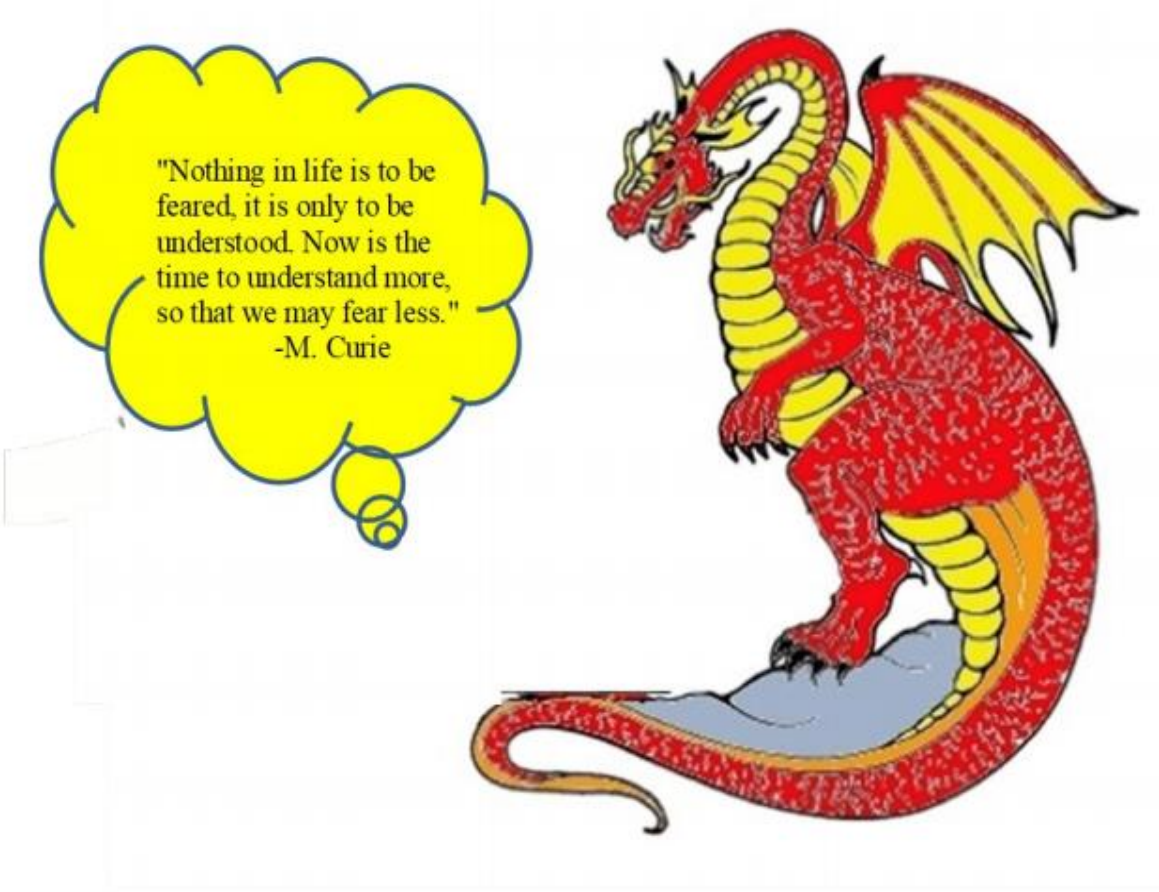
The Research Dragon



Commack High School's
Research Yearbook

2020-2021

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

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

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

Thank you.

Research Staff

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

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

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

Susan Abbott, Anthony Capiral, Lisa DiCicco, Michael Cressy, Chris DiGangi, Fran Farrell, Kristin Holmes, Janet Husted, Paul Giordano, Dolores Godzieba, Dr. John Kelly, Dr. Barbara Kruger, Dr. Fred Kruger, Barbara Lazcano, Brenda Lentsch, Diana Lerch, Daniel Meeker, John Mruz, Margaret Nappi, Bill Patterson, Jackie Peterson, Stephanie Popsky, Jose Santiago, Genny Sebesta, Thomas Shea, Dr. Lorraine Solomon, Zach Svendsen, Laura Tramuta, Fern Waxberg, and Frann Weinstein.

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

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

Ms. Boritz, Ms. Allen, Mr. Keltos, Ms. Lipenholtz, Dr. Santorello, Mr. Elmore, and the administrative staff for their continued support.

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

Science Fair Participation

Regeneron Science Talent Search

Michael Chacon
Brianna Han
Kiera Spahn
Rohan Surana
Joran Walsh
Chapin Zerner

Junior Science and Humanities Symposium

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

Michael Chacon – Selected to present at regional competition
Brianna Han – Selected to present at regional competition
Kiera Spahn – Selected to present at regional competition
Rohan Surana – Selected to present at regional competition
Joran Walsh
Chapin Zerner – Selected to present at regional competition

Junior Science and Humanities Symposium, Northeast Regionals

Michael Chacon
Brianna Han
Kiera Spahn
Rohan Surana
Chapin Zerner – 1st Place, Biological and Biomedical Sciences
Regional Finalist
Selected to present at national competition

Junior Science and Humanities Symposium, Nationals

Chapin Zerner – 2nd Place, Biological and Biomedical Sciences

Toshiba/NSTA ExploraVision Program

Honorable Mention represents the top 10% of nationwide student participation

Leo Abbe- *Honorable Mention*
Sophia Ahmed
Arda Alptekin
Juliette Amram
Naomi Amram
Samuel Byrd
Jillian Cestaro
Matthew Chacon- *Honorable Mention*
Anna Conforti
Rylie Curran- *Honorable Mention*
Jack Damato
Ava Davidson
Elysena DeStefano
Anthony DuBois
Julian Feldman
Michael Florentino
Hannah Ganson
Mitchel Ghermezian- *Regional Finalist*
Ava Glick
Eli Goldberg
Ethan Gordon
Tiffany Gracia-Suarez
Tyler Granelli
Tyler Grimm
Jack Hatcher
Katherine Hochberg
James Horz
Daniel Kamensky- *Honorable Mention*
Abigail Kleinman- *Honorable Mention*
Jin Ko
Lilah Kohler- *Honorable Mention*
Gabriela Kurikose
Alvin Lai
Julia Leahy- *Honorable Mention*
Kevin Lee
Sean Levy- *Honorable Mention*
Edward Liao
Kevin Ma- *Honorable Mention*
Eliza Malik- *Honorable Mention*
Ethan Marijosius
Nicolas Mendez
Crystal Migliacio

Hannah Oh
Sahaj Pandey- *Honorable Mention*
Saharsh Peddireddy
Samuel Radner
Amantej Rana- *Regional Finalist*
Alexandra Schuval
Lily Schwan
Ayan Sheikh
Joseph Sievers Jr.
Ishaan Singh- *Regional Finalist*
Anant Srinvasan
Peter Tine Jr.
DonVeon Tulloch
Constantine Varlamos
Alexa Vrionedes
Alex Walsh
Maheen Waqar
James Yu
Hao Kai (David) Zhang

Long Island Water Quality Challenge

Team A - *CHS Water Challenge Action Plan for Stormwater Treatment*
Soyoun (Ashley) Moon, Melina Nicou, Lakxshanna Raveendran

- Selected as one of the esteemed winners of the competition this year
- Received an art glass award in acknowledgment of the team's outstanding effort
- A grant was awarded to Commack High School toward the implementation of the proposed project

Team B - *Stormwater Treatment at Commack High School*
Ashley Hsu, Samantha Singh, Shreya Sriram

Medical Marvels Challenge

Jin Ko
Saharsh Peddireddy
Amantej Rana
Anant Srinivasan
Peter Tine Jr.

Long Island Science and Engineering Fair (LISEF)

Brianna Han – 2nd Place, Earth and Environmental Sciences
American Meteorological Society Award
Sarah Levine – Society for In Vitro Biology Award
Rohan Surana
Chapin Zerner – Honorable Mention, Computational Biology and Bioinformatics
U.S. Agency for International Development (USAID) Award

New York State Science and Engineering Fair (NYSSEF), ISEF Division

Brianna Han
Sarah Levine
Melina Nicou
Harry Poulose
Lakxshanna Raveendran
Kiera Spahn
Rohan Surana
Kevin Tuzinowski
Chapin Zerner – Lightning Round Finalist

WAC Lighting Foundation Invitational Science Fair

Jayson Bromberg
Michael Chacon
Kevin Chen
Alyssa Collado
Justin Davitashvili – Honorable Mention, General Biology
Sofia DiMauro
Katerina Efthymiou – Honorable Mention, Behavioral and Social Science
Sanjit Gunasekaran – 2nd Place, Earth and Environmental Science
Brianna Han – Honorable Mention, Earth and Environmental Science
Emily Hartman
Annabelle Hohne – Honorable Mention, Behavioral and Social Science
Steven Homenides – Honorable Mention, Earth and Environmental Science
Eric Huang
Robin Hwang – Honorable Mention, General Biology
Michael Jang – 2nd Place, Earth and Environmental Science
Daphne Koutsoukos
Erika Kraft
Yashica Kumar- Honorable Mention, Earth and Environmental Science
Matthew Lee
Sarah Levine
Amy Liu – 1st Place, Chemistry
Jane Maloney

Soyoun (Ashley) Moon
Eshani Mukherjee – Honorable Mention, Medicine and Health
Melina Nicou – Honorable Mention, Computer Science and Modeling
Faith Papazoglou – 3rd Place, Medicine and Health
Grace Papazoglou – 3rd Place, Medicine and Health
Jayden Prestiano
Lakxshanna Raveendran – Honorable Mention, Computer Science and Modeling
Samantha Singh– Honorable Mention, Medicine and Health
Kiera Spahn – Honorable Mention, Biochemistry and Molecular Biology
Shreya Sriram
Rohan Surana
Inaya Syed
Jordan Walsh
Kevin Won
David Yang
Chapin Zerner – Honorable Mention, Biochemistry and Molecular Biology
Marnie Ziporkin

Long Island Science Congress (LISC) – Senior Division

Defne Aktuna – Honorable Mention (6th Place), Biology - Medicine/Health
Victor Angielczyk – Meritous Award (5th Place), Biology - Medicine/Health
Gabriella Barth – High Honors Award (2nd Place, $75), Ecology
Brandon Berkoff – Achievement Award (4th Place), Biology - Medicine/Health
Samantha Borre – Achievement Award (4th Place), Earth, Space, and Energy
Matthew Campisi – Achievement Award (6th Place), Biology - Medicine/Health
Lindsey Chung – Achievement Award (4th Place), Biology - Microbiology/Genetics
Gian Carlo DiFava – Honorable Mention (6th Place), Biology - Medicine/Health
Rishin Chatterjee – Meritous Award (5th Place), Ecology
Christian Dreyer – Achievement Award (4th Place), Biology - Medicine/Health
Mikayla Girimonte – Honorable Mention (6th Place), Earth, Space, and Energy
Elena Gnilitskaya – Honorable Mention (6th Place), Behavioral Science
Jeremy Gordon – Meritous Award (5th Place), Behavioral Science
Madeline Gottlieb – Honorable Mention (6th Place), Earth, Space, and Energy
Sanjit Gunasekaran – Honors Award (3rd Place, $30), Earth, Space, and Energy
Michael Jang – Honors Award (3rd Place, $30), Earth, Space, and Energy
Aareb Jatoi – Meritous Award (5th Place), Ecology
Sydney Kalmaer – Achievement Award (4th Place), Biology - Medicine/Health
Devin Kirschner – Achievement Award (4th Place), Ecology
Christian Kraus – Meritous Award (5th Place), Biology - Medicine/Health
Ashley Lewis – Honorable Mention (6th Place), Earth, Space, and Energy
Warnakulasuriya Thehan Perera – Meritous Award (5th Place), Behavioral Science
Max Schweitzer – Honorable Mention (6th Place), Biology - Medicine/Health
Zeynep Tasoglu – Achievement Award (4th Place), Biology - Microbiology/Genetics
Tryphena Zareif – Honorable Mention (6th Place), Behavioral Science

Neurological Surgery P.C. (NSPC) Health Science Competition

Jasmine Carpio
Annika Chang
Prottaya Chatterjee
Lindsey Chung
Gavin Cressy
Justin Davitashvili
Jessica DeYulio
Elena Gnilitskaya
Ashley Hsu
Robin Hwang
Aareb Jatoi
Alisha Khan
Erika Kraft
Karen Li
Meiya Lin
Lia Maglione
Soyoun (Ashley) Moon
Evan Ni- 4th place in Health-Related Biochemistry/Biophysics($1000Award)
Melina Nicou
Abigal Pappachen
Harry Poulose
Lakshanna Raveendran
Marlee Reiter
Kiera Spahn- 2nd Place in Biology-Microbiology/Genetics($4000 award)
Shreya Sriram
Zeynep Tasoglu
Kevin Tuzinowski
Jordan Walsh
Maryum Waqar
Kevin Won
David Yang
Tryphena Zareif

South Asian American Women's Alliance (SAAWA) Fair

Jasmine Carpio
Jason Duffe
Sarah Franzen
Avi Gupta
Brianna Han – Honorable Mention, Earth and Environmental Science
Alisha Khan
Grace Kim
Sarah Levine – Honorable Mention, Biology

Meiya Lin
Lia Maglione
Melina Nicou – 3rd Place, Biology
Lakxshanna Raveendran – 3rd Place, Biology
Brennan Thomann
Kevin Tuzinowski – 1st Place, Biology
Angela Won
Asmaa Zahran
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 (HSRP)
Cold Spring Harbor Internship Program
Cold Spring Harbor Laboratory DNA Summer Camp
Cold Spring Harbor Laboratory Partners For the Future Program (PFF)
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

Jordan DiPrima, Flora Lin, Soyoun Moon, Amber Syed

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, a unique line of fruit flies could be used to study insulin producing cells in *Drosophila*, comparable to the human gene. The Transposons 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 (StanX-4) 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 these crosses, jump starter males were found, that carried the StanX-4 gene and crossed with Double Balancer virgin females. From the F1 cross, males with the StanX-4 gene transposed from the X chromosome to another were found. These males were crossed with at least 6 virgin Double Balancer females. Afterwards, a brother-sister cross was performed using the offspring from the F2 generation to make F3, where the stock would then become stable and only contain flies who have the StanX-4 gene either on chromosome 2 or 3. After stable stocks were achieved, the P-element insertion location was verified using Inverse PCR, Flybase, and primer design. These strains were sent to Stanford for further verification and potential submission into BDSC fly stock, as well as use in Stanford's ongoing research. Student's success will allow their research to be published.

