
IMSALOQUIUM
2021
IMSA
Illinois Mathematics and Science Academy

April 21, 2021

Dear IMSA Students, Faculty, Staff and Friends,

Welcome to IMSAloquium 2021. This is IMSA's 34th year of leading in educational innovation, and the 33rd year of the IMSA Student Inquiry and Research (SIR) Program.

This year is the first year that all student projects were conducted remotely for the entire academic year. For the second straight year, IMSAloquium will be remote. Projects will be presented concurrently in virtual "rooms" over the course of three morning sessions. After an absence from IMSAloquium last year, we are pleased that students from the IMSA Internship program will again be participating in IMSAloquium. One year ago when we wrote the welcome letter for the first remote IMSAloquium, we commented that as awful as COVID-19 is, it serves as a reminder of the importance of research. At that time, we had no way of knowing that science would bring us highly effective vaccines in such a short time.

Within this booklet, you will find a collection of abstracts from outstanding student projects. The topics range from biomedical research, chemistry and physics to mathematics to the social sciences, as well as business and entrepreneurial projects form our Internship students. Our students have worked hard on their projects, some individually, some in groups, and today is the day for them to display their hard work.

Many of our students have worked with mentors at leading universities, research laboratories, and businesses. Other students have worked with IMSA faculty on campus. In addition, this is the second year that students participated in on-campus SIR courses, and their work is represented at IMSAloquium. The SIR team would very much like to thank both our off-campus and on-campus mentors for their outstanding work with our students. The IMSA SIR program and the IMSA Internship program could not exist were it not for all of our mentors working with and advising our students.

In addition to thanking our SIR mentors, we wish to thank all the IMSA faculty and staff who helped support the SIR and Internship programs throughout the year, and their assistance with coordinating and hosting this year's IMSAloquium.

We hope you enjoy your morning and find it to be a rewarding and educational experience!

Sincerely,

IMSA SIR Program Team
Sowmya Anjur, Ph.D.
Cathleen Cunz
Dave DeVol, Ph.D.

IMSA Principal's Office
Comfort Akwaji-Anderson, Ph.D., Principal
Jeanette Bartley, Ph.D., Dean of Academics and Equity
Paul Gaszak, Dean of Student Support and Equity

IMSA Internship Manager
Sue Fricano

IMSA President
José M. Torres, Ph.D.

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***NOTE:**
All presentations scheduled within these sessions will have a Zoom meeting ID. These Zoom meetings will have one staff member and one student from the presentation group assigned as a co-host.

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Session I - 8:50a.m. – 9:05a.m.

Project ID: BHVSO 04
8:50a.m. - 9:05a.m.

Title: How Diversity Affects Stability: A Look at relations Between People and Its impact on The stability of Nations
Presenter(s): Matthew Dinwiddie
Mentor(s): Patrick Kearney, Illinois Mathematics and Science Academy
Abstract/Project Intention:
A multitude of literature states that conflicts and disagreements over the utilization of resources primarily occur in areas where various cultures and ethnicities collide. To see whether or not a country's diversity directly affects its stability, three things needed to be found: The country's ethnic diversity, the country's cultural diversity (which includes linguistic diversity), and the country's stability. Three data sets in particular proved most useful. The first being the Fragile States Index takes many different things into account then rates the countries based on their respective instability. The second: the Ethnic Fractionalization Index gives the probability that two people randomly meeting will have the same ethnicity. The Cultural Fractionalization Index being data set number 3, provides the probability that two randomly meeting people will have the same culture (language included). The project's main goal was to construct a model on how stability in countries is affected by the relative diversity of that country.

Project ID: BHVSO 07
8:50a.m. - 9:05a.m.

