***Jason Duffe, Gabriela Glickstein, Brandon Lim***

**The Prevention of Shin Splints**

The purpose for our product was to lessen the pain associated with shin splints. Shin splints are acute pain in the shin and lower leg caused by lack of stretching in the tibialis posterior, tibialis anterior, and soleus (lower calf).  Shin splints are a common injury in athletes of running sports.  It has also been shown that if you are an athlete that exercises frequently without stretching well enough could result in this injury.  If there was an easy way to prevent shin splints at an inexpensive price, athletes would not have to worry about a possible unwanted injury.  Currently KT tape™ is the most popular solution for shin splints on the market. This product, however, is too expensive and not that effective. The product we engineered thus far has comparably been reducing shin splint pain. It is reusable, washable and has demonstrated to be a faster working solution in the reduction of shin splint pain. Participants rated their pain out of 10 using a 1-10 pain scale.  Using our data collected of the pain of an athlete’s shins after the product is used, we can determine if our product can help prevent shin splints. Results showed that our product can reduce shin pain.  Our test results averaged from a beginning pain level of 9 to an ending pain level of 1 over 7 days. Participants wore the device at night for a minimum of 7 hours. Our product has been proven to be more trustworthy than the other products on the market for a solution to shin splints.

***Katerina Efthymiou – See Annika Chang***

***Mikayla Elferis – See Emily DiPrima***

***Erika Fenty, Elena Gnilitskaya, Jessica Murrell***

**PPM of *Escherichia coli* (E. Coli) found in Long Island Aquifers**

Long Islanders get their water from 3 main Aquifers: The Upper Glacial Aquifer, the Magothy Aquifer, and the Lloyd Aquifer. The Environmental Protection Agency (EPA) have required drinking water to be tested for total fecal coliforms. The EPA recommends testing for strictly *E. Coli*, one fecal coliform. It is not required to pass safety standards, so most water districts don’t test for it. The goal of this experiment is to test water samples for *E. Coli* from different water districts on Long Island. The districts will be chosen based on which districts get their water from the 3 main aquifers. This experiment is important because most drinking water isn’t tested for specifically *E. Coli* due to the fact that it isn’t required by the EPA. Although total fecal coliforms are tested, some water can have higher amounts of *E. Coli* compared to others. A particular strain of *E. Coli* can cause a dangerous infection leading to diarrhea, nausea and vomiting. The experiment began when we collected 2 oz water samples from all around the county according to their aquifers. Using a plating system our results showed that the are with the most contamination was the Upper Glacial aquifer with an average of 122 colonies grown in 8 days with the Llyod and Magothy having 0 and 2.33 colonies respectively.

***Anysia Finkin – See Mariana Davis***

***John Finnie-Maloney***

**Studying the Correlation Between the Structural Changes Due to Mutations in the Enzyme Rubisco and the Catalytic Effect that Those Mutations Have on Rubisco**

Rubisco is an extremely important enzyme, it is one of the most highly produced proteins, and is utilized by 97% of plants on the earth. However, this enzyme has b many negative attributes including a very slow catalytic rate (3 to 10 molecules every second), being subject to various competitive inhibitors, and using the energy inefficient process of photorespiration. The goal of this investigation was to observe the resulting structural changes within Rubisco as a result of applying *in silico* mutations in its amino acid sequences. When observing the IMFs in SPDB, the relative strength of the hydrogen bonds can be recorded through recording the length of the hydrogen bonds as well as recording which atoms are involved in the hydrogen bonding. In this experiment, I mutated various amino acid sequences in the Rubisco enzyme and observed the common structural changes using existing data from Kellog’s and Juliano’s experiments resulting in neutral (no effect on catalysis), negative (increased catalytic rate, decreased efficiency, or denaturing), and positive (decreased catalysis and increased efficiency) effects on the Rubisco enzyme. Any changes in IMFs will be correlated to the changes in catalytic rate*.* Knowing which amino acid mutations result in changes in catalysis could lead to future improvements in Rubisco.Thus far, results show that with mutations that have no effect on the catalytic process of the enzyme, structural changes are minimal with no evidence of disturbance in hydrogen bonds, very little decrease in the strength of Van der Waal forces, and very little rotation from the surrounding amino acids, and no evidence of steric hinderance within the enzyme.

***Nicholas Gembs***

**The Application of Photosynthesis-Reducing Methods as Natural Herbicides**

Since the dawn of agriculture, the farming industry has been searching for ways to remove unwanted weeds from fields. Many of the solutions to this problem include herbicides such as Glyphosate and Gallant NF. Although these herbicides may be effective at killing weeds, they have many downsides including high toxicity, environmental damage, and high expenses. Due to these issues, scientists have been testing alternative methods to more safely reduce weeds. One method that has been researched extensively (Dayan, 2014) is photosynthesis reduction in the weed as a method of reducing growth. In this experiment, photosynthesis reducing methods will be tested on invasive plants to the northeastern United States. Compounds 0.1 M Sodium hydroxide, 0.01 M Sodium hydroxide, and Carbolime will be sprayed on the leaves of white clover plants in one experiment, and in the soil of these plants in a second. The growth and germination rate of the plants will be monitored over 2 weeks. If one of the tested substances inhibits germination or spread of the plant, then the substance tested is an effective herbicide against the invasive plant specie. It is hypothesized that glyphosate, the positive control, will be the most effective at stunting plant growth because it is a proven herbicide and is known to target and denature enzymes in plants. For the tested variables, it is predicted that the 0.1M NaOH will be the most successful due to its high reactivity rate with Carbon Dioxide. After 3 trials, 0.1 M NaOH was the most effective variable tested at controlling the white clover population, although it was not nearly as effective as the commonly used glyphosate.

***Gabriella Glickstein – See Jason Duffe***

***Elena Gnilitskaya – See Erika Fenty***

***Thomas Grgas – See Jake Coogan***

***Mia Goren***

**The Effect of Vitamins B12 and Folic Acid on Tremors of**

**Parkinson’s *Drosophila melanogaster***

Parkinson’s disease is the second most common neurodegenerative disorder, affecting more than 200,000 people per year. Parkinson’s has also been linked with impaired motor function, including tremors throughout the body. The purpose of this experiment was to test the effects of vitamins B12 and Folic Acid on tremors in gene-mutated Parkinson’s Drosophila, using the LRRK2 #362 gene. Both B12 and Folic Acid have been found to reduce tremors unrelated to Parkinson’s disease, and *Drosophila melanogaster* was used to mimic the effect of Parkinson’s tremors, due to their gene composition for this disease most closely resembles humans. To test the vitamins, B12 and Folic Acid, 100 mcg were mixed into the food of the *Drosophila melanogaster*, and tremors were initiated through strobe optics. These tremors were then measured through a microscope, timing their duration. It was hypothesized that one of, or both of the vitamins would have a positive effect in reducing tremors in *Drosophila melanogaster* because of their effectiveness in tremor reduction unrelated to Parkinson’s. Both vitamins have been found to maintain and protect nerves as well as the myelin sheath, which may correlate with the treatment of Parkinson’s tremors and aid in its reduction. It was found that there was no significant difference between the effects of vitamins B12 vs Folic Acid, but the vitamins themselves lowered tremor duration and severity of the tremors when considered alone.

***Gabriella Goyzueta, Polina Kalmatckaia, Dasha O’Brien***

**The Effects of Microplastics on *Daphnia magna***

Microplastics are small pieces of plastic debris, typically less than 5mm. Microplastics are an ecological concern in many aquatic environments as they are often mistaken for food and ingested by lower trophic level marine organisms. Plastic contamination is very important and a more recently growing problem in many aquatic systems where it has spread to even some out of reach habitats. Microplastics have reached high densities in waters and sediments and have been interacting with organisms and the environment in many ways. The purpose of this experiment is to observe the potential impact that the microplastics have on aquatic micro-organisms. *Daphnia magna* are a model organism in ecotoxicity studies, and this study will help us to better understand the impact these microplastics have on the aquatic food webs, to aid in preserving aquatic environments. *Daphnia magna* were exposed to microplastics obtained from an exfoliant face and body wash. Health and mortality rates of the *Daphnia Magna* were measured over time. Thus far results show that the microplastics are severely increasing the mortality rate of the *Daphnia magna*. Understanding the potential impacts may help us preserve aquatic environments.