SENIORS

Jayson Bromberg, Eric Huang, and Matthew Lee

Comparing the Impact of El Niño Southern Oscillation on the Abundance of Breeding Pairs of *Pygoscelis adeliae* in West Antarctica and East Antarctica

El Niño-Southern Oscillation (ENSO) is an irregularly occurring period of climatic variation affecting sea surface temperatures and winds in the tropical Pacific Ocean. This cycle is divided into three phases: El Niño, La Niña, and ENSO-Neutral, representing periods of warming, cooling, and lack of temperature variation, respectively. While the effect of the ENSO cycle is known to affect the environment in Antarctica, its effect on penguin populations is less explored. This phenomenon may impact the Adélie Penguin (*Pygoscelis adeliae*), which can be found primarily along the coast of the continent, specifically the Western Antarctic Peninsula (WAP), East Antarctica, and the Ross Sea. Databases containing records of the ONI index (which is indicative of ENSO phases) from the National Weather Service Climate Prediction Center and the breeding pair count of *Pygoscelis adeliae* at Signy Station off the WAP coast from the British Antarctic Survey were used in this investigation. Unpaired t-tests were employed to determine whether there was a statistical difference in the number of breeding pairs of *Pygoscelis adeliae* during different ENSO phases. When the breeding pairs of each phase were compared with each other, the p-values found were all well above the threshold of 0.05, which demonstrated that there was no statistically significant difference in the Adélie penguin breeding pair count during the different phases of ENSO. Additionally, the relationship between ONI intensity and the Adelie penguin breeding pair count was investigated. ONI intensity was found by taking the absolute value of the ONI values and classifying into five categories: ENSO-Neutral, weak, moderate, strong, and very strong. Little correlation was found between the ONI intensity and breeding pair count, yielding a r-squared value of 0.036. The results imply that the cycle of warming and cooling of the ocean waters has little bearing on the breeding success of *Pygoscelis adeliae.*

Michael Chacon

The Implications of Selachimorpha Proximity to Underwater Structures within the New York Bight Region

The waters around Long Island are home to a rich maritime history, rooted in whaling, shipping, and fishing, which as a result leaves the bottom of the New York Bight scattered with shipwrecks. It is also home to approximately 26 different shark species, but only a handful are frequent visitors during the summer months. In recent years, New York State has been implementing the use of 10 artificial reefs along the south shore of Long Island. This project

created a database of 62 shark encounters within the New York Bight from 1950 to 2020, relative to the specific underwater structures in the area. Past news reports, shark attack data and data collected by Ocearch satellite tags were used to create the database, as well as documentation of first-hand interactions collected by reaching out to fishermen and local residents. The latitude and longitude of each encounter was then plotted on a Navionics map, and a geometric compass was used to determine the distance between the encounters and specific structures including reefs, wrecks, or fish havens (artificial reef). This was then plotted and organized on Google MyMaps. The results showed the majority (76%) of species had one of these structures within 3km of their location with an average distance of 2.43 kilometers. Sandbar, dusky and sand tiger tended to stay closer to shore and within the surf, while pelagic sharks such as threshers, makos and blue sharks were outside of the 3-mile line. These congregations suggest that the region is a healthy environment that can sustain large marine predators such as sharks, as well as other other fish species. The levels of shark presence around a certain area compared to others can be used to assess the success of certain artificial reefs compared to others.The habitat use of these sharks is crucial to their protection. Since the New York Bight is a nursery for species such as spinner, mako, thresher, white and sand tiger sharks, all efforts must be made to preserve and conserve the waters of these waters where they frequent.

Annika Chang and Marlee Reiter

The correlation of type 2 diabetes mellitus treatment status on phosphorylated-tau, a biomarker for Alzheimer's Disease diagnosis

As average life expectancy increases, Alzheimer's Disease (AD) has become a major health issue for the elderly, affecting approximately 5.5 million people in the US. Type 2 diabetes mellitus (T2DM) is associated with abnormal blood glucose levels and affects about 15.6 million people in the US. Past studies have demonstrated that T2DM is associated with an increased risk of AD. The purpose of the current study was to investigate the relationship between T2DM and p-tau, a sensitive AD biomarker. It was hypothesized that individuals with untreated T2DM would have a higher level of p-tau because people who have T2DM have a higher risk of developing AD. Data was obtained from Alzheimer's Disease Neuroimaging Initiative. The fasting blood glucose level of each participant was collected to diagnose them as diabetic, and this group was divided into untreated and treated diabetic groups based on the concurrent medications log. Participants in each group were separated into groups with mild cognitive impairment (MCI; n=73), AD (n=12), and cognitively normal (CN; n=64) and the concentration of p-tau was collected. After the data was collected, unpaired t-tests on the p-tau levels between treated and untreated diabetic participants were conducted in the CN, MCI and AD groups in Excel. The results from this experiment conclude that T2DM has a stronger effect on p-tau levels when diabetes is left untreated which is shown in the MCI and AD groups.

Kevin Chen

A Comparison Between Potential Solutions to the Lyft Motion Prediction Challenge

The future of personal transport lies in self-driving, autonomous vehicles (AVs). However, of the three tasks involved in AV navigation, prediction methods remain to be improved before commercial applications become realistic. The recent release of a significantly large AV dataset prompted a machine learning approach. This project aimed to train various machine learning models to predict the motion of traffic agents (cars, pedestrians, etc.) and compare their accuracies. Building on the motion prediction example supplied through the L5Kit library provided by Lyft in their 2020 competition, "efficientnet," "regnet," and "resnet50" models were implemented through the PyTorch framework. These models were trained on the data and evaluated by examining the accuracy of their prediction compared to the true path taken by the ego vehicle using the average displacement error. It was found that efficientnet had performed the best, with regnet coming after and resnet50 after that. Though each model was capable of predicting traffic agent motion with good accuracy, training time will become a greater point of interest as scale increases; Efficientnet was also most efficient in this regard. Further investigations could increase accuracy of solutions by creating an ensemble of machine learning models to collectively predict paths. Additionally, it would be valuable to investigate the possibility of additional predictions with varying confidences.

Alyssa Collado and Jane Maloney

How Manufacturing Outputs and Sulfur Dioxide Relate to Pneumonia Deaths in China, and Its Improvement

Air pollution is a prominent issue that is detrimental to the health of the public and the environment. This project focused on China and its contribution to the sulfur dioxide within Earth's atmosphere, due to the burning of sulfur compounds. Air pollutants can contribute to respiratory problems within living organisms. A respiratory infection related to air pollution is pneumonia. Sulfur dioxide causes inflammation to the lungs of an ill person, causing pneumonia. The purpose of this project was to determine if sulfur dioxide concentration contributed to the occurrence of pneumonia caused deaths within China, from 2007-2015. Multiple databases were accessed, including, Our World in Data and Statista, in order to accumulate data on yearly manufacturing outputs, sulfur dioxide emission, and pneumonia deaths in China within the years of 2007-2015. It was hypothesized that as more sulfur dioxide was emitted, there would be an increase in pneumonia deaths. Statistical tests were run on the data after it was organized into a table. A correlation test was done and presented a correlational R-squared value 0.596, meaning there is a moderate positive linear correlation between the amount of sulfur dioxide emitted and the number of people who died from Pneumonia. This supported the hypothesis that as time continued and sulfur dioxide emissions increased, while pneumonia deaths also increased. These results stress the need to lessen the effects of air pollution, as it is a direct harm to health of the general population.

Joseph Cramer

Recording Different Age Group Stigmas Toward Psychosis Related Illnesses

Psychosis related illnesses such as schizophrenia impacts about 1 in every 100 people and affect 2.6 million Americans aged 18 or older. Symptoms of disordered volition, thinking, and affect appear overtly, by which time there may also be some evidence of deterioration of their social and emotional health can be found with those who have Schizophrenia. The topic being pursued is how different high school age students perceived and stigmatize schizophrenia and psychosis. This will be done by making a form that can be filled out by the participant's parents or guardians so that they can participate in the experiment, then create a uniform questionnaire that can find people's stigma scores. The data will be processed by a Chi Test. The data collection has begun to be collected and I anticipate a low trending stigma rate across all of the participants.

Gavin Cressy

The Correlation Between Atmospheric Particulate Matter and Reported Mental Distress Frequency in Alzheimer's Disease Patients of Varying Ethnic Demographics

Alzheimer's Disease (AD) is a neurodegenerative disorder marked by a short-term memory deficit that worsens over time. The aggravation of neurodegenerative diseases like AD have been correlated with fine particulate matter ($PM_{2.5}$) exposure. This experiment investigated the role of ethnicity in mental distress frequency across an AD population exposed to particulate matter using the CDC's "Alzheimer's Disease and Healthy Aging Data" dataset, including mental health frequency data across demographics including Black, White, Hispanic, Native American, and Asian Americans. These data were cross-referenced with $PM_{2.5}$ concentrations in the same areas around the same time periods using the "Daily PM2.5 Concentrations" dataset from the CDC. 95% CI was used to analyze the correlation between mental distress frequency attributed to AD among varying ethnic demographics and $PM_{2.5}$ concentrations. Additionally, T-Tests were conducted to determine statistically significant differences between the mental distress frequencies of AD patients of varying ethnic groups in the same state over the same period. In terms of 95% CI, the 23 correlation values found vary from -0.7838 to 0.9977. Therefore, there appears to be no clear correlation between reported mental distress frequency of AD patients of varying ethnicities and $PM_{2.5}$ concentrations. There is statistical significance in the p-values of the following groups: Asian and Hispanic in Hawaii; Black and White in Indiana, Michigan, Minnesota, and Ohio; Hispanic and White in Hawaii and Massachusetts; and Native American and White in Minnesota. As a result, there appears to be a difference in the reported mental distress frequencies of the AD patients of the aforementioned ethnicities in their respective states.

Katerina Efthymiou and Annabelle Hohne

Policing and Crime Deterrence- The Relationship Between Number of Police Officers Per Capita and Violent Crime

For some time, suggestions have been made that policing methods, policies, and size have an effect on crime rates. However, studies of effectiveness of the police force in deterring crime and lowering crime rates have yielded varying results. The purpose of this investigation was to determine the effect of the number of police officers in large cities on crime rates. Population and police officer employment data was collected from the FBI Uniform Crime Reporting (UCR) Database. Data concerning the number of violent crimes and property crimes was collected, violent crime being separated into categories: murder, non-negligent manslaughter (homicide), rape, robbery, and aggravated assault and property crime being separated into categories: burglary, larceny, motor vehicle theft, and arson. The number of police per 100,000 people and Cambridge Crime Harm Index (CHI) scores were calculated. It was hypothesized that no correlation between police employment and violent or property crime would be found because the effects of different police behaviors on the perceived risk of crime would not have a significant deterrent effect on crime. Correlation tests were conducted between the number of police per 100,000 people and the CHI scores for each type of crime and for total violent and property crime. The R2 value for total violent crime and police employment for 2019 and 2018 were 0.2404 and 0.2118 respectively and 0.0242 and 0.0388 for property crime and police employment. Therefore, no statistically significant correlation exists between police employment and crime. A better understanding of how the number of police officers affects crime will yield a better estimation of how many officers are needed for a given population and could have cost benefits.