Title: The Effects of Sex Education and Abortion Access on Teen Birth and Pregnancy Rates
Presenter(s): Natalie Hulseberg
Mentor(s): Patrick Kearney, Illinois Math and Science Academy
Abstract/Project Intention:
Teen pregnancy and birth is a widespread issue that deeply affects young girls during the most vital stages of development. It can lead to dropping out of high school – a major drawback in the United States today – and impoverishment. Fortunately, there are measures that can be taken to equip students with knowledge to avoid situations of teen pregnancy and birth. Education is the first step. It is impossible to ensure that teenagers will not have sex, so providing them with the tools to make healthy and informed choices for themselves is the best answer. The next step is abortion access. The end-all-be-all is not always teen birth. Especially with minors, providing for and raising a child is usually not an option. Abortions offer another choice for those who cannot carry a pregnancy to full term.

In my project, I focused on two of the major factors: abortion access and sex education. My data included race, religion, median household income, comprehensiveness of sex education, the percentage of counties by state without an abortion clinic, parental consent to teen abortion, teen birth/pregnancy rates, and more.

Project ID: BHVSO 19
8:50a.m. - 9:05a.m.

Title: Use of Data Analytics to Spot Educational Discrimination –
Part I - A Focus on Standardized Testing and Selective Enrollment Schools

Presenter(s): Paola Padilla
Mentor(s): Angel Alvarez, Northwestern University, Feinberg School of Medicine

Abstract/Project intention:

We utilized data analytics to investigate potential inequitable practices and policies within the Chicago Public Schools (CPS) system that may negatively affect underrepresented and disadvantaged students. We analyzed large datasets to determine if CPS policies and practices contribute to low standardized testing performance across different schools in the district. We focused on factors that contribute to school rankings, standardized testing, and admissions within selective enrollment schools. We compiled, organized, and analyzed school performance and census tract datasets acquired through Freedom of Information Act (FOIA) requests. We compared individual schools' standardized testing growth rates to other district schools' rates and national average growth rates. Low student performance is more common among students from low socioeconomic backgrounds, students of color, and students with disabilities. We also investigated equity concerns regarding CPS's tier system used to determine admissions to selective enrollment schools and have found flaws in the method used to calculate tiers, suggesting that a better model can be constructed. Our results highlight several areas of concern involving standardized testing results across multiple schools in the district. Ultimately, we have identified large numbers of schools with data anomalies that raise concerns and call attention to the need for reform in CPS.

Project ID: BIO 04
8:50a.m. - 9:05a.m.

Title: Finding Compounds that Inhibit the Dengue DENV-3-NS5 Protein Using Molecular Docking
Presenters: Brenna Christoffel, Quadri Durojaiye, Nathan Joseph
Mentor: Dr. Angela Ahrendt, Illinois Mathematics and Science Academy
Abstract/Project intention:

Dengue fever is a disease caused by any of the four related dengue viruses. It is a mosquito-borne disease that mainly occurs in tropical and subtropical regions. As of 2019, approximately 400 million cases of dengue infections occur worldwide while 96 million cases result in dengue fever. Symptoms occur around four to six days after infection and last up to ten days. Furthermore, the dengue virus is classified as a flavivirus. These viruses only encode 10 proteins, one of which is NS5. We are specifically trying to target the NS5 protein in the dengue virus because it is very important to the virus's life cycle. It is a large protein with two enzyme domains; one which is responsible for avoiding human immune response and the other that is vital for RNA synthesis. In our SIR, we tested a variety of compounds using online resources like PyMol, Chimera, and Swissdock, to see if they bind and inhibit the protein. For example, we used local docking in SwissDock to test the binding of drug-like compounds from the Medicines for Malaria Venture's boxes to the active sites on the NS5 protein. We compared the different binding poses, Gibbs free energies, and FullFitness values to those of the natural ligands in an effort to prioritize compounds for screening in the lab.

Project ID: BizIN 04
8:50a.m. - 9:05a.m.