***Sanjit Gunasekaran, Parker Lubell, Daniel Realmuto***

**Designing a Paperweight that Detects When it is Moved**

Many people require a way to protect their hard copy documents from unauthorized access. Sometimes information in the wrong hands could have detrimental consequences. For instance, if a teacher writes an exam and a student gains access prior to the exam. Data has shown that 1 out of 11 people had stolen something and approximately 66% of them stole before the age of 15 years old. The purpose of this project was to design a paperweight that detects and notifies the user when the documents are moved. The paperweight was less bulky and simpler solution due to its discrete nature and small footprint. We are currently still engineering our project. Some limitations we ran into were that are parts did not come fast enough, we had problems with the coding system, Python (programming code) was crashing, and the school did not have some simple parts that we needed just to build the project (Micro HDMI to HDMI and HDMI cables). However, we are still continuing to engineer the device and collecting data, and we plan to get results in the near future.

***Avi Gupta, Robin Hwang, Heetaek Ra***

**Human Actions as a Result of Instant/Delayed Gratification**

Being an adolescents plays a big role on whether someone will subject to instant gratification or whether they have the ability to delay their gratification. These skills in adolescents are factors of their academic success (instant gratification is the opposite). The purpose of this experiment was to examine and analyze human actions when given the choice between instant gratification and delayed gratification. It was hypothesized that three-fourths of the participants would succumb to instant gratification (use of internet or parts of the video) to accomplish the task in a faster time rather than the use of the entire video, because it would be more time consuming. Participants watched a nine minute video on protein synthesis and answered questions at the end based off the video. Embedded in the video were questions that were to be answered. After the last question, three minutes were left in the video for participants to be tested if they had watched the entire video. Prizes were given to all participants, but those who earned a perfect score were given a larger prize.  The method on how participants sought the answers were analyzed based on whether or not they used the internet, parts of the video, or the entire video. The results showed that 53% of all participants succumbed to instant gratification and therefore, the hypothesis was proved to be wrong. Additionally, more participants from the 8th grade level succumbed to instant gratification than 9th graders. If people know whether or not they are able to delay gratification, they can be more mindful about their patience. These patience skills will be able to assist them in people’s academic and future lives.

***Brianna Han – See Jodi Consul***

***Emily Hartman, Emma Hatcher***

**Effect of Age on Social Conformity**

Peer pressure is the influence of other peers in a social group and is most evident in high school adolescents. Another type of behavior that is exhibited by many teens is conformity. Conformity is the change in belief and behavior to fit in with a group. Many people conform to gain social acceptance from others. The purpose of this project was to test to see if high school aged students are more likely to conform with someone older rather than someone their own age. This project can potentially be important to society to show the impact that upperclassmen can have on the lowerclassman. We asked common knowledge questions to a group of 5 students. However, 4 of the 5 students were upper classmen who were told prior to the test and told to say the wrong answer. The other student was a lowerclassman and told nothing. The whole group was asked a random common knowledge question, such as “How many rings were on the Olympic flag” to see if the subject student would follow the wrong question or say the answer, they believed to be correct. We hypothesized that if lowerclassmen were tested with upperclassmen students, they would change their answer based on what the upperclassmen students in order to fit in. After the trials of our experiment we concluded that many students do not conform when in a testing group of mixed age groups. However, we saw some conformity when in a group of students within the same grade and gender. Despite these results, we still have variables that may have affected the results we gathered. This includes time, rewards and questions we asked. In the future we would like to test our experiment more organized and with harder questions to determine the true effect of conformity in a high school environment.

***Emily Hatcher – See Emily Hartman***

***James Haupt – See Christopher Citera***

***Theresa Haupt***

**Mechanism of a Bacterial Pilus Assembly Inhibitor**

*E.coli* Type 1 and P pili are hair-like surface fibers that attach bacteria to host cells and cause many infections, including urinary tract infections. These pili are formed by the chaperone-usher pathway (CUP), which uses periplasmic chaperone and outer membrane usher proteins to combine subunits into one surface pilus fiber. Pilicides prevent the growth of these pili. Nitazoxanide (NTZ) was discovered as a pilicide that inhibits folding of usher proteins into the outer membrane (OM). To better understand the mechanisms of NTZ, four deletion mutant strains that are resistant to NTZ (FimD, HdeB, HdeD, and YraJ) were selected from a genetic screen due to their roles in the CUP. The purpose of this study was to compare these strains to the Wild Type (WT), which is also resistant to NTZ, and observe their sensitivities towards NTZ and possible involvement in its mechanisms. To extract the OM containing usher and observe its pilus levels, a mini OM prep was used. This used *E.coli* K-12 with plasmid BW25113. The proteins were centrifuged to isolate the OM usher from the IM. Once extracted, the usher was put in a western blot gel electrophoresis to identify protein bands of specific boiled proteins for each strain. The bands were quantified to obtain the amounts of usher present and the decrease of strains with and without NTZ. It was hypothesized that all four mutants would play a role in the mechanisms of NTZ due to their specific functions in the CUP, and would therefore show altered sensitivities. Results illustrate that the mutant strains exhibit lower sensitivity to NTZ than WT. HdeD displayed the least sensitivity, suggesting that it is more closely related to the mechanisms of NTZ than the other strains.

***Amy Held***

**The Effect of Coenzyme Q10 on the Gene Expression**

**On mrp-5 in *Caenorhabditis elegans***

In this study, the effect of Coenzyme Q10 on the gene expression of the mrp-5 gene in *Caenorhabditis elegans* was observed. The mrp-5 gene is a homolog to the CFTR gene in Homo sapiens, a gene that codes for an ABC transporter-class ion channel protein that conducts chloride and thiocyanate ions across epithelial cell membranes. When there is a low expression of CFTR, an increase in Cystic Fibrosis is seen. Cystic Fibrosis is categorized as a genetic disease where a thick buildup of mucus in the lungs, pancreas, and other vital organs causes lung infections, which could then lead to lung damage and lung failure. The effect of Coenzyme Q10 on if the gene expression of mrp-5 is increased because of COQ10’s antioxidant capabilities, which proves to treat fatal conditions of Cystic Fibrosis. My hypothesis is that Coenzyme Q10 will increase the gene expression in the mrp-5 gene in *C. elegans* due to COQ10’s antioxidant capabilities. A positive correlation would be significant, because it may provide a way to treat Cystic Fibrosis. In this experiment, one plate will be prepared with *C. elegans* without COQ10 and one plate will be prepared with *C. elegans* and COQ10. RNA will be extracted from each *C. elegans* plate using the Qiagen RNAeasy RNA extraction kit, then amplified using PCR. The PCR product will be run through a 1% Agarose gel with SyBr green to see the light intensity of bands, which will be measured using an online software, Gel Analyzer. The intensity of the control and experimental groups will be compared, to see if there is an increased expression of mrp-5 in the presence of COQ10.

***Jillian Helmes – See Jessica DeYulio***

***Annabelle Hohne – See Alyssa Collado***

***Steven Homenides, Kayla Karadenes, Jake Spinelli***

**Converting Mechanical Energy into Electrical energy using the Piezoelectric Effect**

Energy harvesting is the process by which energy is derived from external sources, captured, and stored for small devices. There are specific human movements such as foot, joint and upper-limb motions that have been shown to provide a greater energy and voltage than others. Mechanical energy harvesting principles include piezoelectric, triboelectric, and electromagnetic harvesting. Piezoelectric harvesting is based on the piezoelectric effect, where an electric charge is generated in specific materials such as crystals, ceramics, polymers, and proteins in response to applied involuntary stress. The purpose of our project was to use the motions of shaking metal ball bearings against piezoelectric ceramics, in order to create vibrations that would stimulate, and apply stress to the polycrystalline ferroelectric ceramics and produce electricity. This energy that we produced would be used to power a flashlight (3.7 V) and other small electronics. This technology could be used in the future to provide a portable source of clean energy to the population, as well as providing electricity to those who don’t have access. In our initial device we used polycrystalline ferroelectric ceramic, and 2mm metal ball bearings in order to produce the stress on the ceramics when it was shaken. We wired the ceramics into a multimeter, the cardboard tube was shook for 10 seconds, producing vibrations and stress against the ceramics. We then increased amounts of the balls in the tube. We recorded the volts produced. With 1,000 generated .576V in 10 seconds, 2,000 produced .676V in 10 seconds, and 3,000 generated .857V in 10 seconds. After recording the data, we created our final product, which had one ceramic placed at the end of a PVC pipe, and tested this device by shaking the tube in time intervals of 5, 10, and 15 seconds, and recorded the data in volts. The received average measurements of .679V in 5 seconds, 1.169V in 10 seconds, and 1.640V in 15 seconds.