Elena Gnilitskaya and Tryphena Zareif

The Effect of Lead Levels on Crime Rates in the US

Over the past five decades, lead exposure and blood lead levels (BLLs) in the United States have declined dramatically as many widespread lead uses have been discontinued as it was found that even at low exposures (<0.05 ug/dL) lead is a potent neurotoxin. Aerosolized lead contributes to severe neurological effects that are associated with impulsivity and violent behavior. This study aimed to evaluate the effect of decreasing lead exposure levels over time on the violent crime rate in different states to be used to evaluate the necessity of the elimination of leaded gasoline as it contributes to violent crime. Nationally representative data on blood lead levels over the years 1999 to 2017 were collected from the National Health and Nutrition Examination Survey (NHANES) and the Environmental Protection Agency (EPA). Likewise, violent crime rates per state over the same range of years were collected from the Uniform Crime Reporting (URC)

database. The relationship between the average blood lead level and violent crime rates was analyzed both nationally and by state. The overall evaluation analyzed the trend of waning blood lead levels over time after the ban on leaded gasoline. The correlation of BLLs and violent crime rate produced varying correlation values throughout regions of the U.S. (correlation = 0.849, 0.00, 0.00, and -0.905, depending on the region). Nationally, the correlation value was -0.15992 meaning that these results are inconclusive and insufficient to support decreasing exposure to aerosolized lead to reduce violent crime prevalence.

Brianna Han

Markov Chain Monte Carlo Methods for Estimating Rainfall Rate from Dual-Polarization Weather Radar

Recently, many single-polarization weather radars have upgraded to dual-polarization. This upgrade has allowed weather radars to measure additional properties that can be used to estimate rainfall rates more accurately. The objective of this study was to apply Markov chain Monte Carlo (MCMC) methods to estimate rainfall rates using dual-polarization radar measurements. Droplet size distribution (DSD) disdrometer data was collected from the U.S. Department of Energy's Atmospheric Radiation Measurement facilities at the Southern Great Plains site. Radar measurements of radar reflectivity (Z), differential reflectivity (Z_{DR}), and specific differential phase (K_{DP}) were calculated using these DSDs. To estimate rainfall rate, a Marshall-Palmer distribution was assumed, and MCMC methods were used to infer the Marshall-Palmer distribution parameters, given different combinations of the radar measurements. Rainfall rate estimations were then calculated from the predicted Marshall-Palmer distributions. These estimated rainfall rates were compared with rates calculated from the DSDs using an absolute root mean square error. The root mean square error of the Z, only group was 20.040; Z and Z_{DR} 17.709; Z and K_{DP} 10.257; and Z, Z_{DR}, and K_{DP} 6.1877. According to these root mean square values, the Z, Z_{DR}, and K_{DP} group had the most accurate predictions, as its root mean square error was the least of the four groups. Additionally, as can be seen in the differences of the root mean square error values, the addition of K_{DP} in MCMC estimation increased estimation accuracy more than did the addition of Z_{DR}. Thus, if an improvement in measurement uncertainty and accuracy were to occur, an improvement in the K_{DP} measurement would deem more useful than one in Z_{DR} in terms of increasing the estimation accuracy of this MCMC approach.

Emily Hartman and Jayden Prestiano

The Effect of the Rising Sea Level on Precipitation Levels

Global warming has been a growing issue in the past several years. Due to global warming, many lasting effects have impacted our environment, one being the rise in sea levels caused by the rising temperatures, melting glaciers, and expanding water. The rise in sea level ultimately harms our environment because of the possible future impacts it can cause, including erosion, wetland flooding, loss of habitat for both sea and land animals, and the contamination of soil due to the saltwater. The purpose of this project is to determine if it is feasible to predict the effects that future rise in sea level will have on precipitation trends, based upon data collected in the last decade. Data from The National Centers for Environmental Information was collected to observe the sea level over the last decade. Using the average reading from each year, 10 data points were taken in which was a calculation of 36 annual points that represented the variation in millimeters with respect to 20-year TOPEX/ Jason 1 satellite readings, mean reference. Additionally, 10 data points were collected from the same organization regarding the monthly precipitation trends during the same time span in the same region. From our collected data points, it is evident that the increase in precipitation cannot determine the future precipitation trends. This is seen though the correlation coefficient being 0.298, this shows that there is not a strong correlation between the rise in sea level and precipitation trends. In the future, additional factors should be considered in order to better identify a stronger correlation between the rise in sea level and precipitation trends. Although the correlation was weak it does show that it is not completely uncorrelated. Therefore, due to the correlation coefficient it can be classified that our hypothesis was incorrect and that it is not feasible to determine future precipitation trends based upon the sea level.

Annabelle Hohne – See Katerina Efthymiou

Eric Huang – See Jayson Bromberg

Erika Kraft

Measuring the Effectiveness of Varying Types of Meditation using Leukocyte Telomere Length

Stress affects the immune system's ability to function through stress-associated hormones. Meditation practices awareness of the mind (mindfulness) and body (movement). In this study, mindfulness meditation is represented by the Five Facet Mindfulness Questionnaire and the Self Compassion Scale. Movement meditation is represented by yoga. The purpose of this investigation was to determine if different types of meditation are equally effective in

counteracting acute stress in terms of leukocyte telomere length. It was hypothesized that all types of meditation would be equally effective because they all lower stress levels. Using the data from two previous studies, I compared the means and standard deviations. SCS has a larger r-squared value (0.032) than FFMQ (0.015), however not significantly. People with the highest SCS scores had longer leukocyte telomeres on average (1.275) than those with the highest FFMQ scores (1.158). Those who practiced yoga had the highest average LTL (1.960) and smallest standard deviation. Therefore, yoga was the most effective in this sample.

Matthew Lee – See Jayson Bromberg

Amy Liu

Analyzing Phosphorus-doped Carbon Nanotubes to Maximize Hydrogen Storage Capacity

Researchers have been focusing on advancing alternative methods of hydrogen storage such as hydrogen adsorption on carbon nanotubes (CNTs) with impurities, or dopants, to optimize hydrogen fuel cells and help address the climate change crisis. Since nitrogen doped CNTs were experimentally proven to increase hydrogen uptake, phosphorus dopants, being in the same group as nitrogen, were believed to produce similar effects. To determine the impacts of the position and number of phosphorus dopants on hydrogen uptake to maximize hydrogen storage capacity, 64-atom CNTs were modeled with varying positions and numbers of phosphorus dopants using Avogadro modeling software. Density functional theory calculations were carried out using ORCA software to compute hydrogen adsorption energies for each CNT system. LAMMPS molecular dynamics software was utilized to simulate hydrogen adsorption in each system using a hybrid of the AIREBO and Lennard-Jones Potentials. Results show that the initial configuration of the P8/C56 system obtained the highest hydrogen uptake of 8.97 wt%, significantly higher than the intrinsic CNT which had a hydrogen uptake of 0.78 wt%. The simulations and DFT calculations demonstrated a strong linear correlation between the number of dopants and hydrogen storage capacity (r-squared value = 0.7062) and the number of dopants and hydrogen adsorption energy (r-squared = 0.9556). After varying the positions of phosphorus dopants in the P8/C56 system, it was observed that arranging phosphorus dopants in clusters generated significantly less hydrogen uptake than when evenly distributed over the CNT. Thus, the initial arrangement of dopants in the P8/C56 model exceeds the DOE's target hydrogen storage capacities of at least 6.5 wt%. Analysis of P-doped CNTs contributes a better understanding of underlying trends in maximizing hydrogen storage for further studies.

Jane Maloney – See Alyssa Collado

Evan Ni

An Investigation of the Relationship Between Immunoglobulin G Concentrations and BMI in Rheumatoid Arthritis Patients

In the United States, Rheumatoid Arthritis (RA) affects roughly 1.3 million people countrywide. Although RA is not fatal on its own, health complications may arise that lead to a reduced lifespan of up to 15 years. Therefore, it is imperative to further investigate the factors that may contribute to RA to identify possible treatments for the disorder. The purpose of this investigation is to determine the relationship between BMI and immunoglobulin-G titers in RA patients. Using a database provided by the Nation Library of Medicine, BMI was compared to the tetanus and pertussis (IgG) titers using Pearson's Correlation Test and the effect of BMI on a RA patient's IgG titers was determined. It was hypothesized that patients with a higher BMI reading will correlate with lower immunoglobulin concentrations compared to their normal and low BMI counterparts, as previous studies concluded that RA patients possessed higher IgG titers and joint pain while patients who possessed more adipose tissue experienced less severe symptoms. Based on the comparison between patients' BMI and the concentrations of tetanus and pertussis immunoglobulins, Pearson's correlation coefficient yielded values of -0.026 and 0.091, respectively.

Jayden Prestiano – See Emily Hartman

Marlee Reiter – See Annika Chang

Kiera Spahn

Increased Hepatic Expression of COL I and COL Ill Genes in a Model of Nonalcoholic Steatohepatitis with Fibrosis: A Call for Targeted Therapy

Today there are millions of Americans affected by nonalcoholic steatohepatitis (NASH). Nonalcoholic fatty liver disease (NAFLD) is the larger subset that NASH falls under. NAFLD starts from fibrosis, cirrhosis and hepatocellular carcinoma (HCC). This study's purpose was to find a disease driver in the mice models with the larger purpose of targeted gene therapy to help those with NASH. Mice were put into two groups, sham normal diet and fast-food diet (FFD). Sections of their livers were placed on slides and NAFLD activity scores were scored based on steatosis, lobular inflammation and ballooning. Quantitative polymerase chain reaction was conducted to measure the expression of colla1/c011a2 and c013a1 genes. Col 1 and Col 3 genes all experienced increased expression in the livers from the FFD group and increased NAFLD activity scores. The increased expression of the colla1/c011a2 and c013a1 genes, suggests a possible disease driver in human NASH and the use in future research of targeted gene therapy for those with NASH.

Rohan Surana

The Potential Impact of Police Activity on Children's Future Income in the United States

This research aims to assess whether police activity has a positive or negative effect on financial outcomes. Using multiple linear regression techniques, and controlling for parental income, it was determined that an increase in police activity, represented by police protection employment, is accompanied by a decrease in the median future income of individuals that grow up in counties across the United States. Specifically, an increase of police employment level by one standard deviation was associated with a decrease of median future child income by 0.127 standard deviations when controlling for parental income. This means that on average, an increase of 86 police protection employees for every 100,000 county inhabitants is correlated to a decrease in their income by approximately 746 dollars, or about 2 percent of the average median income among the analyzed counties. These values were determined using the regression coefficient of police protection employment level which had a p-value of 0.037, a value that indicated a high probability of an independent effect on median future child income. Regressions also suggested that police protection employment is typically greater in areas with a larger percent African American population, indicating that police activity might be dependent on the racial distribution of communities.

Kevin Tuzinowski

Benchmark study of Ab initio Gene Prediction Programs using Density Based Spatial Clustering of Applications with Noise (DBSCAN)

Advances in genetic output from next generation sequencing (NGS) has made data science in the field of biology even more important, due to NGS's ability to sequence an entire genome at once. Currently, the most important part of identification that occurs in genetics-related wet-lab biology within those genomes are locating exons. Exons are the sequences that comprise RNA and are often what codes for a protein. New benchmark methods are needed to evaluate the accuracy of gene prediction methods. A machine learning algorithm known as DBSCAN offers a solution to the search for new benchmark methods. Based on a set of points, DBSCAN groups together areas of higher density based on a distance measurement and a minimum number of points. The reference data was constructed by finding orthologous proteins from 20 human proteins using Orthoinspector 3.0. Uniprot/Ensembl databases were used to locate DNA/Exon maps for the reference protein sequences. Flanking regions of different sequence lengths were pulled, accuracy of protein regions across databases was identified using PipeAlign2. Using five gene prediction algorithms, Augustus, GeneID, Genscan, GlimmerHMM, and Snap, predictions were evaluated based on accuracy using Fl scores. DBSCAN clusters were made in 3D using Fl scores, gene lengths, and %GC content of the sequences. Augustus is the optimal gene prediction

algorithm, as it outperforms in almost every circumstance (90.91 %) involved with sequence characteristics.

Jordan Walsh

Computer Modeling of Fetal Heart Rate and Uterine Activity during Pregnancy

During labor, uterine contractions and fetal heart rate (FHR) are monitored to ensure that the fetus is not experiencing any problems, such as a lack of oxygen, that would necessitate an intervention such as a cesarean section. The proper interpretation of uterine activity and FHR data by medical professionals requires training, and this data can only be generated during labor in pregnant women. The purpose of this project was to create a mathematical model that simulates a typical uterine activity and FHR signal over time, allowing medical personnel to gain experience in interpretation while eliminating the possibility of adversely affecting a live delivery, in addition to avoiding legal issues associated with using historical data from previous patients. The three components of a uterine activity signal -- the main contraction, regular noise resulting from maternal breathing and the measuring tool, and irregular noise resulting from fetal movements -- were modeled in Matlab by an asymmetric Gaussian function, Perlin noise, and an impulsive noise function, respectively. The baseline signal with variability, in addition to periodic accelerations and decelerations, associated with a fetal heart rate signal was modeled by a 1/f noise signal with a peak of 0.1 Hz. These simulated signals can be used to train clinicians in delivery and prevent unnecessary C-sections, thus limiting the risk of complications for the baby and/or mother from unwarranted procedures.