Title: Cyber Security Intern with the Illinois State Treasurer's Office
Presenter(s): Gnandeep Chintala
Business Mentor(s): Joseph Daniels
Abstract/Project intention:

At the Treasurer's Office, I work in the IT department to help run a Security Information and Event Manager (SIEM). This system is used to track data and security events across State Treasurer's Office. The focus of my business project for the State Treasurer's Office is to understand how a SIEM is a much more effective and helpful method of tracking events in comparison to other security methods. My methods for this business project adapted over the course of the six months as I worked with different types of security systems and SIEMs from different sources. I also researched about the SIEM capabilities of various companies like AT&T, Splunk, and IBM. Through my research project, I was able to help the State Treasurer's Office find a new SIEM and customize the capabilities of the SIEM.

Project ID: BizIN 10
8:50a.m. - 9:05a.m.

Title: Data Science with Climate Pros
Presenter(s): Tony Martin
Mentor(s): Don Smith III
Abstract/Project intention:
Climate Pros is a refrigeration service run from a data science-focused management using a variety of different systems, such as Watchtower. They have many consumer-focused projects where the data science results are displayed through a variety of programs that the company developed. Over the course of six months, the company provided opportunities to learn more about the intricacies of data science and how to use machine learning to analyze the provided data. The company also included opportunities to learn some website design concepts by having opportunities to design code to be incorporated into a website project. The most significant impact of these projects was to learn how to use a variety of databases to accumulate data and provide analysis.

Project ID: BizIN 16
8:50a.m. - 9:05a.m.

Title: Investing with the Illinois State Treasurer's Office
Presenter(s): Storm Stern
Mentor(s): Rekha Vaitla, Deputy Director of Corporate Governance and Sustainable Investments
Abstract/Project intention:
The Illinois State Treasurer's Office Invests with the state of Illinois' $31 Billion. Since this isn't their money, they must ensure that they do not make bad investment decisions. The treasurer's target investments are all very safe and sustainable. We invest in both equities (AKA stocks) and debt (AKA bonds). Over the last several months, I have been conducting research on sustainable companies, and I have been providing support on the corporate governance aspect of things as well. I have done extensive research and made numerous company analysis reports, using various measures and standards to determine the sustainability of companies that the Treasurer's Office is thinking about investing in. I have also done research on public events regarding corporate governance, and helped advise companies on various issues within their companies. In the last couple months, I have done lots of research and work on Facebook. My work is presented to a committee made up of State Treasurers from other states, and financial professionals from investing firms. Overall, I have been helping with various projects and topics, which all fall under the umbrella of either sustainable investments or corporate governance.

Project ID: CHEM 03
8:50a.m. - 9:05a.m.

Title: Design of SARS-CoV-2 Main Protease Inhibitors by Computer Aided Drug Design in Collaboration with the COVID Moonshot Initiative

Presenter(s): Jack Grotke, Ariela Asllani
Mentor(s): Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project intention:

In early December 2019, a novel coronavirus pandemic broke out in the city of Wuhan, China Hubei Province. As of the end of February 2021, nearly 114 million people have been infected worldwide, and over 513 thousand have died in the United States alone.. SARS-CoV-2 is a positive-sense, enveloped, single-stranded RNA Betacoronavirus and is the disease-causing agent for Covid-19. Of many SARS-CoV-2's proteins, its main protease (MPro) is the primary target for drug discovery efforts. The COVID Moonshot project focuses on inhibitors for mPro using the crowdsourced medicinal chemistry insights of companies and chemists around the world. A fragment from the COVID Moonshot database (x2600) was selected as a starting point to design new compounds. Using molecular simulation software such as SeeSAR, new compounds were designed and their binding affinities computed. ADME prediction websites such as AdmetSAR and SwissADME, were utilized to compute the new compounds' pharmacokinetic and physicochemical properties. The newly designed compounds improve on aspects such as binding affinity, torsion angles, ligand lipophilicity efficiency, and pharmacokinetic properties.

Project ID: CHEM 04
8:50a.m. - 9:05a.m.