***Ashley Hsu, Melina Nicou, Lakxshanna Raveendran***

**Testing Dog Fur as a Natural Sorbent for Oil Spill Cleanup**

Oil spills have extreme impacts on marine ecosystems by killing animals. For instance, the Exxon Valdez oil spill contributed to the deaths of over 282,000 marine animals. Furthermore, dissolved oxygen levels in the nearby waters decrease and shoreline pipes clog due to oil hardening. The purpose of this investigation was to determine the most oil adsorbent type of dog fur and to compare its efficiency to that of current methods of oil spill clean-up. We tested Shih Tzus, Labradoodles, and Poodles due to structural aspects of the hair that make it beneficial for adsorption along with their dense water-repellent coats. Labradoodles have imbricate cuticle scale patterns, Shih Tzus have crenate intricate cuticle scale patterns, and Poodles have ovate imbricate cuticle scale patterns. To test the dog hairs’ efficiency, equal masses of fur were placed into 20 mL of crude oil. The Sorption Capacity formula was used to determine adsorption efficiency. It was hypothesized that standard Poodle fur will have the highest sorption capacity in oil-cleanup in comparison to Labradoodles and Shih Tzu fur because of their structurally twisted oval rod-shaped hair follicles being similar in shape and structure to a particular type of human hair which is known to be an efficient sorbent. It was also hypothesized that dog fur will be a more efficient oil cleanup method compared to oil skimming due to the less likelihood of dog hair to deteriorate and malfunction like oil skimmers due to lack of parts. Results have shown that Labradoodles are the most efficient dog hair for oil adsorption. Results have also shown that oil skimmers are efficient methods of oil spill cleanup.

***Erica Huang, Yashica Kumar, Denise Phelan***

**The Effect Color Font has on Students’ Ability to Concentrate**

Different colors have different effects on human behavior according to the color theory. Color is a powerful element that creates extreme psychological and physiological reactions. For example, red causes aggressive behavior and impulsive decisions, while blue calms you down and induces logical thinking. Additionally, red causes an increased heart rate while blue causes a low or steady heart rate. This all happened due to how parts of the visible light spectrum reflect off an object and is perceived by our brain. The purpose of this study was to determine if color had an impact on students’ ability to concentrate. This study can benefit teachers and educational institutions to help design and balance color applications in classrooms in order to help students’ concentrate. Data was collected on high school students to find amount of N’s in a total sequence of 184 M’s and N’s and the amount 1774s out of 72 similar numbers. The order of the sequence for both problems was changed for each color. Red, blue, and black colored font forms were distributed to participants to determine the effects color has on concentration. It was hypothesized that the red colored fonts will result in worst scores (scores that are the furthest away from the actual answers), while blue fonts will result in better scores (scores that are closest or are the actual answers). The color red induces brash behavior and aggression with a low concentration rate, while the color blue calms and induces logical thinking with a high concentration rate. Based on our results there is no statistical difference between colored font and students’ ability to concentrate. All of the participants seemed to find the exact or close to the exact amount of N’s and 1774’s for all color forms. Results thus far indicate that there was no major effect color had on students’ concentration.

***Eric Huang, Luke Maciejewski***

**The Effects of Sulfates on Planarian Behavior**

Sodium sulfate, calcium sulfate, and magnesium sulfate are three types of sulfate that can be found in the water we drink. These sulfates are harmful to people’s health, pipes and our water supply. They can act as a laxative; irritant to the skin, eyes and gastrointestinal system; and can cause weakness and dizziness. In our experiment, we tested if planaria can be used as a bio-indicator for if there are sulfates in water based on their behavior. We placed the planaria in different petri dishes with solutions of all 3 sulfates, and artificial pond water as the control, and performed a line crossing assay for three minutes, five times for each solution. The solutions created were 350mg/L for sodium sulfate and 525mg/L for calcium and magnesium sulfate. We found these to be the median concentrations of the sulfates in drinking water. We hypothesized that if planaria are exposed to various sulfates, then magnesium sulfate will have the greatest effect on them because it can cause hypermagnesemia in most organisms. When planaria was placed in magnesium sulfate it moved erratically and often curled up in the solution. We found that planaria placed in each of the sulfates crossed more lines on average than planaria placed in the control. By comparing the results, we noticed that on average, planaria placed in sodium sulfate crossed the most lines, while planaria placed in calcium sulfate crossed the least lines, out of the three sulfates. This data partially supports our hypothesis since the behavior of the planaria in magnesium sulfate was different then all the other solutions, but the planaria weren’t as stimulated as the planaria in the sodium sulfate. We believe that planaria will be able to be used to determine if there are sulfates in the water and if they are a threat to the environment.

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***Robin Hwang – See Avi Gupta***

***Kylie Ianuzzi, Asmaa Zahran***

**The Effect of Bacteria on Mascara**

This project was designed to test how much bacteria was present on mascaras throughout a series of 10 weeks. Bacteria on mascara is dangerous for an average humans’ eyes as well cause infections, such as pink eye. Bacteria such as Streptococcus aureus, Streptococcus pneumonia, and Pseudomonas aeruginosa are known to cause conjunctivitis (pink eye) in the eyes. Although makeup products have the potential to contain harmful bacteria, mascara and any products being applied near the eyes is most important to take care of, given they can cause the most long-term issues. Based on the results of this experiment, mascara users should be aware of the expiration date as well as continue to replace expired tubes. Five agar petri dishes, each with different types of mascara, were used to detect the number of bacteria on each brand of mascara will be observed throughout ten weeks in the course of four trials. The petri dishes included one mL solution of sterile distilled water mixed in with the type of mascara being of tested in the specific dish. Each petri dish was observed every two weeks, and the number of colonies of bacteria were observed and recorded. Many experiments and scientists highly recommend discarding a tube of mascara every three months to prevent eye infections and irritations. We hypothesized that when the mascara wand is exposed to open air and placed back in the tube, bacteria will still be present even before the expiration date. The project was meant to create a visual to prove the number of bacteria colonies present on a mascara wand as well as in the tube and the dangers of the substance after the expiration date. Our hypothesis was supported by the increase of colonies as well as the growth in bacteria each trial. For example, throughout all four trial, a mascara by NYX called *Le Frou Frou* showed the most colonies in bacteria. While other brands like Maybelline showed little to no increase of colonies throughout all four trials.

***Michael Jang, David Yang***

**Designing of Drug Delivery Nanodevice**

Since the immune system destroys a significant portion of drugs that are administered in the body and current chemotherapy methods rely on the premise that proliferating cancer cells are likely to be killed before healthy cells, scientists invented the idea of a drug delivery system; to protect and direct the drug until it reaches the affected part of the body. If one can control the activation of the drug, then the efficiency of a possible cure may be improved as well as the minimization of detrimental side effects. One of the current ways of controlling the tempo of drug release was done by UV light which is extremely harmful to human health. In an attempt to lower necessary light intensities for the delivery systems, complexity of the delivery molecule was increased. Therefore, the main goal of the research was to create a structure that can absorb visible or IR light for drug activation, by changing the molecular structure and including more pi bonds. In a modeling program called Gaussian, energy gaps are calculated as specific bonds between the drug locations and the device are stretched to simulate the activation and separation of the drug. First one benzene ring was tested, however more benzene rings were added to increase the complexity of the device. The results show that increased complexity of the devices results in a lower necessary light intensity. They also show that spacers are necessary to separate benzene rings as the pi orbitals of the rings interfere with one another.

***Juvin Johnson, Jun Ko, George Li***

**The Effects of Aluminum Sulfate Used for Cleaning Sewage on the**

**Regeneration Rate of Planarian**

Aluminum sulfate is a white or colorless crystalline-like solid used in the sewage treatment process of sewage plants. Planarians go through a regeneration process called bidirectional regeneration. This allows the planarians to reproduce asexually, with the use of stem cells called neoblasts to replace the lost body part. A planarian would begin regenerating once transversely cut, and finish once the eye spots were visible through a compound microscope. The experiment was designed to test the effect of aluminum sulfate on the regeneration of planarians, and to further our understanding of human introduced chemicals into freshwater environments and its implications on health. Three planarians were placed in 0.20%, 0.10%, 0.05% solutions of aluminum sulfate. The control group that did not contain the solution. The planarians sat in the solutions for 1-2 minutes to check for stress (curled into a c-shape). If the planarians died, the aluminum sulfate solution was diluted further and tested again. If it survived, it was cut bilaterally. The amount of time taken to regenerate eyes fully was then recorded. Aluminum sulfate can cause gastric irritation, nausea, vomiting, purging, and irritation to the eyes and nose. We assume that this applies to planarians, and regeneration of eyes will be slowed down in solutions of diluted aluminum sulfate. Thus far the results showed that the planarians placed in the 0.20% solution took 18 days to regenerate, and the planarians placed in the 0.10% solution took 7 days to regenerate. The planarians placed into the 0.05% solution took 6 days to regenerate, which is the same amount of time it took for the planarians that were placed into the control group to regenerate.