Chapin Zerner

Using Machine Learning to Predict Features Related to the Immune Response in Covid-19

Leukocytes such as T Cells and B Cells are essential components of the adaptive immune response, interacting directly with antigens such as SARS-CoV-2. The area of direct contact between an antigen presenting cell and a T Cell Receptor (TCR) or B Cell Receptor (BCR) is known as Complementary Determining Region 3 (CDR3) and represents a unique insight into the adaptive immune response. Through the analysis of published Peripheral Blood Mononuclear Cell (PBMC) data, TCR and BCR CDR3 chains were extracted and converted to tetramers through a moving window. By use of biochemical factors, tetramers were then converted into matrices containing information on properties such as hydrophobicity, coupled with the relative abundance of the tetramer. A total of 269 patients were analyzed, divided between healthy, mild, moderate, and severe classification as self-reported by patients, and corroborated using a World

Health Organization score. A neural network was created to predict patient severity based upon their CDR3 regions. This was accomplished with 75% accuracy when discerning between mild and moderate patients, in line with similar studies involving biochemical matrices in breast cancer. In order to remedy the inconsistencies associated with qualitative disease severity binning, a quantitative measure was developed based on granulocyte-related gene expression data. This yielded a total 54% accuracy when discerning between all four severity groups, as opposed to the baseline 25% accuracy prior to this conversion. Such results demonstrate the power of biophysical properties in informing the network decision-making process and have far-reaching impacts within COVID-19 study and beyond.

UNDERCLASSMEN

Leo Abbe, Daniel Kamensky, and Kevin Ma

Treatment of Parkinson's Disease Via Brain Implants and Deep Brain Stimulation

Parkinson's Disease is a deadly neurological disease that affects millions of people around the world. In just the U.S alone, 60,000 people are diagnosed with Parkinson's every year, and about 1 million people in the U.S live with Parkinson's. There is currently no cure and Parkinson's disease claims thousands of lives each year. DBS, (Deep Brain Stimulation) is a treatment developed by scientists to ease side effects of Parkinson's using brain implants that interact and communicate with neurons, providing electrical stimulation to patients and easing their symptoms. Unfortunately, it does not slow down the disease's progression. Our project will cover several methods to improve treatment in this area as well as potential ways to slow down the progression of the disease, from the monitoring of dopamine levels via brain implant to marking a-synuclein proteins so that scientists can better monitor abnormal protein buildup in a patient's nerve cells.

Sofia Ahmed and Ava Glick

The solution to Allergies

Allergies are highly prevalent in today's world. There is a wide range of technologies available for the treatment and prevention of allergies, and many more are in development and undergoing testing. We have devised a new technology to prevent allergic reactions called Anti-IgE. It entails a pill with medication to counteract antibodies in the bloodstream which cause the allergic reaction and create symptoms like itchy hives, rashes, trouble breathing, swelling of the throat, nausea and vomiting, and in some severe cases, anaphylaxis and even death. A dispenser and allergy test tube are also included. The test tube comes with a light that flashes different colors depending on the type of food allergy a person has, and a certain amount of pills will be dispensed depending on the severity of the allergy.

Defne Aktuna

Effect of Bilirubin Levels on the Frequency of Cardiovascular Symptoms of COVID-19 Patients

COVID-19 is a respiratory disease that emerged in late 2019 in Wuhan, China. In some cases, COVID-19 causes inflammation in the lungs and in the heart, which could result in mortality. Separately, it has been demonstrated that people with Gilbert's Syndrome, a harmless condition in which the body produces an excessive amount of bilirubin, are less likely to develop cardiovascular disease. It is hypothesized that patients with higher levels of bilirubin could develop cardiovascular complications of COVID-19 less frequently because of the protective effects of bilirubin. It is proposed that as more data becomes readily available, this correlation will be explored. By learning about the protective effects of elevated levels of bilirubin on cardiovascular disease, it could aid in treatment of COVID-19 and identify lower-risk groups.

Arda Alptekin, Ethan Gordon, Tyler Grimm, and Ayan Sheikh

Revolutionizing the Efficiency of Car Batteries

The car battery is a device that we use in our daily commutes, although we believe battery use is harmless, there are major drawbacks that have negative impacts on the environment, which causes disruptions in the ecosystem and our lives. Car batteries are essential as a starter for every automobile and supply 12 volts of power to the car computer, GPS, lights, and windshield wipers. Car batteries were made in the mid 1800's and standardized in the early 20th century. By introducing the use of solar panels and copper infused wires, batteries could become more eco efficient, whilst increasing the lifespan of the battery. By having longer laying batteries the annual sales of new batteries would decrease and less batteries would end up in landfills.

Juliette Amram, Gabriela Kuriakose, Alexandria Schuval, and Lily Schwan

Allergy Patch

More than fifty million Americans suffer from allergies every year, making allergies the sixth leading cause of chronic illness in the United States. Of those fifty million, over a thousand experience anaphylactic shock. During anaphylactic shock, the throat can swell up, causing a victim to be unable to breathe. This study observed the effects of berries on inflammation with the intent of finding a remedy for severe allergic reactions. It was found that some berries contain anthocyanins and flavonoids, unique types of antioxidants that can heal and reduce inflammation in the body. These nutrients can be mixed into a medicine and inserted into a transdermal patch

which can then be worn by allergy patients. The nutrients would be absorbed into the bloodstream and calm any inflammation present. This molecular sensing self-dosing patch containing a fortified anti-inflammatory berry extract can save many lives if it is made into a reality.

Naomi Amran, Kathleen Hochberg, and Alexa Vrionedes

The C.R.S: The Answer to Coral Bleaching

Coral bleaching is the whitening of coral from the loss of the algae that live within the coral. Bleaching is associated with severe damage to coral reefs, which are home to approximately 25% of all marine species. Marine life alone depends on coral reefs for food, shelter, breeding/spawning grounds, protection from predators, and everyday life in general. Considering this, the bleaching of coral can impact entire ecosystems substantially. Similar to the COVID-19 vaccine technology, The C.R.S. (Coral Resilient Submersible) uses CRISPR and genome editing to help prevent future coral bleaching. By injecting coral zygotes with the latest cas9 CRISPR technology, we will be able to administer the Symbiodium D gene which gives an enhanced heat resilience. This technology will help limit the amount of Coral Reefs suffering from coral bleaching in the present and future of marine life.

Victor Angielczyk and Christian Kraus

Diagnosing Melanoma Using Open Source Computer Vision (OpenCV)

Melanoma is one of the most dangerous cancers due to its ability to spread rapidly to multiple organs if not treated quickly. In early stages, Melanoma is considered a relatively treatable form of cancer as a 99% survival rate is predicted during stage 0/I/II. However, Melanoma will rapidly metastasize, sometimes in as short as one month, turning into stage III/IV, lowering the survival rate to just 25%. Melanoma can form anywhere on the skin, which makes detecting it tedious, as dermatologists may have to look over the entire body to detect a cancerous tumor. Our goal was to create a program, using OpenCV for Python. OpenCV is a programming library originally developed by Intel for real-time computer vision, and then released to the public as an open source project. The program runs a picture of a lesion believed to be cancerous through a Haar Cascade, which was trained using OpenCV and images from the ISIC Archive. This allows for rapid detection of cancerous tumors at home, in turn allowing faster treatment, resulting in higher survival rate. This tool can be used as a supplement to dermatologists, as people will be able to use a home computer to check. Trained dermatologists are believed to have a successful detection rate of 75-85% which our program will try to replicate. Our final program, using Haar Cascade feature detection, had around a 30% success rate of correctly detecting melanoma from other

negative sample images of skin, and a false positivity rate of 4%. The program was not able to differentiate between benign and malignant lesions. However, these results do not diminish the impact that computer vision can have on the field of medicine.

Gabriella Barth

Wildfire Severity and Chronic Respiratory and Cardiovascular Disease Mortality Rates in the Western United States from 2002-2014

The frequency and severity of wildfires has been increasing. This upsurge in fires has been linked with warmer temperatures caused by an increase in greenhouse gasses released into the atmosphere. Studies have shown that long-term exposure to common pollutants from wildfires can increase mortality from cardiovascular disease and exacerbate the effects of respiratory illnesses like asthma and chronic obstructive pulmonary disease. The purpose of this study was to look at the effect of wildfires in the western United States for chronic respiratory and cardiac disease mortality rates the year following the wildfire. This information could give better understanding of health risks associated with wildfires and if certain states are impacted more than others. Wildfire data was collected from the National Interagency Fire Center website for the years 2003-2012.The results were normalized to the square miles per state. Cardiovascular Disease and Chronic Respiratory Disease mortality rates were obtained from the US Health Maps website for the years 2004-2013. Results show COPD and Cardiovascular disease mortality has been decreasing from 2004-2013 in the Western United States and Cardiovascular disease mortality is 5x's more of a threat than COPD in these areas. Therefore, my hypothesis was not supported, as the incidence of Chronic Respiratory and Cardiovascular Disease mortality rates did not increase in areas with increased wildfires. The mortality risks associated with wildfires were not equally distributed throughout wildfire prone areas, COPD mortality rates varied while cardiovascular disease mortality rates were stable. Only Colorado had significant correlations, with a Moderate Negative correlation for both COPD (r=- 0.668) and cardiovascular disease (r= - 0.543), but I am not very confident in these results as this area had the least number of wildfires to start.

Brandon Berkoff, Matthew Campisi, and Christian Dreyer

The Relationship between the Mortality Rate of Respiratory Illnesses and the Annual Composition of Air Pollution in the United States

Air pollution can occur from natural events, like bush fires or it can arise from sources such as industry, motor vehicles, heating appliances, and tobacco smoke. The composition of air pollution varies depending on the season, the weather, or the source of the pollution. There is

surmounting evidence about the adverse health effects from air pollution. By understanding this data, we will be able to identify and safeguard communities at risk. Age-standardized mortality rates of asthma, chronic obstructive pulmonary disease (COPD) and tracheal, bronchus & lung cancers were collected for the years 1994, 2000 and 2014 for five select metropolitan urbanized counties within Florida and California using the World Health Map database. Additionally, Air pollution data of carbon monoxide, sulfur dioxide and nitrogen dioxide were collected for the same years from the Air Quality Statistics Report database. Results showed an overall decline in mortality rates of respiratory illnesses between the years 1994 to 2014 and an overall decline in the mean levels of the air pollutants during that time. This could be attributed to the implementation of laws and regulations of the Clean Air Act. Additionally, California was found to have a higher overall mortality rate which corresponds to the Environmental Quality index data.

Samantha Borre

Climate Zones Impact on Olympic Athletes Performance in 3 Summer and Winter Endurance Events for the past 15 Olympics

Climatic and topographical factors have been shown to influence the type of sport prevalent within a given area. The geographical environment is closely related to sports and sports culture. Nineteen countries have hosted the Summer Olympics Games on five continents, while twelve countries have hosted the Winter Olympic Games on three continents. The environments across these areas vary due to many factors. These factors ranged from conditions of weather, altitude, air pollution, and distinct settings of a course. The aim of this experiment was to see if climate zones influence an Olympic athletes' performance. Winners of similar endurance events from the summer and winter games were compared based on their climate zone relative to their sport. The purpose of the study was to gain insight if climates zones can impact an athlete's medal standing. Data was collected for the gold, silver, and bronze winners for 3 Summer and 3 Winter endurance events for the past 15 Olympics. The 'Climate Zone of the World' website was used to determine the climate of where the Olympic was held and the climate of the participants' home country. Results show that Winter Olympic Medalists typically come from a colder climate while Summer Olympic Medalists typically come from warmer climates. The Chi test for Summer and Winter shows there is a difference between the medal distribution and the types of climate zone (Psummer= 0.01603; Pwinter = 3.391E-41). Countries closer to the equator tend to have more Arid and Tropical climates and countries in these climate zones have won more summer event medals. Temperate climates are more North and Polar climates are extremely North, and countries in these climate zones have won more Winter event medals. Therefore, my hypothesis was supported, as most Olympic medal winners came from a climate zone similar to the climate most suitable for their event. Summer had the most matching Host Climate:Participant Climate (n=33) compared to Winter (n=25).

Samuel Byrd, Anthony DuBois, Michael Florentino, and DonVeon Tulloch

Solving Eutrophication in marine biomes

Polluted runoff caused by the spreading of fertilizers is dangerous to aquatic ecosystems. Eutrophication causes algae to grow excessively, therefore allowing it to absorb the oxygen in its surrounding area. Although there are many existing solutions to this problem such as rain gardens, bioretention systems, and phytoremediation, along with various filters, they all possess flaws, such as cost, space, and efficiency. However, the future ideas towards solving this issue accept more efficient, cost effective processes including a filtration mechanism utilizing microbes to filter out harmful chemicals from stormwater runoff. In order for this to become a reality, multiple breakthroughs would need to be taken into consideration, including bacteria that can work effectively in cold temperatures. The issue of eutrophication not only affects aquatic ecosystems, but our daily lives, as well. The prevention of polluted runoff is crucial to protecting the biosphere of Earth.