Title: Modeling COVID-19 antivirals with Computer Aided Drug Design in conjunction with the COVID Moonshot project

Presenter(s): Avdhan Kandikattu
Mentor(s): Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project intention:

In late 2019 to early 2020, SARS-CoV-2 emerged and caused the 2019-novel-coronavirus (COVID-19) to transmit throughout the globe in a short period of time. Due to the sudden emergence of the virus, specific antiviral drugs are still in the process of being manufactured, which could be necessary for treating COVID-19 patients. To accelerate the development of antiviral drugs, the COVID Moonshot, a crowdsourced drug-discovery model, provides fragments that can be used to inspire compounds to be submitted to and synthesized by the COVID Moonshot team. Using SeeSAR, a computer aided drug design software, the x0669 fragment was chosen from the COVID Moonshot project and grown over the course of multiple weeks into several compounds. Ten of those compounds showed high affinity and beneficial properties and were submitted to the project, which will be tested for their usability as a part of future COVID-19 antiviral drugs.

Project ID: CHEM 06
8:50a.m. - 9:05a.m.

Title: Covid Moonshot: Fragment Screening for SARS-CoV2 Main Protease (mPro)

Presenter(s): Daniel Liu, Naveena Mutharasan
Mentor(s): Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

The viral replication of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is particularly active early in the course of the disease, giving great value to antiviral therapeutics which hold the potential to halt further progression to the hyperinflammatory state and later stages of disease. Because antiviral therapy is currently high in the interests of the people, an internationally crowdsourced effort aptly named the Covid Moonshot Project was created to accelerate the development of an antiviral drug. To aid in this initiative, numerous new compounds were designed and tested through various dynamic visualization programs and property-predicting applications. The top eight compounds designed were submitted to the Covid Moonshot labs around the world for further development.

Project ID: CHEM 07
8:50a.m. - 9:05a.m.

Title: Utilizing Computational Chemistry to Crowdsource a Treatment for SARS-CoV-2
Presenter: Quinn Verdeyen
Mentor: Dr. John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
In December 2019, a novel coronavirus was detected in the Chinese city of Wuhan, Hubei Province. Nearly affecting all facets of life in China, this virus soon spread to the rest of the world, and on March 11, 2020, the World Health Organization declared a worldwide pandemic for SARS-CoV-2. Due to this unprecedented situation, medical researchers were left racing to find a viable treatment for the novel coronavirus through both conventional and innovative technologies. Likewise, this study utilized fragment-based drug design, a growing field within computational chemistry, to aid in the search for a viable treatment. To accomplish this, SEESAR was used to collect chemical structures, and their respective binding affinities, based on known SARS-CoV-2 Mpro drug-fragments. These structures were run through ADMET data collection sites to gather data pertaining to drug toxicity, protein inhibition, and synthetic accessibility. As a result, the top compounds resulting from this study were submitted to COVID Moonshot, a global crowdsourced research effort led to find a viable oral treatment to SARS-CoV-2. Currently, these compounds are under review for potential biological assay.

Project ID: CHEM 08
8:50a.m. - 9:05a.m.

Title: Design of oral antivirals for COVID-19
Presenter(s): Kristina Williams
Mentor(s): John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
COVID-19, caused by the SARS-CoV-2 virus, has resulted in over 119 million cases worldwide and over 2.6 million deaths as of March 2021. Remdesivir is an intravenous antiviral used to treat the virus, but there is still a need for oral antivirals for COVID-19. To find suitable molecules to be used in an antiviral medicine, SeeSAR, a drug design platform, was used to design and measure estimates of sample molecules binding to the main protease (Mpro) of SARS-CoV-2. SwissADME was used to calculate and compare ADME properties for all resulting newly designed compounds. 99 compounds were designed and analyzed, and the results were presented in the paper. The best 10 compounds were submitted to COVID Moonshot, a crowdsourced initiative with the goal to find an antiviral drug for COVID-19.

Project ID: CHEM 09
8:50a.m. - 9:05a.m.