***Polina Kalmatckaia – See Gabriella Goyzueta***

***Paul Kang – See Deborah An***

***Emma Karadenes – See Elizabeth Demacopoulos***

***Kayla Karadenes – See Steven Homenides***

***Charlson Kim***

**3D CNN Based Automatic Diagnosis of Alzheimer's Disease**

**Using Text and MRI Inputs**

Alzheimer's disease (AD) is an irreversible brain degenerative disorder affecting more than 30% of 85-year olds worldwide. Currently, there is no effective cure for AD, but the development of accurate and early diagnosis methods such as machine learning algorithms is vital for patient care allowing for effective treatment. The purpose of this project was to create and compare two functioning 3D multimodal Convolutional Neural Network models utilizing different methods of transfer learning to effectively classify patients with AD. Three inputs of data from ADNI (MRIs), Oasis (MRIs), and Kaggle.com (Clinical Data) were utilized as the input training vectors and the models were built using Jupyter Notebook, Tensorflow, TF-Slim, and TFlearn. In order to reduce the computational expensiveness of the code, two methods of transfer learning were implemented. Finally, for both methods, the outputs were combined using ensemble learning to display a final accuracy for the two models. The goal of this project was to propose model with ensemble learning that would result in a higher accuracy and a decrease in error throughout the runtime session due to its multi modal input. It was also hypothesized that the transfer learning method of fine tuning a pretrained model would take less training time but result in a lower accuracy than the method of transfer learning that utilizes transfer values. This is due to the second method utilizing a more complex structure with an additional neural network for training. The results showed that the learning model with the highest accuracy and lowest total loss was the transfer learning by transfer values model tested on the Oasis Longitudinal data. The results displayed very little disparity between the multiple models emphasizing the efficiency of the simpler transfer learning by fine tuning method.

***Jun Ko – See Juvin Johnson***

***Christine Kong***

**Understanding the Rate of Sorting of Monocarboxylate Transporter 1 in Glioblastoma Cells**

Glioblastoma is the most common primary brain tumor in adults, but current treatment options are mostly unsuccessful. Studies have shown that exposure to stress may promote tumor progression. Exposure to stressful events results in the activation of adrenergic receptors, which release norepinephrine and epinephrine, which stimulate the breakdown of glycogen. Glycogen can then be broken down into lactate for energy for the cancer cell. Monocarboxylate transporter 1 (MCT1) helps to regulate the transport of lactate and is therefore a novel anticancer target because it carries lactate through the cancer cell. Understanding how α2-adrenergic and β2- adrenergic receptors affect the rate of sorting of MCT1 is integral in expanding treatment options for glioblastoma in the future. Four different time points for stimulation were used with clonidine and isoproterenol as agonists. Immunofluorescence microscopy protocol was followed and images were acquired using ImageJ software. It was found that MCT1 sorted to the early endosome at roughly the same rate following each treatment, indicating that the different agonists do not affect how much MCT1 is initially taken into the cancer cell. It was also found that isoproterenol stimulation causes more sorting of MCT1 to late endosomes at ten minutes, but after 80 minutes of stimulation, only the iso+clon dual treatment caused an accumulation of MCT1 in late endosomes (P<0.0001). This high internalization of MCT1 in late endosomes suggests a blockage of glycogen breakdown that triggers a cellular need for lactate, signifying the promotion of tumor growth.

***Daphne Koutsoukos – See Jordan DiPrima***

***Erika Kraft***

**Determining the Light Pollution Class of New York Counties**

For most of Earth’s history, the ability to view stars and galaxies has inspired questions about the universe and our relation to it. But today, light pollution restrains the ability to view the stars for most of the world's population. Light pollution is the uncontrolled use of artificial outdoor lighting that changes the color and contrast of the night sky. The increased use of artificial lights is negatively affecting our health, animals, and the environment. In animals, light pollution interferes with circadian rhythms and can interfere with bird migratory patterns. In humans, light pollution can cause sleep disorders, disability and discomfort glare. The purpose of this project was to determine the light pollution classification of four counties in the state of New York based on population and if there is a correlation between light pollution and population. The population of all 62 New York Counties in 2018 and its population density per square mile was recorded. Four counties were investigated, and the location’s latitude and longitude were recorded. Pictures were taken around same time at three azimuths. Using the Light Pollution Classifications Chart, the light pollution classification for each location was determined. A dark sky park was used as a control. It was hypothesized that if a county in New York has a high population, then that county will have a high light pollution class because a high population typically means more outdoor light fixtures. The light pollution classification of Suffolk, Nassau, Queens, and New York counties are six, seven, eight, and nine, respectively. The dark sky site (Custer Observatory), had a light pollution class of three. However, due to a small sample size, I am not very confident in these results. Further, investigation is still ongoing.

***Christian Kraus, Matthew Leyberman***

**Acid Vs. Buildings:**

**How do Different Building Materials React with Sulfuric Acid**

Acid rain is a problem in which chemical gases react with water and oxygen to form solutions of sulfuric and nitric acid. This precipitation can be harmful to man-made structures and nature. In this study, building materials such as marble, vinyl siding, and wood were used. Sulfuric acid represented the acid rain. A 1x1in. sample of material was placed in a solution of sulfuric acid after being weighed. Different temperatures of sulfuric acid, 37°C, 5°C, and room temperature, were used. Different concentrations, 1% and 10% sulfuric acid, were also used. Marble chips lost the most weight for all trials. The highest concentration and the highest temperature did the most damage to all materials. The marble, when placed in room temperature 1% sulfuric acid, lost more mass (.02g) than any other building material in the same conditions. Vinyl in room temperature 1% sulfuric acid lost an average of .003 g and wood in 1% sulfuric acid gained an average weight of .04 g. In 10% room temperature sulfuric acid, marble lost .06 g each trial, while wood lost an average of .06 grams but with more variability. For future experiments we can use brick, concrete, and other building materials to see how they react with acid rain. We can also use tap water as a negative control.

***Yashika Kumar – See Erica Huang***

***Joshua Lang, Matthew Lee***

**A New Implementation of Piezoelectric Materials to Convert the Vibrations of Ocean Waves into Electricity**

Modern technological societies that dominate the world rely heavily on energy. However, many of the resources used to produce the energy necessary to sustain society are limited. The finite amount of resources that are used to produce 66% of the world’s energy, such as coal and petroleum, is expected to be depleted by 2088, emphasizing the need for alternative sources of energy. An attractive candidate for an alternative source of energy is wave power, which can be exploited by harnessing the vibrational energy released by waves upon impact. This is achieved using the piezoelectric effect, where piezoelectric materials, such as ceramic, produce electricity when exposed to vibrational energy. The purpose of this project was to investigate the efficiency of vibrational energy produced by the impacts of waves against barriers to be converted to electrical energy using piezoelectric materials, in this case, piezo vibration sensors. The piezo vibration sensors were mounted in a wave tank and tested with different wave strengths. The piezo vibration sensors utilized compressions sustained from the vibrational energy to convert it into electricity. The electricity generated from the piezo vibration sensors was measured using a multimeter. This determined the strength of the wave that generated the electricity. Our results are pending, as our materials were missing or insufficient.

***Nicholas Leahy – See Jodi Consul***

***Matthew Lee – See Joshua Lang***

***Ruth Lee – See Nathan Cheung***

***Aspen Levine – See Justin Davitashivili***

***Sarah Levine, Julianna Murray***

**Mineral Concentrations and the Physical/ Behavorial Development of *Neritina reclivata***

Greater than 200.0 meters below the Indian Ocean’s surface exists the pressurized, chemosynthetic ecosystem of the hydrothermal vent, where a species of deep-sea peltospiroid snail known as *Chrysomallon squamiferum* resides. To determine the adaptational differences between the *Chrysomallon squamiferum* and the common freshwater *Neritina reclivata* species, it was decided to simulate an aspect of a hydrothermal environment by introducing six tanks to different minerals found in black smoker vents. The minerals selected were covellite (CuS), pyrite (FeS), and galena (PbS). The setup included two tanks with four *Neritina reclivata* specimens for each mineral test, one with 0.50g and the other with 1.0g. Two tanks were set aside for the control. Since the independent variables all contain sulfur, it was anticipated that the snails would experience internal poisoning and thus die off, especially the galena since lead is highly toxic to organisms. The pH remained 7.0 throughout experimentation. The two pyrite tanks had all snails alive and active by day 20, as with the .50g galena tank. All snails in the covellite tanks and the first control tank died by day 9. By day 20, all snails in the seconds' control tank and in the second galena tank died off, leaving all .5g pyrite, 1.0g pyrite, and .50g galena tank snails left. Algae buildup was a direct cause of snail survival, which was absent in the control, possibly due to other uncontrolled variables in water quality. Somewhere between 0.5-1.0g of galena may be over the acceptable quality for algae/ snail populations, which would explain the differing results for galena tests. Copper is an effective exterminating agent for algae, thus the snails died off. As future snail research continues, other aspects of the different ecosystems (e.g. predation or morphological characteristics) should be considered.