Matthew Campis – See Brandon Berkoff

Jasmine Carpio and Meiya Lin

Impact of Dietary Variability on Oropharyngeal Cancer Mortality Rates in the United States

Oral cancer is the eighth most common cancer, with 90% of the cases involving squamous cell carcinoma. Consumer products like animal fats, alcoholic beverages, poultry meat, and bovine meat contain nitrosamines which have shown to have a carcinogenic effect. Furthermore, hidden sugars in food have been known to contribute to obesity which is linked to several different cancers. Previous studies observed a reduction in oral cancer risk with a high fruit intake due to monoterpenes, which inhibit tumor growth. Additionally, vegetables and certain vegetable oils contain isothiocyanates which aid in blocking tumor production. Data was collected from the US Health Map database for Oral Cancer rates and the Our Health Map database for Dietary Consumption for the years 1980-2013. A correlation between food consumption category and the oral cancer rates revealed a moderate to high negative correlation for vegetable Oils (r= -0.923), vegetables (r= -0.705), sugars and sweeteners (r= -0.608), supporting they may contribute to the decrease in oral cancer rates. There was also a moderate to high positive correlation for bovine meat (r= 0.868), animal fats (r= 0.525), and alcoholic beverages (r= 0.494); supporting they may contribute to the increase in oral cancer rates. The correlation for poultry meat (r= -0.969); and sugars & sweeteners didn’t support our original hypothesis. We believe that this is due to many natural sugars and sweeteners being packed with antioxidants.

In addition, the category, poultry meat, had consisted of uncommon meats that are consumed at low rates like fowls, ducks, pigeons, turkeys, geese and quails. Diets that consist of high vegetable, vegetable oil, and natural sugar intake are important because they correlate with a decrease in oral cancer rates in the United States, as opposed to diets that consist of cured and dried meats, alcoholic beverages, and animal fats. Enhancing the understanding of a diet on oral cancer rates can aid in identifying oral cancer risks.

Jillian Cestaro, Ava Davidson, and Hannah Ganson

MRSA Capsule

We studied the Methicillin-resistant Staphylococcus aureus (MRSA) bacteria to gain knowledge of how it attacks immune systems and how treatment is given. We learned that MRSA has a lasting effect on the body and treatment is very harsh. We also researched the precautions taken in order to reduce the amount of MRSA in hospitals and on certain surfaces. We found out that the materials used to clean surfaces are toxic to the environment and the human immune system. Therefore, we proposed the idea of a natural remedy that is emitted to create a bubble surrounding the person using it. We will create the MRSA Capsule to help make treatment easier and be protective from MRSA.

Matthew Chacon, Sahaj Pandey, and Sean Levy

Inserting a non-mutated gene TP-53 into mutated TP-53 using nanorobots

Throughout history, cancer has been a leading cause of death, and scientists have attempted several different means of combating cancer. Some ways scientists have attempted to reduce the harmful effects of cancer includes chemotherapy, radiation therapy, and cancer surgeries. Although, none of these techniques have been able to completely cure cancer. Our idea of using diamond nanorobots to locate colon cancer cells, and to administer genetic information of a non-mutated TP-53 gene into the mutated TP-53 genes located in the colon cancer cells has the capability of being revolutionary in cancer treatment. Instead of traditional gene therapy, our idea uses diamond nanorobots as the vector, which are more durable than commonly used vectors, which are generally genetically modified viruses. Through the use of nanorobots in cancer treatment, will rapid detection of colon cancer cells and delivering of genetic information from non-mutated TP-53 genes into mutated TP-53 genes be possible?

Rishin Chatterjee and Aareb Jatoi

Environmental Factors Effect on the Mortality Rates of Alzheimer's in the United States

Alzheimer's Disease is a progressive disease where there is currently no cure, it starts with dementia and leads to death. Alzheimer's is caused by the buildup of plaques such as beta amyloids in the spaces between neurons in the brain. This accounts for a sufferer's memory loss where confusion sets in along with an inability to perform basic life functions. Currently, we found no studies correlating weather impacts with the prevalence of Alzheimer's Disease, therefore, this study aimed to investigate environmental influence on Alzheimer's Disease in different geographic US cities. Due to data limitations, mortality rates were used to assess the prevalence of Alzheimer's disease. Five cities were chosen ranging in temperature, climate, and population. The LiveStories database was used to collect Alzheimer's mortality rates from 1999-2018. Yearly temperatures and precipitation were obtained from the NOAA National Center for Environmental Information for the same years. Our data showed moderate correlation between temperature and mortality rates in Tucson only (r= 0.6798), Tucson has extremely hot summers and warm winters with low precipitation. But the correlation could be because Tucson had an Alzheimer's mortality surge and the highest rate at the end of our study. There were no other significant correlations between Temperature or Precipitation to Alzheimer's Mortality Rates. Our hypothesis was not supported; higher temperatures and humidity did not generally result in higher Alzheimer's mortality rates. We also found the Koppen Climate Classification did not appear to correlate to Alzheimer's Mortality Rates, although this would need to be further investigation due to the small sample size.

Lindsey Chung and Zeynep Taşoğlu

Identifying Predicted Synergies against *Escherichia coli* Using the Overlap^2 Method

Antibiotic resistance is a proliferating global issue that is endangering the efficacy of antibiotics. In order to counter emergence of resistant strains, synergies of antibiotics have been studied. Synergy occurs when two drugs act together with efficacy beyond the additive effect of each drug on its own. The overlap^2 method was used to find synergies in a chemical genetics' dataset of *Escherichia coli*. This project aimed to find common gene mutants among the known synergies, cefsulodin and mecillinam, and vancomycin and amoxicillin. It was hypothesized that these antibiotics would synergize due to their common mechanism of action. Any gene mutant that had a significant Z score is considered to be significant gene mutants. These are growth scores less than the negative Z score or greater than the positive Z score. Any concentration of vancomycin or amoxicillin inducing a significant growth score for the putative synergy prediction mutants, mutants that showed a significant response to the majority of concentrations of the known synergy pair, was predicted to synergize. Gene mutant ECK0148-MRCB was the

putative synergy predication mutant but was not significant for either amoxicillin or vancomycin. However, significant gene mutants ECK0730-PAL and ECK0729-TOLB, which is part of the same transcription unit, for mecillinam, appeared in the concentrations of amoxicillin 1.5, 1.0 μg/mL, and in vancomycin 10, 20 μg/mL. Amoxicillin 0.25, 0.5 μg/mL did not exhibit a significant response to either. This may mean that the concentrations in which the two gene mutants appeared will be predicted synergistic antibiotics, while the concentrations that did not exhibit them will be predicted non-synergistic antibiotics.

Anna Conforti, Eli Goldberg, Tyler Granelli, and Alex Walsh

Extinguishing Wildfires Efficiently

As wildfires have been becoming an increasing problem in our society over the years, we must attempt to quicken the process of putting out these massive wildfires and by doing that we can reduce the damage done to the environment and our atmosphere. In our opinion the current technology can be improved a lot, so we took the best aspects from the technology today and combined them to make a potentially useful powder in putting out wildfires with more efficiency and less damage to the environment. Making this technology is not only important to us but it should be important to our society because we do not get a second Earth and the damage, we are causing could be irreversible 10 years from now.

Rylie Curran, Lilah Kohler, and Julia Leahy

Early detection and treatment of Postpartum Depression

Postpartum depression (PPD) is a form of mental illness that manifests after giving birth and affects up to 15% of mothers. The treatment options are limited but have been expanding overtime. Postpartum depression is caused by low estrogen levels, and includes symptoms such as anxiety, irritability, loss in strength/appetite, and restlessness. An association was also found between some risk factors of possible hormone-related etiology such as Premenstrual dysphoric disorder. Currently, the way to test your estrogen levels is through blood work. This process is very time consuming, not accessible to all and not immediate. As a result, Postpartum Depression can go undetected/untreated, which can have many negative effects on a mother's physical and mental health. Finding a quicker, non-invasive way to detect estrogen levels within the bloodstream would help many PPD sufferers across the world. Our innovation is a novel device that when placed on the patient's wrist detects and measures the estrogen levels through the absorption of light.

Jack Damato, Nicolas Mendez, and Hannah Oh

The Future of Water Providers: Desalination Stations

The history of Africa is full of turmoil and war. This extreme problem has led to a lack of development in their society, which has also caused an extreme water crisis to spread across the entire continent. Our plans for the future are to create stations capable of combating this issue effectively and efficiently. By creating a desalination machine that utilizes renewable energy and a renewable water supply we would be able to pinpoint large areas of Africa that need more help than others. Creation of our design would lead to far less greenhouse gas emissions and slow down global warming. Our design runs off of tidal energy, which is used to pump water to a station where it is cleaned and distributed to communities. It would likely take about a few months to implement this machine, which is barely any time when thinking about large scale implementation. Soon, many countries in Africa will have enough water to supply them for the future leading to their development and urbanization.

Ava Davidson – See Jillian Cestaro

Justin Davitashvili and Robin Hwang

Various Phylogenetic Analyses for SARS-COV-2 and their Effect on Symptom Variance Based on Geographical Region

The SARS-CoV-2 has caused a public health crisis since December 2019 and has gone through thousands of mutations. After the original strain, named Wuhan/Hu-1/2019, was first identified on December 26, 2019, two more variants of this original strain (Wuhan/WH01/2019 and Wuhan/IME-WH05/2019) were identified only four days later. This demonstrates that there were variants of the virus even early on during the pandemic. The purpose of this project was to analyze different mutations of SARS-CoV-2 by relating the number of mutations in each variant's receptor binding domains (RBD) located on the spike protein with the number of global deaths. Using the Nextstrain database, which documents new variants of viruses, multiple analyses on the SARS-CoV-2 were done based on their clade, mutation, and source of origin. Then, an algorithm (coded in the Java programming language) was used to organize each variant based on clade, date, and number of RBD mutations and was coded in the form of a search engine. After running correlation tests between the percent prevalence of each clade and the number of global deaths, there was no notable relationship in most clades. However, in clade 20H, there was a significant correlation between the percent prevalence of the clade and the global deaths ($R2 = 0.80$). Over time, the virus has exhibited signs of convergent evolution, since older clades start to fade away and new clades start to form. The variants in the most popular

clades as of current time (20H and 20I) almost exclusively have more than five RBD mutations, and variants of both clades (especially 20H) have demonstrated an increase of global deaths as the strains became more prevalent in society.

Elysena Destafano, Tiffany Gracia-Suarez, Crystal Migilaccion, and Maheen Waqar

An answer to a Spina Bifida

Spina Bifida is a birth defect where the spine and the spinal cord don't form and close correctly. It affects your nerves that control different parts of your lower half of the body causing several different issues like kidney failure and death. Our idea is to take a bacteria called Alcaligenes latus hydrocephalus and edit it in CRISPR so we can put it into the brain to suck up all the excess fluid. We will use Alcaligenes latus and put it into the brain so it can absorb the water from hydrocephalus. Hydrocephalus is a condition in which an accumulation of cerebrospinal fluid (CSF) occurs within the brain. It increases pressure in the skull and causes brain damage. We want to put this into the brain so it absorbs the water so hydrocephalus doesn't cut off mobility to the lower half of your body. Scientists around the world are working on new technology and a cure for this terrible birth defect that is affecting many lives daily.

Jessica DeYulio

The Correlation Between Blood Types and The Risk of Acute Myeloid Leukemia When Controlling for Gender

Acute Myeloid Leukemia (AML) is a cancer of the blood and bone marrow in which there is an overproduction of white blood cells, which occurs mainly in adults. AML is more common in males. The risk of getting Acute Lymphoblastic Leukemia or ALL is increased for people in the blood group AB. Since ALL and AML are both types of leukemia, they both should have a correlation between the blood type and risk of AML, however studies found that there is not a relation. However, since gender affects the risk of AML, I predicted that whether or not blood type affects the risk of AML may be different by gender. The purpose was to determine if blood type's correlation with AML is different depending on gender, allowing doctors to properly assess the risk of their patients contracting AML depending on their gender. It is proposed to explore this correlation using large data sets containing blood type and gender. A future implication of this study is to properly assess the risk of patients in order to catch AML as early as possible.

Giancarlo Difava and Max Schweitzer

The Effect of Socioeconomic Status on Alcohol Drinking in the New York State Region

During adolescence is when one's views and behaviors towards tobacco, alcohol use, violence, and sexual activity are shaped. The socioeconomic status of the household where a teenager grows up in can influence these deviant behaviors. Besides the influence of peers, predictors of early age drinking also include a broken family structure and poor family relations. Studies find problem drinking during adolescence has been associated with problem drinking in early adulthood. Binge drinking is a prevalent pattern among young adults, peaking during late adolescence to early 20s, corresponding with the college years. The purpose of this study is to determine if socioeconomic status influences binge or heavy drinking. Finding correlations can help targeting areas with alcohol abuse prevention efforts. The World Health Map database was used to collect the prevalence of Binge drinking and Heavy drinking for 15 counties throughout New York for the years 2009-2012. Poverty rates were obtained from Small Area Income and Poverty Estimates (SAIPE) for those areas. Results show counties with larger poverty rates seemed to have a higher Binge and Heavy Drinking percentage, these include Herkimer, Oswego, St. Lawrence, Otsego, and Essex County. These counties also had the smallest populations. Correlations confirm a moderate to strong positive correlation between Poverty Rates for both Binge and Heavy Drinking.