Title: Molecular Modeling of Hydrocarbon Solvent Interactions and Lithium-ion
Presenter: Mathew Illimoottil
Mentor: Dr. Golab, Illinois Math and Science Academy
Abstract/Project Intention:
Much work goes into the creation and analysis of organic molecules that can stabilize lithium ions. Stabilization is important for ion transport in Li-ion batteries. Compounds also need to be stable across the voltage window for the battery's operation. We evaluated the potency of a few solvents in their interaction with lithium ions. We used Spartan Student v8 to model and analyze the interaction of different organic electrolytes, used as solvent molecules, with lithium ions. We created an accurate model of the Li-ion - electrolyte system by comparing initial calculations to known experimental data. We calculated different solvation properties of Li ions in 3-, 4-, and 5carbon chains of various hydrocarbons, specifically, ethers, fluorides, and fluorinated ethers. We compared our results with existing data on the effects of 1,4-dimethoxylbutane and fluorinated 1,4-dimethoxylbutane solvents on the oxidation window to make predictions on the propane and pentane compounds. We did a similar process for variations of fluorinated cyclic carbonates and partially fluorinated ethers. We found that -- similar to the fluorinated 1,4-dimethoxylbutane, the cyclic carbonates, and the partially fluorinated ethers found in the papers -- the experimental compounds also resulted in lithium-ion stability across the voltage window for the battery’s operation.

Project ID: ENVR 01
8:50a.m. - 9:05a.m.

Title: Effects of Eutrophication on Water Quality
Presenter(s): Philip Yi
Mentor(s): Patrick Kearney, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Eutrophication causes an influx of excess nutrients and detritus in fresh aquatic bodies and is known to detrimentally affect the water quality. By analyzing the effects of Eutrophication on a water body and its water quality through a span of 40 years, the effect it has on water quality can be quantified and found. In Illinois, statewide monitoring of nitrate levels began in ~1980, and since then, the quantity of nitrates has almost increased twofold from 234 million lb N/yr to 452 million lb N/yr. This increase in nitrates in aquatic bodies causes Eutrophication to occur, and as a result, the quality of water decreases. Measured oxygen levels, pH, and turbidity in specific bodies of water are used to represent the quality of water and are compared to nitrate levels to calculate the effect of nitrates on water quality. To minimize outside factors, forestry data from different counties throughout Illinois were compared and used to see how results differed based on forestry. The rise of nitrates in aquatic body shows a direct relation to the decrease of water quality, and actions to reduce major factors of Eutrophication should be used to mitigate significant decreases in water quality.

Project ID: MEDH 05
8:50a.m. - 9:05a.m.

Title: Using Protein Ligands to Start Development of a COVID-19 Treatment
Presenter: Cameron Magana
Mentor: John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
For over a year now, the novel virus known as SARS-CoV-2 has been causing infections throughout the world, resulting in many seriously ill patients, and even numerous deaths. A consortium called COVID Moonshot was created in response to the virus, and it aims to crowdsource designed molecules from across the world to test for potential antivirals. Through the use of programs such as See-SAR and AdmetSAR, many compounds were designed based off of a fragment ligand from SARS-CoV-2's main protease, 5R83. The ligand (x0434) was sourced from COVID Moonshot's database of fragments.

After designing over 100 new compounds, the strongest binding ones were selected, and then run through AdmetSAR, an ADMET structure–activity relationship database, to predict the characteristics of each molecule as a drug, such as its ability to pass through the blood-brain barrier and its capabilities of hERG inhibition. After analyzing the compounds for the safest potential drugs, five were selected as the best potential candidates.

Project ID: MEDH 08
8:50a.m. - 9:05a.m.