***Corey Levy – See Ethan Darvin***

***Matthew Leyberman – See Christian Kraus***

***George Li – See Juvin Johnson***

***Karen Li – See Defne Aktuna***

***Kimberly Liao, Kristen Chao, Maheen Khan***

**An Improved Formula for Renal Parenchymal Area and Total Kidney Volume for Increased Accuracy in Renal Dimensions**

With conditions such as chronic kidney disease (CKD) and polycystic kidney disease (PKD) on the rise, it is critical to accurately measure renal area in these patients. Measurement of renal dimensions and identifying changes inform physicians about the presence and progression of renal diseases. Currently, there is an existing elliptical formula utilized in clinical setting, but it grossly underestimates kidney volume. Modification of this formula has been demonstrated to provide a better estimation of the renal parenchymal area in a model of murine kidney disease. While treating the kidney as an ellipse with the major axis the polar distance, this technique involves extending the minor axis past the hilum into the renal pelvis to obtain a new minor axis. The study sought to determine whether this modified formula is applicable to additional models of kidney diseases. Left and right kidneys were sourced from different strains of male and female rats with tubulointerstitial disease or glomerulosclerosis as well as from healthy animals. In each model examined the use of the existing methodology underestimated renal parenchymal area whereas the use of the modified elliptical formula yielded a calculated renal parenchymal area similar to the true parenchymal area. Since the use of this modified elliptical formula provides a better estimate of renal dimensions, the extent of renal scarring can now be easily computed by making just two axial measurements. Therefore, this technique provides a more accurate, noninvasive method of monitoring kidney disease.

***Brandon Lim – See Jason Duffe***

***Flora Lin – See Lindsay Chung***

***Amy Liu – See Gavin Cressy***

***Parker Lubell – See Sanjit Gunasekaran***

***Siyang Ma – See Krish Dayal***

***Luke Maciejewski – See Eric Huang***

***Vishwanath Madhavan***

**The Correlation Between the Percentage of Women in**

**the Armed Forces and the Global Firepower Index**

The purpose of this investigation is to discover if there is a the correlation between the percentage of women in the armed forces of a nation and the ranking of the nation on the Global Firepower Index. In the United States, women have mostly served in administrative, medical capacities or other non-direct combat action units. In 1994, the U.S. Department of Defense had banned women from assignment to direct-ground combat action units. However in 2013, U.S. Secretary of Defense Ash Carter had lifted the ban, allowing for the integration of women into all units by 2016. In Australia, women constitute 16.7% of the Australian Defense Forces. Women, world-wide, are an integral part of many military’s structure. The data for the number of men and women was collected by directly emailing a nation's’ defense department or ministry of defense. The data, provided by Australia, France, Germany, Poland and Norway, was analyzed and used to calculate other information, such as percentages, ratios, and military size if not originally provided. Data was then compared to the nations ranking for the 2018 Global Firepower Index ranking. It was hypothesized that the percentage of women in the armed forces and the military ranking based on the GFP would have a strong negative correlation. My hypothesis was no supported since the correlation coefficient calculated between the percentage of women and GFP rank was r = -0.2869. This shows that there is a weak, negative correlation suggesting that a higher Global Firepower ranking nation may have a larger percentage of women in it’s armed force.

***Alexis Maikowski***

**Correlation between Temperature Changes and**

**Incidence of Malaria in Latin America**

Malaria is a mosquito-borne disease found in tropical regions that causes vomiting, headaches, tiredness and fever. Despite efforts to prevent malaria by vaccinating human populations and using pesticides to kill off mosquito populations, humans in Third World countries and in tropical areas continue to become infected with malaria. Another problem that has been affecting Third World and tropical countries is global warming, which is the consistent rise in global temperatures. Global Warming is believed to be caused by increased levels of carbon dioxide in the atmosphere from human activities such as burning fossil fuels. Global warming causes rainfall levels to increase, which helps mosquitos to breed because it causes stagnant water to become more available. The purpose of this investigation is to look for a correlation between malaria cases, global warming and rainfall. Malaria is not common in the United States, so countries in Latin America will be studied, specifically Mexico, Costa Rica, Nicaragua and Puerto Rico. These countries have a tropical climate and also high mosquito populations. Using data previously complied by weather stations and the World Health Organization, average temperatures, average rainfall and the average number of malaria cases will be analyzed to feel if a correlation exists. It was hypothesized that malaria, rainfall and temperature will show a positive correlation because as temperature and rainfall increase, malaria populations would also increase. Based on the graphs, there is a positive correlation between rainfall, malaria and average temperature.

***Izza Malik – See Candace Arneaud***

***Jane Maloney***

**The Effect of Heavy Metals on Damselfly Nymphs**

Many different industries dump chemicals and other hazardous substances down the drain which have a severe effect on aquatic life. Commonly found heavy metals in waste water include copper, nickel, zinc, cobalt and cadmium. In humans, long term exposure to high concentrations of these heavy metals (ZnCl2, PbNO2, etc.)can lead to gradual and progressive neurological degenerative damage including diseases like Multiple Sclerosis, Parkinson’s, Alzheimer’s and Muscular Dystrophy. *Daphnia magna* was used because they are the model organism for ecotoxicity studies. *Daphnia* wereexposed to zinc chloride and lead nitrate and their heartrate was studied. Using a dissecting microscope, a baseline heartrate of the *daphnia* with no chemical exposure was found to be 165 bpm. The *Daphnia* were then exposed to zinc chloride and lead nitrate for 10 days. The LC50 was determined to be 1x10-10 of zinc chloride and 1x10-8 of lead nitrate. Afterwards the heart rates were measured, and the average was determined. The *Daphnia* were then fed to Damselfly Nymphs and their behavior was observed. It was hypothesized that by feeding heavy metal exposed *Daphnia* to Damselfly Nymphs, that the Nymphs will show an overall decrease in health and behavior. With testing it was found the heartrate of the zinc chloride Da*phnia* waslower than the control group, but those exposed to the lead nitrate solution showed a heartrate higher than the control group.

***Jonathan Mitra – See Isaar Chadh***

***Ashley Moon, Harry Poulose, Kevin Won***

**What Combination of Lemon Essential Oil, Tea Tree Oil, and**

**Lavender Essential Oil Makes the Most Efficient Antimicrobial Soap?**

Antibiotic resistance, due to the overuse of antibacterial products is a very prevalent and pressing issue. The overuse of products such as hand sanitizers, hand soaps, and other consumer products that claim to kill bacteria, have become inadequate. As of June 2018, an estimated 700,000 people have died due to antibiotic-resistant infections. (Coin et al 2018). This coupled with the fact that the estimated death toll will increase over the coming years, makes it imperative to find an alternative solution. The purpose of our project was to use essential oils as an alternative ingredient in antibacterial soap. We used different mixtures of lavender, lemon, and tea tree essential oils with differing proportions, and tested our mixture on E. coli bacteria. We then measured the zones of inhibition created after 2 days. We hypothesized that the use of lemon essential oil, tea tree oil, and lavender essential oil, instead of triclosan, in antibacterial soaps will be able to reduce the likelihood of inducing antibiotic resistance. Thus far, the results show it was found that mixtures containing equal parts of all the essential oils and the mixture with lemon being the dominant ingredient yielded the largest zones of inhibition. These observations may be used in developing an effective soap.