Sofia Dimauro and Daphne Koutsoukos

Predicting Lyme Disease Through Image Classification

Lyme disease is a tick-borne illness that affects over 300,000 people in the United States yearly. The most common signs of Lyme disease include a red, circular "bulls-eye" rash that occurs three to thirty days after the bite and is frequently followed by muscle and joint aches. The rash appears several days to weeks after the tick bite in around 70 to 80 percent of infected people. Early diagnosis of Lyme disease can aid the afflicted sooner before serious health problems arise. Using Python, a high-level programming language, to create an image processing algorithm may be a catalyst in early detection. The CDC symptoms list was used in conjunction with methods in the Python image library (PIL) to dissect images and patient symptoms for the algorithm to determine whether it is probable that the infected. We have finished the methods where each image is filtered, contrasted and separated into layers based on color. We have also made the method to iterate through an entire training set. Currently we are completing the analysis of the filtered images. We are about to test the code with a training set of over 200 images, including bullseye and placebo rashes, and generating an F-score to determine the reliability of the algorithm.

Christian Dreyer – See Brandon Berkoff

Anthony DuBois – See Samuel Byrd

Jason Duffe, Sarah Franzen, and Asmaa Zahran

The Effect of Covid-19 and Quarantine on the Psychological Health of Children

In the beginning months of 2020, the world was faced with a severe respiratory illness, known as COVID-19. As the disease continued to spread, there had been signs of Posttraumatic Stress Disorder (PTSD) among children due to major changes to their everyday life. This is a psychiatric disorder that can be triggered by past events. Becoming aware of the impact that COVID-19 has on the mental health of children will allow us to protect the future generations. It is important that the public is educated on how the youth are impacted, not only physically, but emotionally and mentally. To collect our data, we have extracted previous data done to a similar topic during the period of the epidemic, Ebola. Since COVID-19 is extremely current, it was difficult to extract data in regard to our study. We decided that by comparing data from Ebola, we will be able to predict data in regard to COVID. We hypothesize that the younger the person is, the harder it will be for them to cope with PTSD associated with COVID-19 because people of this age are in their formative years and any traumatic experiences could result in detrimental effects on their mental health. To perform this experiment, we will be utilizing mental health data from the Ebola outbreak. This is an effective way to perform this experiment because Ebola is a pandemic that had similar results on the mental health of children. This data will be used in a comparative perspective because the data surrounding COVID-19 is extremely current and not fully developed. It has become clear that epidemics and pandemics where a child is experiencing trauma firsthand, result in an increased amount of Post-Traumatic Stress Disorder and Post Psychological Symptoms.

Julian Feldman, Kevin Lee, and David Zhang

Using GAC and Nanofiltration to Filter Fracking Contaminated Tap Water

Fracking is the process of injecting liquid at extremely high pressure into subterranean rocks to open up cracks and let oil and gas flow to be extracted. The fracking fluid used is mostly water, but it can contain hundreds of chemicals, many of which are harmful to the humans and the environment. Fracking companies also do not list the chemicals they use, and different fracking companies use different chemicals. Some of the chemicals used are hydrochloric acid, muriatic acid, methanol, benzene, formaldehyde, and 1-4 dioxane. Some studies show that up to 40% of

the fluid comes back up to the surface where it can spill into rivers, streams, and drinking water sources like aquifers. Homes near fracking sites can have contaminated tap water but by using a combination of nanofilters and GAC filters, many of the chemicals present in harmful amounts can be removed from tap water.

Michael Florentino – See Samuel Byrd

Sarah Franzen – See Jason Duffe

Hannah Ganson – See Jillian Cestaro

Tiffany Gracia-Suarez – See Elysena Destafano

Mitchel Ghermezian, Amantej Rana, and Ishaan Singh

Implementing Machine Learning and Nerve Signals in Prosthetic Finger Control

Past prostheses have either had limited motions due to the nerves being lost during amputation or because they rely on other muscles to move. Other prosthetics, which had more motions, were very slow. We fixed both these problems by implementing machine learning. This program will take the limited inputs of the remaining nerves and see what else was commonly activated for people with full nerves, then simulate that activation. This will allow for fingers to be activated individually, allowing them to do tasks such as eating, driving, and playing sports. The long delay between the nerve activation and the movement will be minimized.

Mikayla Girimonte, Maddie Gottlieb, and Ashley Lewis

Influence of Climate Zones and Average Daily Sunlight on Substance Use and Self-Harm Mortality Rates in the United States

Adolescence and young adulthood are times when a person is more likely to begin abusing drugs like alcohol, tobacco, prescription drugs, and other illicit substances. Early substance use coupled with the use of multiple substances has been shown to be a strong predictor of later substance use problems and disorders. Several studies have shown levels of depression, anger, irritability, and anxiety can be affected by the season, where people who are exposed to more sun appear less stressed. By understanding environmental impacts on substance abuse behaviors, it could

help with coping strategies, intervention, and prevention of substance use. This study aimed to investigate the impact of different climate zones and daily sunlight on substance abuse in terms of alcohol and drug use mortality rates. The Köppen climate classification was used to select 16 counties that represent various climate conditions throughout 15 states in the United States. The Washington Post link was used to collect data on the Average Daily Sunlight. The US Health Map database was utilized to collect age-standardized data on the selected counties for Alcohol Use, Drug Use, and Self-Harm mortality rates for the years 1990-2014, in six-year intervals.

Ava Glick – See Sofia Ahmed

Eli Goldberg – See Anna Conforti

Ethan Gordon – See Arda Alptekin

Jeremy Gordon and Thehan Perera

The Correlation between Adolescent Vaping and Public State Education Spending on Tobacco Prevention and Control in the US

In 2019, the FDA claimed Tobacco use is the single largest preventable cause of disease and death in the United States. American schools are attempting to put an end to the adolescent vape addiction crisis through the use of anti-vaping education programs. This study correlated data on youth tobacco use in 2017 with per pupil spending per state in years 2016. Results showed that as per pupil spending increased across states, rates of e-cigarette use decreased (moderate negative correlation [r = -0.499]) and rates of cigarette use slightly decreased (weak negative correlation [r = -0.284]). The youth cigarette and e-cigarette usage was acquired from the CDC's YRBSS data, and the pupil spending data was extracted from governing.com archive, which retrieved its data from the US Census Bureau. Adolescent vape addictions can be dangerous, so this study will be helpful in finding if health programs are effective, or just lack proper funds to function properly. The ends of the scales in our data revealed that in 2017, Maryland had the lowest amount of youth vaping and smoking in the United States. To contrast, the state of Colorado had the highest, particularly in the city of Denver. Based on the moderate negative correlations we found, the 37 states' spending's per pupil is effective against vaping, but not smoking among the youth. However, since the correlation for the corresponding data was moderate or weak, the conclusion is up to debate and prone for further research.

Maddie Gottlieb – See Mikayla Girimonte

Tyler Granelli – See Anna Conforti

Tyler Grimm – See Arda Alptekin

Sanjit Gunasekaran and Michael Jang

Calculating Dvorak T-Numbers Using an Image-Based Machine Learning Algorithm

The Dvorak Technique is a method used to estimate the intensity of a tropical storm using a satellite image of the storm. The Objective Dvorak Technique (ODT) was developed to improve the accuracy of the Dvorak Technique and remove the subjective aspect of it. However, the ODT is only applicable to some tropical storms and therefore the Dvorak Technique must be used for these storms. The purpose of our project was to improve the accuracy and the scope of the ODT using a Convolutional Neural Network (CNN). The CNN was created through the usage of the keras and tensorflow API in python. This CNN was trained using the GOES satellite image archives, and to test its accuracy, we compared the T-numbers from our code and the ODT. After converting T-Numbers to wind speeds, we analyzed if our output values were closer to the wind speeds from the weather reconnaissance than the wind speeds from the ODT. For our test set and training set we are using over 100 images from the GOES-16 dataset. In order to test accuracy, coordinates (with the independent variable being weather reconnaissance wind speeds and the dependent variables being either CNN wind speeds or ODT wind speeds) were plotted on 2 separate scatter plots, one for each dependent variable. Our CNN outputted a coefficient of restitution (r2) value of 0.8986, while the ODT produced a r2 value of 0.9305. While our CNN was slightly less accurate than the ODT, this study will provide another useful tool for calculating Dvorak T-Numbers.

Avi Gupta and Brennon Thomann

The Impacts of Tornado Frequency and Severity on Wildfires in the Midwest

Wildfires and tornadoes can be linked to many problems in society. Both these events are produced through the presence of similar phenomena. Tornadoes are formed by supercell thunderstorms and similarly, the most severe wildfires, in terms of acres burned, are formed by lightning strikes. As a result of both of these conditions, increased amounts of thunderstorms can lead to increased tornadoes and wildfires. In order to try and discover these possible connections, we ran statistical analysis and worked to relate the number of acres burned by Midwestern Wildfires based on characteristics of that year's tornadoes. Data was collected from the National Interagency Fire Center on the number of acres burned by wildfires each year since 2002 in 12

Midwestern states. Similarly, data on the amount and intensity of tornadoes in the same states during the same period were retrieved from the National Centers for Environmental Information's Storm Events Database. Lastly, comparative studies were carried out between multiple groups: number of acres burned per state per year vs. the number of tornadoes in that state per year and number of acres burned per state per year vs. the average intensity of tornadoes in that state per year. Although previous studies have shown some correlation between tornadoes and the number of acres burned by wildfires, studies demonstrate no correlation between these variables (largest $R^2 = 0.0683$). By looking deeper into the possible connections between tornadoes and wildfires, we were able to provide a better understanding of the relationships between seemingly distant weather phenomena.

Jack Hatcher, James Horz, Samuel Radner, and Joseph Sievers

Demining in Third-World Countries

Landmines have been a worldwide issue for a long time, their explosions can cause major damage, injuring or even killing people. Many people have lost one of their limbs or even their life from stepping on a landmine, this ends up causing a loss in productivity in the country's workforce. Because of this risk, landmine infested land is not being used for productive purposes like farming. Many of the countries that have landmines don't have the money to remove them. This is why there is a need to remove landmines, both because of the risk and the land. There are many ways to find and remove landmines so far. One of the most accepted ways of detecting landmines is using a metal detector. But there can also be many other methods of finding them too, such as organic detectors, or the Mine Kafon. Then an explosive charge destroys the landmine. Yet the methods still are dangerous and laborious. This is what we plan to fix with our future technology of a landmine removing two-drone system. We chose to use one drone with a hyperspectral camera to find landmines, and a drone with a mounted projectile launcher to remove them. This would lead to improved lives and stronger economy for the country that now will be able to utilize this once unused land.

Kathleen Hochberg – See Naomi Amran

Steven Homenides and Yashica Kumar

The Impact of the Japanese Celebration of Midsummer Day of the Ox on the Nitrate Levels at the Conowingo Dam in Northern Maryland

The Midsummer Day of the Ox is a Japanese celebration that occurs four times a year and is celebrated through the consumption of American Eels (Anguilla rostrata): which live and are exported from the Northeastern rivers and lakes of the continental United States. The sudden surge in the harvesting and exportation of these eels negatively impacts the nitrate levels in the aquatic-ecosystems surrounding the Conowingo Dam, in northern Maryland, as they act as the primary reproductive host for its ecosystem's primary nitrate filter, the Eastern *Elliptio* mussel (*Elliptio complanata).* It was hypothesized that due to the recent increase of American Eel exports, and the decline of the Eastern *Elliptio's* primary reproductive host (the American Eel), the population of the mussels would decrease, thus impacting the nitrate levels at the Conowingo Dam. Data for U.S. exports of American eels to Japan obtained from the ACCSP Data Warehouse was correlated to the American eel quantitative population data between the years of 2005-2016 from the "American Eel: Collection and Relocation Conowingo Dam, Susquehanna River, Maryland." Data for the total nitrate were obtained from the United States Geological Survey Lab between the years 2005-2016. It was concluded based upon the results of the correlation test, that there is a relatively strong correlation between the American eel exports and the nitrate levels in the Conowingo Dam as the r-squared value was calculated to be approximately 0.90 Additionally, there was a weak correlation between the American eel population to both the U.S. exports of American eels and the nitrate levels, as the r-squared value was roughly -0.3. This establishes the idea that the American eel exports have a direct effect on the nitrate levels in the water in which they live, resulting in the conclusion that the celebration has a substantial effect on the nitrate levels at the Conowingo Dam.

James Horz – See Jack Hatcher

Ashley Hsu

Improved Visualization of Heatmaps with Controlled Downsampling

Due to aliasing in computer graphics, heatmaps of large single-cell RNA-sequencing (scRNAseq) datasets are inaccurate representations since computer screens sample signals at a rate incommensurate to the large volume of scRNAseq data. It was hypothesized that there was sufficient redundancy among samples, due to clustering by cell type, to display a simplified heatmap with minimal information loss. Hence, an algorithm was coded to display heatmaps at

appropriate resolutions with respect to the computer screen to prevent the aliasing effect. The scRNAseq data (n=20,128) were collected from three publicly available data sets. In total, the combined data sets contained 14, 435 cells and 126 genes. The algorithm was coded in RStudio ver. 1.3.1093 using the GMD (ver 0.3.3) package for the heatmap.3 function. Hierarchical clustering and k-means clustering was performed with the goal of placing similar samples in adjacent rows. The samples in each cluster were then averaged to display a simplified heatmap with 500 columns. In conclusion, the condensed heatmap captures the details of the large original data set but at a lower resolution.