Title: Development of SARS-CoV-2 Therapeutics Using Computer Modeling
Presenters: Pranav Patel and Jack Pinto
Mentor: Dr. John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The Covid-19 pandemic-declared on January 30th, 2020-is still an ongoing and raging problem in the world. With over 117 million cases and over 2 million deaths, the coronavirus pandemic has slowed daily-life. In order to develop therapeutics to SARS-CoV-2, the COVID moonshot project was initiated. In this project, scientists from across the world come together to develop and synthesize compounds to aid in development of therapeutics. In this project, Scientists develop their own compounds and publish their research online for open access to anyone. My group designed compounds using seeSAR and admetSAR and submitted them to the COVID Moonshot Consortium. Our designs began from fragment x0354. In order to develop new compounds, we first designed the compounds using seeSAR From this fragment, we were able to design over 293 compounds, From the designed compounds, we selected the top 20 compounds by binding affinity to input into admetSAR to check for Lipinsky's rules and other physical and therapeutic properties such as bioavailability and toxicity. From those compounds, our group was able to submit twelve of the compounds because they passed all five of Lipinsky's rules and had positive bioavailability and negative toxicity. We are currently in the process of performing the same procedure for fragment x11366.

Project ID: MEDH 09
8:50a.m. - 9:05a.m.

Title: Designing Potential COVID-19 Therapeutics
Presenter: Philip Paulson
Mentor: John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
As of March 9th, 2021, there have been over 117 million confirmed COVID-19 cases and over 2.9 million deaths. A group called COVID Moonshot started developing therapeutics for COVID-19 using Fragment Based Drug Discovery, and discovered 74 good fragments to base drugs upon. They then released this information to the public and asked medicinal chemists across the globe to send in structures based off of the initial fragments. We used SeeSAR to generate these structures, and then we screened the 20 with the best binding affinity to the main protease of COVID-19 through two online programs, SwissADME and admetSAR. None of the structures were found to be inadequate. We submitted the top five compounds with the best binding affinities to COVID Moonshot for further drug development.

Project ID: MEDH 10
8:50a.m. - 9:05a.m.

Title: COVID-19 therapeutics from computer aided drug design
Presenter: Ashwath Ramesh
Mentor: Dr. Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The Covid -19 pandemic has infected over a hundred million people worldwide, and millions of people have died due to not being able to receive the proper treatment to adequately fight the sickness. As a result of the limited time of Covid-19's existence, the COVID moonshot project has been created to assist in the development of Covid antivirals. This project is an open source initiative made to assist scientists and design new compounds for further development. To create compounds for moonshot, SeeSAR, a virtual drug design platform, was utilized. An existing fragment was uploaded to SeeSAR and 106 new compounds were designed. To predict the effectiveness and safety of these new compounds their structures were analyzed by SwissADME, a free online tool designed to evaluate a compound's pharmacokinetics. Combining the data from the two programs, the top eight compounds were submitted to the COVID Moonshot project, where they will be synthesized and further tested.

Project ID: MEDH 16
8:50a.m. - 9:05a.m.

Title: **Mathematical Modeling of Glioblastoma Multiforme**
Presenter: Jade Bates
Mentor: Dr. Sowmya Anjur, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Glioblastoma Multiforme(GBM) is the most aggressive and common type of brain cancer in adults. In this study I used a mathematical model to demonstrate the cell proliferation of GBM. The model was found by compiling data from several studies which look at the proliferative index, mitotic Index and percent of cell migration. I ran correlation analysis on the mitotic index and proliferative index. This model can help scientists understand the process of cell proliferation in GBM.

Project ID: MEDH 29
8:50a.m. - 9:05a.m.

Title: Developing software to characterize gel electrophoresis data
Presenter: Shouri Bochetty
Mentor: Sangram Sisodia, University of Chicago
Abstract/Project Intention:
The project is focused around using and implementing image analysis techniques for analysis of Gel Electrophoresis data specifically in Alzheimer disease mice. To do so, experimentation was done with tools like watershed, graphing of intensity to quantify protein concentration in gel electrophoresis bands. The results indicate that the best quantification of protein concentrations of the gel occur at a specific RGB color frame and with a specific intensity. In addition, using watershed and a noise filter had a significant effect upon the accuracy of the determination of protein concentration. In addition, after using the various tools, a map/graph of the intensity was generated and establishing a baseline noise level for the peaks proved to be useful. Overall, the project will help ensure the accuracy of biological data in terms of protein quantification.