***Eshani Mukherjee, Olivia Owens***

**Aggressiveness in Green Crabs with Plant v. Animal Diets**

*Carcinus maenas,*also known as the European Green Crab, are common littoral crabs which are originated from Europe and Northern Africa, and later spread throughout North America, South Africa, Australia, etc. These crabs are highly aggressive.*C. maenas* are considered opportunistic omnivores, meaning that they eat whatever they have access to, and they mostly favor meat related foods. It was hypothesized that the plant diet will cause *C. maenaes* to be the most aggressive when eating it as their normal and no change in aggressiveness eating their normal diet of meat. The amount of protein in one Asian clam can be 9.09% to 12.75% while the amount of protein in seaweed can be 10.8% to 23.1%.  Seaweed includes the amino acids serotonin and tryptophan and contains high amounts of magnesium. These cause the organism to become tired and less aggressive.  Magnesium is a mineral that helps relax your muscles.  Tryptophan is an amino acid that helps in the production of serotonin. Serotonin is a neurotransmitter made in your brain that elevates your mood and promotes feelings of sleepiness, relaxation and calmness. There are less amounts of serotonin and tryptophan in clams, this can lead to more agitated behavior. The invasiveness of these crabs makes it important to study their behavior as this research may provide more information on alternative food sources that can prevent native species from going extinct. Throughout the experiment, the crabs were living in one tank with a clear, Plexiglass divider in the middle separating the two. The crabs were either fed a diet that was strictly seaweed or clams. When they were fed, the *C. maenaes* were placed in a different tank to decrease the chance of the other crab accidently consuming the wrong food. In the same tank, the crab's behavior was recorded to see if there were any changes. Results indicate that consuming seaweed will cause the crabs to become less aggressive. Our recordings support the hypothesis by showing that Crab B (fed plant diet) reacted less and less to both the wooden dowel and net. Crab A (fed animal diet) reacted to the wooden dowel and net the same consistently.

***Stephen Mullen – See Cole Darienzo***

***Julianna Murray – See Sarah Levine***

***Jessica Murrell – See Erika Fenty***

***Narumichi Nakamura – See Jayson Bromberg***

***Angelina Necroto, Brennan Thomann***

**Stress Response in Brown Planarians Due to Nitrates and Phosphates**

Aquatic pollution is the incorporation of harmful substances into a body of water degrading water quality and rendering it toxic to humans or the environment. Artificial fertilizers are significant contributors to aquatic toxicity. Common types of compounds used in the creation of artificial fertilizers are nitrates and phosphates. Since planarians have the ability to make c-shapes to demonstrate their stress, they make good model organisms to understand toxicity. This project will help identify the toxicity of chemicals found in nitrate fertilizers. In our experiment we thought as the concentration of the chemicals increased the amount of stress the planarians exhibited would also increase. The compounds tested were ammonium phosphate, ammonium nitrate, calcium nitrate, and potassium nitrate. After creating 1%, 2%, and for ammonium phosphate 0.5%, solutions, planarians were placed into the solution and for ten minutes the amount of c-shapes made was recorded. It was found that for the planarians, ammonium phosphate was the most harmful chemical (all planarians died even at 0.5%) while calcium nitrate was the least harmful (some survived at 2%). The data collected in this experiment could potentially direct the design of fertilizers better for the environment.

***Evan Ni – See Aryaram Anand***

***Melina Nicou – See Ashley Hsu***

***Dasha O’Brien – See Gabriella Goyzueta***

***Matthew Pace – See Mariana Davis***

***Abigail Pappachen – See Jessica DeYulio***

***Thomas Parangelo – See Jayson Bromberg***

***Denise Phelan – See Erica Huang***

***Harry Poulose – See Ashley Moon***

***Heetak Ra – See Avi Gupta***

***Faizali Rahim***

**The Effect of Plant Food on the Nitrogen Concentration of the Soil of Roundup Ready and Conventional Alfalfa Seeds**

Roundup Ready (RR) alfalfa seeds are being used around the world for their advantage of growing them in the presence of an herbicide without harming the crops. It was observed that this type of seed diminishes the amount of nitrogen in the soil, causing reduced growth of the alfalfa plant over time. In order to optimally grow crops, the nitrogen concentration, pH, temperature, and other factors need to be considered. In this research, nitrogen fertilizer was used as a nitrogen fixing liquid to keep the nitrogen concentration of soil at a sustainable level. The negative control used was the conventional alfalfa seeds without the fertilizer, while the positive control used was the conventional alfalfa seed with the fertilizer. The experimental group was RR alfalfa without fertilizer, and RR alfalfa with fertilizer. The nitrogen concentration of the soil in all four groups was measured using a LaMotte™ Kit before the seeds were planted and then again after one week. The hypothesis was supported when comparing the change in nitrogen concentration before and after the experiment because the p-value of the T-Test conducted was less than 0.05 (p= 0.026). When comparing the change in nitrogen concentration before and after Trial 1 because the p-value of the T-Test conducted the hypothesis is not supported since the p-value was greater than 0.05 (p= 0.227). When comparing the change in nitrogen concentration before and after Trial 2 because the p-value of the T-Test conducted the hypothesis is not supported since the p-value was greater than 0.05 (p= 0.180). This experiment could have implications for the agricultural field since it will suggest that the nitrogen fertilizers are able to help the growth of the plants.

***Lakxshanna Raveendran – See Ashley Hsu***

***SShamtej Singh Rana, Michael Zarief***

**The Effect of Mushroom Bacteria on the Growth of**

**Oyster Mushrooms (*Plearotus Ostreatus*) and its**

**Appeal to *Neritina natalensis* (Nerite Snails)**

The food industry, specifically mushroom farming, utilizes different techniques to defend plants from predators. Among these plants are Oyster Mushrooms, a versatile and edible mushroom. They are easy to cultivate and can be grown in a wide range of environments and on different substrates. One of the deadliest predators of the oyster mushroom is the Nerite Snail. The purpose of this experiment was to test the effect of different growing media on the creation of bacteria and its appeal to the Nerite Snail. The different substrates used in this experiment had different compositions by mass of phosphorus, nitrogen, potassium, carbon, and oxygen, which are important to mycelia growth and production of bacteria. It is expected that the mushrooms grown on more nutrient rich substances will have higher nutrient content and will produce bacteria with larger amounts of ethylene (C2H4), Lineolic Acid (C18H32O2) and 1-octen-3-ol (C8H16O), chemicals which have shown to attract the snails to the substrates and mushroom caps in past studies. Mushrooms were pasteurized and grown in different substrates for six to eight weeks, the natural growth period of most indoor mycelia. After growth, an XRF semi-quantitative analysis was conducted on the substrates, to find their percent composition by mass of ethylene, Lineolic Acid and 1-octen-3-ol. Additionally, the substrates were placed near the snails, in pairs, and the strength of the presence of the three chemicals were compared to which substrate the snail was attracted to. It was hypothesized that mushrooms grown on substrates richer in the Carbon, Hydrogen, and Oxygen were going to be more attractive to the mushrooms, because they would have a larger percentage of composition of 1-octen-3-ol, ethylene, and lineolic acid. Results showed that Blue oysters had greatest growth with leaves and sawdust/coffee showed greatest growth for brown oysters. It was also seen that carbon and hydrogen were large factors in attraction to Nerite Snails.

***Daniel Realmuto – See Sanjit Gunasekaran***

***Marlee Reiter, Kiera Spahn***

**The Effect of Epicatechin Given to Alzheimer’s disease *Drosophila melanogaster***

Alzheimer's disease (AD) is a multifactorial brain disorder that causes memory failure and problems in carrying out daily activities. It is the sixth leading cause of death in the U.S. and the most common reason for dementia, the loss of cognitive function. The purpose was to see if Epicatechin had a positive effect on *Drosophila melanogaster* with AD. Epicatechin is a flavonoid, a type of natural phenol that has multiple health benefits and an antioxidant. An antioxidant protects cells against unstable molecules that can cause harm. They terminate chain reactions and inhibits oxidation Epicatechin was chosen because it is an active ingredient in cinnamon, like cinnamaldehyde, which had promising results in a previous experiment conducted. The possible outcome includes longer life expectancy and greater locomotor ability. This is significant because it could lead to new information in understanding AD, and help millions affected by AD. The negative control group consisted of wild type flies that were given food without Epicatechin. The positive control group had wild type flies and were given Epicatechin. The experimental group had flies that had overexpressed tau protein and were given Epicatechin in doses of either 3.0mM, 0.6mM, 0.12mM. The effect of the Epicatechin was tested and measured using, a survival assay, and a climbing assay to test the locomotor abilities of the flies. It was hypothesized that the *Drosophila melanogaster,* exposed to Epicatechin with a solubility of 0.6mM, will have a higher life expectancy and perform better on the survival assays. In the previous experiment using cinnamaldehyde, an ingredient like Epicatechin, the most concentrated solution killed the flies, while the least concentrated had no visible effects, therefore the median solution will most likely perform the best. To analyze our results, we looked at trends that demonstrate from the graph of day 16 to 32, the 0.12mM concentration of epicatechin, lowest, increased lifespan the most in tau protein flies with AD. This contradicted our hypothesis of the middle concentration increasing the lifespan the greatest. In these same graphs the 3.0mM of epicatechin, the highest, increased lifespan in the wildtype control flies. The graphs for day 40 to 48 however do not demonstrate these trends as a result of limitations, including flies getting stuck in the food as a result of changing temperatures. However, after analyzing the results, it was concluded that as a result of the epicatechin increasing the lifespan of both the wildtype control and AD flies, the epicatechin is not specific to AD flies and acts as a regular flavonoid that has some positive lifespan effects.