Robin Hwang – See Justin Davitashvili

Michael Jang – See Sanjit Gunasekaran

Aareb Jatoi – See Rishin Chatterjee

Sydney Kalmaer

Obesity Risk on Prevalence of Fast-Food Restaurants

When a person's body mass index (BMI) is over 30, they are considered obese. Obesity is a disorder involving excessive amounts of body fat. Many children today are either overweight or obese, due to factors including their genetics, medications, physiological well-being, physical inactivity, diseases, and the environment. Obese children and children who were obese at older ages are twice as likely to be obese as an adult. Fast-food restaurants help to spur obesity due to their accessibility and affordability. Often people will choose a quick meal over having to cook for themselves, even though fast foods are high in calories and low in nutrients. Understanding the relationship between obesity and proximity to fast food establishments between various regions could provide insight on factors associated with obesity risk. The number of fast-food restaurants across the US for 2019 was obtained from a Data World Dataset. Adult Obesity rates were obtained from the County Health Rankings website for the same year. Five states were selected based on high overall obesity rates, and 10 counties within each state were selected. The purpose of this study was to look at adult obesity in different counties relative to the number of fast-food restaurants within that area. My hypothesis was not supported as West Virginia had the highest number of Fast-Food restaurants per population per area and even though the graph showed it had the highest obesity risk compared to other counties there was no correlation found to obesity risk ($r = -0.0723$). West Virginia was also a closer proximity to healthier food. Meanwhile, Mississippi which had a lower number of Fast-Food restaurants per population per

area and an average obesity risk on the graph compared to other counties but there was a strong positive correlation to obesity risk (r= 0.7118). Mississippi also had the lowest proximity to healthier food. I am not very confident in my results and further investigation is needed.

Daniel Kamensky – See Leo Abbe

Alisha Khan and Lia Maglione

The Effect of Altitude on Asthma Prevalence in Various Countries

Asthma affects 5-10% of the population or an estimated 23.4 million people, including seven million children. In 2021, CDC estimated that 6.2 million underaged Americans have asthma-resulting in 10 American deaths daily. Asthma is defined as a medical condition where a person's airways become inflamed, narrow, and will produce extra mucus, causing difficulty in breathing. As altitude increases, the amount of oxygen in the air will decrease. Asthma and other health conditions such as accelerated heartbeat and increased breathing rates may occur when the oxygen level of one's breathing air falls below 19.5%, which is considered oxygen-deficient. The purpose of this study was to analyze and determine if there was a correlation between altitudes and prevalence of asthma rates. Using the "Our World in Data" database, we recorded age-adjusted asthma prevalence for 20 countries dispersed globally of varying altitudes for the years 1990-2015. Subsequently, we found the average altitude (above sea level) for each designated country. We correlated the altitude to asthma prevalence level and found as altitude increases, the asthma prevalence decreases, as shown by a moderate negative correlation (r = -0.51). However, many confounding variables could have impacted the results, such as weather, topographical features, or pollen which requires further investigation.

Grace Kim and Angela Won

The Effects of Ocean Acidification on the King Crab Population in the Bering Sea

Ocean acidification is a global problem that is caused by the burning of fossil fuels. When fossil fuels are burned, carbon dioxide is released, which ultimately creates carbonic acid. Over the past years, CO2 levels in the atmosphere have increased making oceans 30% more acidic. The Bering Sea is becoming the most acidic ocean to exist. The Red King crab and Blue King crab populations occupy this area. The purpose of this experiment was to identify the trends between the Red King and Blue King crab populations and the pH levels, to observe whether species are adjusting to acidic conditions. Carbon Dioxide levels in air and sea water were obtained from the Alaska Ocean Acidification Network from Moorings for the years 2013 to 2019 in the Bering Sea. Red (*Paralithodes camtschaticus*) and Blue (*Paralithodes platypus*) King crab populations for adults and juveniles based on gender were obtained from the Alaska Fisheries Science Center

- RACE Division - Shellfish Assessment Program for the same years. Our data concluded that as the atmospheric CO2 levels increased, the Red King crabs thrived more than the Blue King crabs. The Red King's mature females were overall greater than the Blue King's mature females in population. Meanwhile, the Red King's immature males were greater than the Blue King's immature males in population. Therefore, it appears the Red King Crabs adjusted better to their environment and were able to reproduce more. This data supports that the Red King crab survives in lowering pH levels better than the Blue King crab, which can determine how organisms may respond to climate change. In addition, the Red King crab and the Blue King crab populations can be researched even further, such as the genetic composition to see if there are any significant differences, reasoning how the Red King crabs are adapting better to the environment.

Abigail Kleiman and Eliza Malik

Increasing Accessibility of Vaccines Under Developing Nations

The Tetanus disease caused by *Clostridium tetani* bacteria is a deadly and dangerous disease. In third world nations, there is a lack of electricity and refrigeration making it extremely difficult to transport vaccines from factories to doctors' offices. There is already an existing vaccine for the Tetanus disease, but it requires needle technology and the use of cold chain methods. This new vaccine technology would be a transdermal patch that uses microneedles to let vaccine formula soak through the skin. By adding sucrose, polymers, and nanoparticles, the storage temperature of this Tetanus vaccine would be decreased to a number where cold chain methods are not needed. The goal of this new vaccination method is to eliminate the use of cold chain methods and needles to make vaccines more accessible for all.

Devin Kirschner

Influence of plastic pollution on Coral Disease Outbreak Risk in the Hawaiian Archipelago

In the growing years pollution has increased tenfold as well death and destruction to many ecosystems and the life living there. Litter and pollution, more specifically plastic pollution has been growing in tremendous amounts since most plastics do not decompose. Plastic pollution affects both terrestrial and marine ecosystems greatly and causes immense damages. In turn, there is a growing concern in the status of the coral reefs. Currently, coral reefs are becoming ill or on occasions dying because of the pollution. The purpose of this investigation was to determine the impact plastic pollution has on coral reef disease outbreak risk in the Hawaiian Archipelago. The LITTERBASE database was used to track plastic pollution in Pacific Ocean near the Hawaiian Islands from 2007-2015. Satellite determined heat stress maps for Coral

Disease Outbreak Risk were obtained from the NOAA website, and using a 66-box grid were converted to a relative area for each heat stress level (% low, % moderate, % high). This relative area was then correlated to the plastic pollution levels. The average ocean temperature around the Hawaiian Islands was very consistent over the years so it could be ruled out as a confounding variable. Results show that plastic pollution appears to affect Coral Disease Outbreak Risk (r= 0.05043 for correlation with moderate % stress and r= 0.5538 for correlation with high % stress), however, due to gaps in data and limited years of data, I am not very confident in these results. Further investigation is required.

Jin Ko and James Yu

Expression, Acetylation, and Activation Project

Lactose intolerance is a condition originating from a region near Turkey around 2,000 to 20,000 years ago affecting many people from African, Asian and Eurasian descent. The condition's prominence rose as a result of poor farmer's diets containing only milk allowing for mutations to harbor and develop. As we know in the present day, lactose intolerance has been a recurring tribulation within several generations among family trees inducing symptoms such as stomach pains, diarrhea, and nausea. With the presence of such manifestations, humanity has given birth to numerous adversaries including lactose infused drugs and probiotics. This article proposes the uses of histone modifications infused within sonoporation waves to tackle the condition from its origin. The processes acetylation and methylation are responsible for expressing and repressing genes; the root cause for lactase deficiency pertaining to the deactivation of the LCT gene.

Lilah Kohler – See Rylie Curran

Daphne Koutsoukos – See Sofia Dimauro

Christian Kraus – See Victor Angielczyk

Yashica Kumar – See Steven Homenides

Gabriela Kuriakose – See Juliette Amram

Alvin Lai, Edward Liao, Ethan Marijosius, and Constantine Varlamos

FIBERLESS: Dissolvent that Catches Microfibers in the Washing Machine

Microplastics are commonly found in marine and aquatic environments and result in hazardous marine pollution. The most common type of microplastics are microfibers, and they source from washing machines believe it or not. We analyzed the present-day products that were created for microfiber pollution and noticed that they don't have a way to easily dispose of the waste. So, propylene carbonate is a solvent that we will put inside washing machine filters to break down loose microfibers caught after washes. This slightly acidic solvent will be a powder for convenience to the general public, paired with a filter specifically made for the kind of process we have created. With an easy method of cleaning, the filter along with the solvent will act efficiently and effectively towards the capture and disposal of microfibers. In the future, ways such as FIBERLESS can be used to dissolve microfibers in washing machine filters.

Julia Leahy – See Rylie Curran

Kevin Lee – See Julian Feldman

Sarah Levine

Cellular Asphyxiation and Neurotrophic Protein Hyperexpression in Glioblastoma Multiforme Pseudopalisade/ Necrosis Regions

Glioblastoma multiforme is the highest grade of astrocytoma characterized by a combination of hypoxia and intense vascular proliferation of oncogenic tissue with the assistance of astrocytes. This combination commonly induces both localized necrosis of neural cells and fortification of glioma cells around the said necrosis, forming structures called pseudopalisades. There are a wide variety of proteins that serve to aid in the growth, development, and survival of these cells called neurotrophic factors. These proteins have a strong correlation already with oncogenic development and proliferation, but whether they are involved in the barring of oxygen in hypercellular perinecrotic zones is unclear. For this experiment, the neurotrophic proteins DANCR, CD34, BIRC5, POSTN, PROM1, FOXO3, and ABL1 were analyzed for any hyperexpression in regions identified as "pseudopalisades around necrosis" or "perinecrotic zones" in the H&E altered images provided by the Ivy Glioblastoma Atlas Project. Expression filters were used to create a heatmap of probable gene expression. The area of pseudopalisade/perinectric zone was calculated, and the ratio of the area of expression over the total area was determined through a simple Python feedback loop. Chi-squared test was used to

determine the proteins exhibited a statistically higher rate of expression, suggesting its potential as a target for therapeutic drugs.

Sean Levy – See Matthew Chacon

Ashley Lewis – See Mikayla Girimonte

Karen Li and Abigail Pappachen

The Correlation Between Atmospheric Polycyclic Aromatic Hydrocarbon Concentrations and the Prevalence of Obesity in US States

Polycyclic aromatic hydrocarbons (PAHs) are organic compounds that can spread through the atmosphere. The prevalence of PAHs has caused concern due to its many health risks. When inhaled, PAHs have a tendency to distribute in areas of localized fat. Studies have shown that PAHs inhibit lipolysis, which can lead to obesity. The purpose of the experiment was to further the understanding of the relationship between PAH exposure and adult obesity prevalence. The experiment was conducted by compiling PAH concentration data from all 50 states, which was then narrowed down by population. This data was compared to the adult obesity prevalence data of the same locations. The results show very little correlation, if any, between PAH concentrations and regional obesity ($R2 = 0.06$). This helped us reach the conclusion that although links between exposure to PAHs and obesity have previously been drawn, there is no causal relationship between the two on a larger scale.

Edward Liao – See Alvin Lai

Meiya Lin – See Jasmine Carpio

Kevin Ma – See Leo Abbe

Lia Maglione – See Alisha Khan

Eliza Malik – See Abigail Kleiman

Alvin Lai – See Ethan Marijosius

Nicolas Mendez – See Jack Damato

Crystal Migilaccion – See Elysena Destafano

Soyoun Moon

An Analysis of Non-Communicable Diseases (NCDs) and Mental Health of Aboriginals and Torres Strait Islanders in a Changing Climate

Indigenous Peoples are ethnic groups that live with an interconnection to the natural environment. Partly because of this environmental sensitivity, Indigenous Peoples are more adversely affected by health disparities than their non-Indigenous counterparts. Environmental factors, such as air pollution and contaminated water sources, are one of the main causes of non-communicable diseases (NCDs). NCDs include cancers, chronic obstructive pulmonary disease, kidney disease, rheumatic heart disease, and cardiovascular disease. The purpose of this analysis was to examine the consequences of climate change on First Peoples by analyzing the relationships between environmental changes and their resulting physical and mental health. The data used was obtained from the Australian Institute of Health and Welfare (AIHW), Australian Indigenous Health Bulletin, and the Australian Government Bureau of Meteorology. First, the data was compiled for environmental changes, NCDs, and mental health indicators of Indigenous communities, which was then tested to see if there was any correlation. The data collected showed that there was an increase in temperature, extreme fire weather, and rainfall during the wet season and a decrease in rainfall during the dry season. The results showed that there is a strong positive relationship between environmental changes and physical, as well as mental health. The correlation coefficient for both relationships were close to 1.