***Caitlyn Rothar – See Faith Chi***

***Jackson Rubin – See Daniel Baek***

***Funda Sahin - See Elizabeth Demacopoulous***

***Ethan Sontarp***

**U-Pb Geochronology of Fluid Flow Events in the Barstow Formation, California**

Diagenesis is the compositional change in geologic samples such as fossils, which are often used to date significant geological events in their vicinity. Fossilized dentin from teeth can undergo diagenesis during a geologic fluid flow event due to its high porosity. By contrast, tooth enamel cannot sequester Uranium during a fluid flow event because of its low porosity, which is required in order to date a fluid flow event in a sample. The purpose of this experiment was to investigate components of fossils, namely dentin, enamel, and foot bones, for their viabilities as models for determining the age of geological events, using U-Pb geochronological dating methods. Tooth and bone samples from California’s Barstow Formation were prepared, then analyzed using LA-ICPMS (Laser Ablation- Inductively Coupled Plasma Mass Spectroscopy) to determine the concentration of certain isotopes of U, Pb, and rare-earth elements (REE). Iolite software was used to process the isotope data from several locations in fossils. A preserved sample was dated at ~10 Ma for both enamel and dentin locations. An eroded sample showed results with differing ages for the enamel sections and the dentin sections, with the dentin at 10 Ma and the enamel at 4.5 Ma. The bone sample varied in its local dates of diagenesis because of an ancient fracture, with an average age of 4.5 Ma that was consistent with the enamel ages. The samples yielding 4.5 Ma and 10 Ma differed in their REE content, distinguishing between two known fluid flow events in the Barstow Formation. Going forward, these results suggest that a dentin sample may be a stronger candidate than an enamel sample for U-Pb dating of older geological events, whereas enamel locations would be more viable for dating the most recent fluid flow event.

***Anthony Speciale, Jackson Zumpano***

**Investigating Water Filtration:   
How Different Materials Filter Pollutants out of Water**

The Flint River, located in Michigan, is polluted with lead and has been for an extended period. This threatened and affected many Michigan residents. Young children are particularly vulnerable to the toxic effects of lead and can suffer profound and permanent adverse health effects, particularly affecting the development of the brain and nervous system. Lead also causes long-term harm in adults, including increased risk of high blood pressure and kidney damage. We engineered a water filtration system centered on lead. We used three materials: gravel (8mm in size), sand (2mm), and activated charcoal. Activated charcoal will represent 65% of the space, with sand and gravel taking up 15% each. It was hypothesized that activated charcoal would have the greatest impact on the water being tested. Activated charcoal is widely used as an adsorbent in wastewater treatment plants due to its physical and chemical properties. It is highly porous and has a large surface area and its negatively charged surface attracts more metal ions. It does so by creating chemical bonds with the lead it plans on separating from the water it is in. At this point in our experiment, our results are pending, making the overall results of the experiment inconclusive.

***Kiera Spahn – See Marlee Reiter***

***Jake Spinelli – See Steven Homenides***

***Shreya Sriram – See Defne Aktuna***

***Joseph Strickland***

**Use of Head Movement in Combination with Pressure Pads to**

**Control a Motorized Toy**

Electric Wheelchairs are designed to be an efficient form of travel for those who cannot walk properly anymore or at all. The most common method of controlling an Electric wheelchair has been through the use of a joystick. The joystick allows dynamic analog motion input which gives the user precise control in maneuvering in the wheelchair. Such as moving the joystick a little from its Deadzone(0 position) which would move the Electric wheelchair slowly or moving the joystick at the maximum distance from its Deadzone to achieve the maximum speed. But the one thing that using a joystick lacks is the availability to certain people. Some people may not have the cognitive function to move their hands in the way that a joystick requires, so an alternative method of control is required. Here is where the use of pressure pads come in. By making the method of control a system based on how much pressure is being applied, the connection between The user and Motor speed can match the same feel that a joystick provides. In this project, 4 pressure pads are used in order to allow for all 4 directions of movement. By placing pressure pads on the left, right, upper back side of the head, and the lower back side of the head(On the wheelchair) an 4 way directional movement system can be performed, which if combined input is taken into account is 8 possible directions to control the electric wheelchair. By combining 2 pressure pads input’s for example left and upper back of the head, the main function of left which would normally be turn left, and the main function of up which would be go forward, can be transformed into turning left and moving forward at the same time. This applies to any combination of input. This allows the pressure pads control setup to open the market of Electric wheelchairs to a whole new audience of people who could not use such technology due to their medical conditions. The target audience would be people that have arthritis, or any medical condition that limits their ability to use their hands to operate a joystick.

***Matthew Strogach – See Christopher Citera***

***Rohan Surana – See Kevin Chen***

***Amber Syed – See Lindsay Chung***

***Zeynep Tasoglu, Maryum Waqar***

**Study of Resistance in *Escherichia coli (E. coli)* under the influence of**

**Amoxicillin and Hydrogen Peroxide (H2O2)**

Antibiotic resistance in bacteria is a growing issue that currently has no definite solution. *E. coli K12* is an example of a bacteria that is treated with amoxicillin even though it has shown resistance to it. Hydrogen peroxide is known as an antiseptic, since it kills bacteria by oxidizing, thus changing its chemical structure. The purpose of this experiment was to test if the combined usage of amoxicillin and hydrogen peroxide will lower resistance rates. In this study, *E. coli K12* was grown and exposed to an amoxicillin and hydrogen peroxide infused disc and was cultured in an incubator at 37°C for 24 hours. The bacteria closest to the zone of inhibition was re-cultured and again exposed to a new amoxicillin and hydrogen peroxide infused disk. This process was repeated to obtain 3 generations. These results were compared to set-ups of an amoxicillin only disk, a hydrogen peroxide only disk, and a blank disk with distilled water. The plain disk infused in distilled water and the H2O2 plain disk were put on the same LB plate, that was split in two. The rest of the experimental groups were put separately in the plate. The experiment was conducted in 3 trials. It was hypothesized that if both hydrogen peroxide and amoxicillin are used, then the growth of *E. coli* will decrease or stop. This is due to amoxicillin’s and hydrogen peroxide’s individual capabilities of inhibiting bacterial growth. The mean growth of all trials for the combination of amoxicillin and H2O2, disproved our hypothesis. In the first generation this group had the highest mean distance from the disc to bacterial growth, showing the combination was most effective for that generation. However, in the second and third generations, the H2O2 group was more effective unlike in the first generation since it showed the highest mean distance.

***Brennan Thomann – See Angelina Necroto***

***Kevin Tuzinowski, William Yuk***

**The Differences in the Gene Expression of the STA6 Gene in**

***Chlamydomonas reinhardtii* (Green Algae) Between**

**Nitrogen Deprivation and Thiamine-deplete**

One promising solution to the worldwide search for alternate sources of energy is biofuels. Biofuels are renewable and eco-friendly with benefits such as fewer greenhouse gas emissions, sustainability, and improved health as a result of reduced pollution. Biofuels are derived from starches and triacylglycerols which are produced by photosynthetic eukaryotes. Thiamine(vitamin B12) and nitrogen are essential for algal growth. Recent studies have shown the vast applications of nitrogen deprivation on algae can be used as a method for increasing starch yields. The purpose of this experiment was to investigate if the effects of gene expression of the STA6 gene while using thiamine to assess if thiamine deplete could be used as an alternative to nitrogen deprivation. Since the STA6 gene is heavily involved in starch biosynthesis, potential upregulations of the STA6 gene due to thiamine-deplete could lead to new biological pathways to increase yields of starches in the algae *Chlamydomonas reinhardtii*. We hypothesized that under thiamine-deplete, the algae would have the greatest transcription of the STA6 gene. It was expected that thiamine deplete would better facilitate starch production, as opposed to the more stressful nitrogen deprived conditions. Each sample of algae was given a total of five days of exposure to our nutrient deprived conditions. To measure the regulation of the STA6 gene, we first extracted RNA from each sample. Using RT PCR, we then amplified our RNA samples. Then using gel electrophoresis we ran gels and analyzed them using the ImageJ Software. Our results confirmed that nitrogen deprivation increases starch yields. However, we were unable to obtain data that shows whether thiamine-deplete has an effect on starch yields due to the inconsistencies of our methods.

***Shawn Uthup – See Adam Dubi***

***Michael Van Loon – See Michael Benin***

***Nicholas Vazquez – See Justin Davitashivili***

***Louis Viglietta***

**Inhibition of the Corrosion of Carbon Steel by Naturally Derived PlantExtract**

In many industries, such as pickling and ore refining, the manufacturing process requires carbon steel machine components to be in contact with acidic solutions. To prevent corrosion and thus associated maintenance costs, many manufacturers use artificial inhibitors to slow or prevent corrosion. However, given that these inhibitors are often toxic and detrimental to the environment, it is important to research the use of natural, plant-derived inhibitors as an alternative to these more dangerous options. The purpose of this investigation was to determine if the extract *Carica papaya* seeds, which are commonly treated as waste, could be used to inhibit the corrosion of carbon steel in a hydrochloric acid solution. These plants are known to contain antioxidants and phenolic compounds, which may inhibit corrosion. To test this, carbon steel plates of dimensions 2 cm x 2 cm x .064 cm were suspended in 2M hydrochloric acid for 24 hours in the presence and absence of the plant extract. The masses of the plates were measured prior to and after treatment with the acid solution, and the mass lost was calculated. It was hypothesized that in the presence of the extract, the mass lost to dissolution would be significantly less, because the seeds of *Carica papaya* are known to contain several phenolic compounds, such as ferulic acid, which can chelate and chemisorb to the metal’s surface, creating fewer active sites for dissolution. However, it was found that the extract did not inhibit corrosion effectively. The masses lost were, on average, approximately the same in the presence of the extract. Thus, the extract had little to no effect on corrosion rate.

***Caroline von Hof – See Grace Cutrone***

***Jordan Walsh***

**Cross-Condition Gene Module Network Visualization**

**In *Chlamydomonas reinhardtii***

*Chlamydomonas reinhardtii* is a single-celled green alga. It has a 24-hour cell cycle, with cell growth during light hours, rapid mitosis during the light-dark transition, and resting during darkness. This project’s purpose was to determine whether most genes in *C. reinhardtii* had cyclically varying expression levels throughout a 24-hour period, or whether their expression was relatively uncorrelated throughout. The expression patterns of specific gene loci were identified, and the functions these genes control were inferred based on this. Gene expression data from a *C. reinhardtii* sample was clustered separately using Weighted Gene Co-expression Network Analysis, and simultaneously with the ManiNetCluster machine learning method, in R. Modules consisting of day and night nodes mutually sharing gene expression patterns with ManiNetCluster nodes were identified. If more of these modules were functional linkage, then it would be concluded that most *C. reinhardtii* genes control functions that cyclically vary throughout the 24 hours, whereas if more modules were preserved (direct day-night correlation), most genes would have roles that do not vary cyclically. It was hypothesized that most modules would be functional linkage, since it was thought that most of the organism’s core functions cyclically vary, like photosynthesis. Among all modules, 1,405 were preserved, while 597 were functional linkage. In the future, this network analysis could be applied to other organisms to determine how their biological processes vary throughout a 24-hour period and to identify specific loci on the genome that can be targeted for gene treatment of a specific cellular function.

***Maryum Waqar – See Zeynep Tasoglu***

***Liam Whitewolfe – See Victor Angielczyk***

***Jenny Won***

**Bacteria Growth in Organic and Conventional Foods**

Bacteria are the single most common life form on the plane. Our over-prescription and misuse of antibiotics has led to a natural selection 'war' in which antibiotics kill the weaker bacteria, leaving the resistant ones to thrive. These surviving bacteria have a mutation that the allows them to decrease their uptake of the antibiotic, destroy the antibiotic metabolically, or alter the antibiotic's ability to enter the cell is altered. The surviving bacteria are far more dangerous than the original population since the antibiotic used can no longer kill the resistant survivors. Worse, they pass this genetic trait on to future generations. The purpose of this project was to test for antibiotic-resistant bacteria present in organic and inorganic vegetables. I hypothesized that the non-organic vegetables would have more bacteria than the organic vegetables that the bacteria on the non-organic vegetables will be antibiotic resistant because they had more exposure to chemicals and pesticides. In organic farming, less pesticides are used, so you may expect the bacteria to be less antibiotic resistant than on non-organic farming. In farming, drugs such as antibiotics and hormones are used to boost growth. In this experiment, organic and conventional foods were soaked into sterile water for two days, then the organic and conventional foods were serially diluted and pipetted onto agar plates containing Luna Broth or Ampicillin antibiotic. Plates were incubated overnight, and the number of colonies will be counted.

***Kevin Won – See Ashley Moon***

***David Yang – See Michael Jang***

***William Yuk – See Kevin Tuzinowski***

***Asmaa Zahran – See Kylie Iannuzzi***

***Mariam Zahran***

**The Effect of Temperature on the Susceptibility for   
Heat-Sensitive *Drosophila* to have a Seizure**

Approximately 50 million people around the world have epilepsy, ranking it the fourth most common neurological disorder. The seizures can sometimes be controlled through medications and surgery, however due to economic reasons in many countries, treatment is not an option for these people. Many people without a clear cause of epilepsy may have a genetic form. There are many different genes associated with epilepsy and the relationship between genes and seizures is complex. Dravet syndrome is a type of epilepsy where seizures are often triggered by hot temperatures or fever. This heat-induced seizure occurs from a mutation which does not allow the sodium channel to open and close properly which leads to neurons being unable to generate an appropriate electrical signal, causing hyperactivity in the brain circuits inducing the seizures. Drosophila melanogaster or fruit flies, are model organisms to study neurological disorders. The purpose of this experiment was to analyze the effect of varying temperatures on the susceptibility of a fly with a heat-sensitive mutation to have a seizure. I hypothesized that as the temperature increased, the susceptibility to have a seizure would also increase since as the temperature regulates sodium channel function. Mutated *Drosophila* were placed in water baths of different temperatures and observed for how long it took for them to become inactive and how long it took for them to recover. After finding the temperature that the flies are more susceptible to seizures. The flies will be given tablets with natural herbs and vitamins in them to test if the natural tablet is able to prevent or decrease the effects of epilepsy. Results were compared from each temperature to each other to find the temperature that makes the mutated *Drosophila* the most susceptible to a seizure. Results show that as the temperature increases, the more susceptible the mutated fly is to ‘pass out’. Along with it taking less time for the fly to ‘pass out’ as the temperature increases, it also takes more time for the fly to wake up and react to stimulants.

***Michael Zarief – See SShamtej Singh Rana***

***Tryphena Zareif – See Alyssa Collado***

***Chapin Zerner***

***(With Kyle Dunn, St. Anthony’s High School and Avinash Reddy, Wheatley School)***

**The Effect of Increased Salinities and Introduction of**

**Phytotoxic Pesticides Roundup and Spectracide Triazicide on the**

**Health and Phytoremediation of *Lemna minor L.***

*Lemna minor L.* is a glycophytic freshwater bioindicator organism found in nearly every region of the Earth which exhibits phytoremediator properties. Climate change results in saltwater intrusion, increased brackish water concentration, heightened drought conditions. Overuse of phytotoxic pesticides and herbicides leads to contamination of freshwater supply similar to saltwater intrusion. Insecticides (Spectracide Triazicide®) and herbicides (Roundup®) are widely used. The purpose of our experimentation was to examine the phytoremediation and health of *Lemna minor L.* in various saline solutions with and without the introduction of phytotoxic pesticides and herbicides. Using procedures in previous studies, testing vessels were divided into various molar NaCl and pesticide concentrations. Hypothesized results were that total carotenoid and chlorophyll content would decrease, and peroxidase, total nitrogen and phosphorus content would increase as a result of deterioration of the plant and its metabolic processes. Experimental results displayed significant physical signs of deteriorating health, i.e. frond area and root length, yellowing color. Peroxidase levels decreased, and carotenoid/chlorophyll A/B content suggested salt catalyzes pesticide active ingredient processes. Insecticide Spectracide® was more effective at degrading *Lemna minor L’s* health and phytoremediation than Roundup®, which targets the shikimate pathway. *Lemna minor L.’s* close relation to *Oryza sativa,* Asian rice exemplifies the need for such organisms to survive in the presence of increasingly toxic levels of both NaCl and phytotoxic pesticides.

***Christopher Zizzadoro – See Jack Coogan***

***Jackson Zumpano – See Anthony Speciale***

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