Eshani Mukherjee and Samantha Singh

The effect of Parkinson Disease on Circadian Rhythm

Parkinson's Disease (PD) is a brain disorder that leads to shaking, stiffness, and difficulty with walking, balance, and coordination. People that have PD lose the nerve endings that produce norepinephrine. Norepinephrine is the main chemical messenger of the sympathetic nervous system. Fatigue is a common symptom of PD. It can affect the patient's circadian rhythm. The purpose of this study was to reinforce the importance of sleep as sleep is being put off by many people intentionally. Insufficient sleep leads to a general slowing of response speed and

increased variability in performance, particularly for simple measures of alertness, attention, and vigilance. The studies that were used in this project are Mr. OS Sleep and Sleep Heart Health Study. Tables with PD patients (diagnosed and being treated and not being treated) and non-PD patients were compiled and then the means of the AHI numbers from both were compared. It was hypothesized that patients with PD, to a higher extent, will have a worse sleeping pattern compared to people without PD because PD patients may experience sleep deprivation as a symptom, this could lessen the amount of REM sleep they receive. PD patients had a mean of 15.194, a standard deviation of 7.452, with a standard error of 1.242. Non-PD patients had a mean of 10.139, a standard deviation of 4.291, with a standard error of 0.715. A paired t-test was used to test the effects of PD on circadian rhythm at a 0.05 level of significance. Overall, the alternative was accepted while the null was rejected. There was a significant difference between the PD patients and the non-PD patients. We concluded that Parkinson's Disease noticeably affects circadian rhythm.

Melina Nicou and Lakxshanna Raveendran

Deep Convolutional Neural Networks for Lesion Identification and Grading of Diabetic Retinopathy

Diabetic Retinopathy (DR), a complication associated with diabetes, is a common cause of acquired blindness amongst the population, and its prevalence is expected to increase in the following years. Detecting the severity of DR is a time consuming and often complex process. For this reason, the use of convolutional neural networks (CNN) for improved DR grading has been explored. The objective of our project was to develop a CNN that could be used for DR grading. A two-stage CNN was developed using Tensorflow and Keras. The CNN was trained using 15, 275 fundus images from an open source Kaggle database of containing 35,126 high resolution RGB images with any of the following DR grades; No DR, Mild non-proliferative DR, Moderate non-proliferative DR, Severe non-proliferative DR, or Proliferative DR. Images from the dataset were divided into 2 sets, one for training the CNN and the other for testing/validation, in a ratio of 3: 1. In the first stage, lesions were accentuated by the use of a gaussian blur, a brightness filter, and edge enhancement. In the second stage, a base CNN architecture, Resnet, was used with the addition of dense layers to assign a DR grade based on severity. The CNN is able to differentiate between fundus images with and without DR with 71% accuracy after 7 epochs of training. This model can be compared to current models which have received a 75% accuracy, as its use is more feasible in comparison to these models. This system can be distributed at a lower cost because of the use of open-source software, allowing for easier detection. The accuracy rate suggests feasible clinical usage, allowing for less medical persona to spend time making diagnoses.

Hannah Oh – See Jack Damato

Sahaj Pandey – See Matthew Chacon

Abigail Pappachen – See Karen Li

Faith Papazoglou and Grace Papazoglou

Correlation between Cholesterol and Alzheimer's Disease

Alzheimer's Disease (AD) affects millions of people worldwide. The effects of this disease are detrimental, making it imperative to find a better treatment option that can lower the risk of the development of AD. The purpose of this investigation was to determine if there is a direct correlation between cholesterol level and the development of AD. Using data previously collected within both the OGNACC and NACC databases, the presence of hypercholesterolemia between healthy patients (Non-AD) and AD patients was compared. It was hypothesized that cholesterol levels are linked to AD, as people with higher cholesterol levels would be more likely to develop this disease. Therefore, if cholesterol is decreased through the use of a drug or diet, it could be an effective prevention method for patients with hypercholesterolemia in order to prevent the development of AD in the future. From the databases, 44 patients were randomly selected, 22 AD patients and 22 non-AD patients, all with a reference to whether they have or don't have hypercholesterolemia, high cholesterol levels. After calculating the percentage of patients with hypercholesterolemia between the different groups being studied, it was found that there was a difference. In the AD group 40.91% of the patients had hypercholesterolemia while only 31.81% of patients had hypercholesterolemia in the non-AD group. Even though the percentage gap is not large, these results still demonstrate that AD patients are more likely to have high cholesterol levels compared to healthy patients. These observations can further be used to help prevent people with high cholesterol levels and hypercholesterolemia from developing AD.

Saharsh Peddireddy, Anant Srinivasan, and Peter Tine Jr.

Coccolithophorid Algae and Biosand Filtration in Autotrophic Sulfur Denitrification

During the early to mid-1990s sulfur denitrification was a topic of interest in the scientific community that was heavily experimented with. Succeeding this period, this technology was not actively studied but was adopted by aquariums around the world which found the denitrator to be helpful with managing ammonia from fish waste. Sulfur denitrators are relatively inexpensive

but their small and limited capacity made them an unlikely candidate for filtering drinking water. Thus, the technology was not further pursued. The purpose of our project is to create a device that modifies the sulfur denitrification technology to clean and purify water for human consumption in less developed countries.

Thehan Perera – See Jeremy Gordon

Harry Poulose

Using text-mining to establish correlations between bacterial diseases

The spread antibiotic resistance to multiple strains of bacteria has caused the resurgence of once-curable diseases in our societies. According to the CDC, antibiotic resistance causes around 2.8 million infections and around 35,000 deaths per year in the U.S alone. Novel resistance mechanisms have impeded our ability to treat common bacterial diseases such as pneumonia, tuberculosis, blood poisoning, and gonorrhea. To combat this, physicians have begun to retarget current antibiotics towards diseases that have similar epidemiologic factors with the help of disease correlation databases. These databases use publicly available data from hospitals and patients to establish meaningful correlations. However, these databases are not exhaustive and are often not up to date with medical research. Text mining, a branch of artificial intelligence that analyzes large sets of text, has recently been used in the medical industry for collecting and interpreting large sets of data. The purpose of this project was to evaluate the effectiveness of text-mining in establishing novel correlations between bacterial diseases that have shown resistance to antibiotics. Abstracts pertaining to each of the diseases were mined from PubMed to be analyzed for similarities in resistance mechanisms. Python code was written to parse through each abstract to check for the occurrence of common resistance genes; the occurrences of each gene in each disease was then analyzed using the chi-squared test of association. Five novel correlations between diseases were found with a p-values less than 1.9920×10^{-8}. The results may support the use of text-mining techniques in other areas of data analysis and interpretation.

Samuel Radner – See Jack Hatcher

Amantej Rana – See Mitchel Ghermezian

Lakxshanna Raveendran – See Melina Nicou

Alexandria Schuval – See Juliette Amram

Lily Schwan – See Juliette Amram

Max Schweitzer – See Giancarlo DiFava

Ishaan Singh – See Mitchel Ghermezian

Joseph Sievers – See Jack Hatcher

Samantha Singh – See Eshani Mukherjee

Shreya Sriram, Kevin Won, and David Yang

Use of Convolution Neural Networks to determine structural similarities between proteins of Neurological diseases.

Use of Convolution Neural Networks to Determine Structural Similarities between Proteins of Neurological Diseases. Many common degenerative diseases are neurological in origin. The purpose of this investigation was to determine if there were any similarities in the structures of proteins created from Alzheimer's disease and Parkinson's disease, since increased understanding of the structural characteristics of proteins in the neurological diseases would likely supplement the efforts of the progression of neurological disease treatment. Due to the complicated nature of these diseases, the proteins were analyzed using convolutional neural networks (CNNs), a type of deep learning, which were used to correlate protein structure properties in order to allow an extensive and comprehensive analysis. It was hypothesized that if machine learning is utilized in the form of CNNs to analyze the structural similarities between neurological disease proteins, these similarities could be used to apply to new proteins or to aid in our understanding of their structure. To perform this experiment, protein database (PDB) files were converted into comma separated values(csv) files through python code, each one of which would represent the xy, yz, or xz axis. Filters were placed over each of the planes to allow the CNN to distinguish between variables such as pH, aromaticity, and charge: 16 in total. All 48 images, (16 for each of the 3 planes) were combined into one larger image easily read by CNNs. The CNN had an accuracy of 94.37% at categorizing proteins to their respective diseases using their 3-dimensional structure. As a result of such a high accuracy, the algorithm could eventually

aid in differentiating structural similarities between proteins of neurological disease origin that could supplement current disease prevention efforts.

Ayan Sheikh – See Arda Alptekin

Inaya Syed

Utilizing Graphite for Damage Prevention in Automotives

When it comes to damage in automotives, the damage can be costly towards people of lower class. Copper and other materials are expensive to repair. Graphite, however, is a well-recognized material, yet the uses for such a material is quite limited. Past studies have shown HEAs, or High Entropy Alloys, are most recommended for automotive construction. HEAs are easy to manipulate into phase structures. However, it is believed that graphite would be a possible substitute for alloys, such as copper and aluminum. What was proposed through this experiment is to use graphite for automotive construction to prevent such costly damage. Copper is also found as a material most common in cars and is the opposite of graphite. While graphite is flexible through observation, copper is the complete opposite. Copper may be malleable, however, it is difficult to cooperate with due to the risks, such as possible metal poisoning. Graphite is the better solution since it is not too difficult to work with, as well, will not cause poisoning. Testing this hypothesis, constructing a track, and a 3" x 3" graphite and copper car, utilizing CO_2 cartridges for a substitute of fuel. Continuing to create several crash tests, what was tested was both cars' capability and susceptibility to damages, using the number of dents that each car had after every trial, also, using the correlation of the cost of the materials to the damage produced. This resulted in copper being a better material than graphite by a significant difference, making this experiment invalidated.

Zeynep Taşoğlu – See Lindsey Chung

DonVeon Tulloch – See Samuel Byrd

Brennon Thomann – See Avi Gupta

Constantine Varlamos – See Alvin Lai

Alexa Vrionedes – See Naomi Amran

Alex Walsh – See Anna Conforti

Maheen Waqar – See Elysena Destafano

Maryum Waqar

A proposed study on the effects of initial immune cell count on the likelihood of contracting Cytokine Release Syndrome in patients undergoing CAR-T cell therapy

Cancer affects more than 18.1 million people yearly, with 9.5 million associated deaths. CAR-T cell therapy, a type of treatment associated with these CAR-T cells involves taking a patient's T-cells from their blood and attaching the gene that binds to certain proteins on the patient's cancer cells. An important side effect to this treatment is cytokine release syndrome (CRS). CRS is immune activation in which there are elevated inflammatory cytokines. Commonly considered factors include age, previous treatments, gender, etc., however CRS remains as a prevalent disease post the CAR T-cell treatment. This proposed research study focuses on seeing if there is a correlation between initial immune cell count and the probability of contracting CRS post treatment. Once the appropriate experimentation is conducted and the data becomes available a correlation test along with other statistical analysis will be done to conclude if there is a correlation. Considering the effectiveness of the therapy itself, it would be ideal to analyze factors that cause a toxicity such as CRS to occur. Research on this will be beneficial to society in coming up with cures/preventions of these side effects hence making the therapy the ideal solution for all cancer patients eligible.

Angela Won – See Grace Kim

Kevin Won – See Shreya Sriram

David Yang – See Shreya Sriram

James Yu – See Jin Ko

Asmaa Zahran – See Jason Duffe

David Zhang – See Julian Feldman

Marnie Ziporkin

Using Typhoons and Tropical Cyclones as an indicator of Coral Bleaching through Heat Stress Monitoring within the Coral Triangle from 2012-2020

Asia's Southeastern countries make up the Coral Triangle, the most biodiverse marine region with almost 600 species of reef-building coral beneath the water's surface. As climate change progresses, intense weather events are expected to increase, putting the coral reefs at risk. Warming waters create a higher potential for tropical storms (hurricanes, typhoons, and tropical cyclones) to develop. These weather patterns can negatively impact coral reefs causing bleaching or disease. The purpose of this study was to determine if bleaching alert events identified through heat stress monitoring correlates to weather disturbances within the Coral Reef Triangle Region. Weather disturbances consisting of cyclones and typhoons were chosen based on their proximity to the Coral Triangle. Data was collected from the AccuWeather website for the years 2012-2020 to encompass the 2014-2017 global coral bleaching event. The heat stress events were represented by bleach alert monitoring satellite data collected from the NOAA Reef Watch Website. The relationship between the level of bleaching damage and the time of year were analyzed. My hypothesis, where a greater number of weather events correlates to higher bleaching alerts, was not supported as the number of weather events was consistent for all the years analyzed. There did appear to be a correlation with Tropical Cyclones occurring in the 4^{th} quarter and Bleaching Alert Levels 1 and 2 ($r = 0.7656$ and $r = 0.9162$ respectively) and with the Tropical Cyclones in combined 4^{th} and 1^{st} quarter (in-season) and Bleaching Alert Level 2 ($r = 0.8288$). No other correlations were significant for Tropical Cyclones or any Typhoons weather events. There was evidence of the impact that the 2014 -2017 bleaching event impacted the coral reefs by a shift in the bleaching alert events during that time period.

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