Project ID: PHYS 02
8:50a.m. - 9:05a.m.

Title: The LRS vacuum expectation value and the H++->WW decay channel
Presenter(s): Archan Das
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The doubly charged Higgs boson H++ may have a second decay channel that decays to two W bosons. Each of these bosons can decay into either lepton-neutrino pairs or quark-antiquark pairs. Using the all-lepton channel gives us a signature of four leptons and missing energy from the neutrinos, a very low-background signature. Doubly charged Higgs bosons' decay into W bosons is dependent on the vacuum expectation value, or VEV, a physical constant that is unknown. Previous theoretical research has come to varying conclusions on the real value of the VEV. We generate samples of doubly-charged Higgs decay using different potential Higgs masses (300, 800, 1300 GeV) and VEV values (1, 3.5, 5, 9). We find that the cross section of the WW decay channel is not affected by VEV at high Higgs masses.

Project ID: PHYS 04
8:50a.m. - 9:05a.m.

Title: Using the Higgs Combine Tool to Calculate Limits of the Cross Section of Doubly Charged Higgs Bosons.
Presenter(s): Nate Graf and Karrick McGinty
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The Higgs Combine Tool (HCT) is a tool to calculate limits and do statistical analysis on the data collected by particle detectors. We create and edit data cards and then calculate the limit on the cross-section of the production of a particle, given a background estimate, using a Bayesian technique. We then used the HCT to create graphs to show the results more clearly. The specific type of analysis we used was a Markov Chain Monte Carlo calculation. We applied this to create preliminary sensitivities for the search for a doubly charged Higgs boson.

Project ID: PHYS 15
8:50a.m. - 9:05a.m.

Title: Dark Photon Phenomenology
Presenter(s): Eva Tuecke
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The dark photon, a non-Abelian U(1) gauge boson, is part of a system of dark matter particles called the dark sector. Dark photons can interact weakly with the Standard Model via kinetic mixing, allowing the dark photon to decay to an even multiplicity of leptons. Two possible production mechanisms exist: the SUSY portal or the Higgs portal. The generated SUSY particle or non-SM Higgs, respectively, decays to a dark particle, which then generates a cascade decay of dark photons. These dark photons are highly boosted and will decay to lepton jets—a highly collimated opposite-sign pair of leptons. ATLAS previously did a search for prompt lepton-jets in proton-proton collisions, but found no statistically significant deviation from Standard Model predictions. However, this ATLAS paper didn't take pion contamination into account, which is a major issue when distinguishing between lepton jets and QCD jets. We received access to the source code from another search, which had accounted for hadron contamination by looking at 19 different possible decay channels. Using these 19 decay channels will allow us to do a more comprehensive search for dark photons that properly models showering and hadron contamination.

Session I - 9:10a.m. - 9:25a.m.

Project ID: BHVSO 01
9:10a.m. - 9:25a.m.

Title: The Relationship Between COVID-19 Death Rates and Socioeconomic Status
Presenter(s): Akash Basavaraju
Mentor(s): Patrick Kearney, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Since the beginning of COVID-19 pandemic in early 2020, many have wondered if COVID-19 disproportionately affects minorities and low-income individuals. Studies have shown that minorities, especially Black and Latino, and low-income groups do in fact have higher COVID-19 transmission rates compared to White Americans. However, not much research has been conducted regarding the relationship between COVID-19 death rates and income level. The goal of this project was to find the relationship between COVID-19 death rates and a few socioeconomic factors: average income, race, and population density. Every county in two U.S. states, Oregon and New Mexico, were the test subjects of this project. Public data regarding these categories was compiled and calculated into a few different factors. To find the COVID-19 death rate in any given county, we divided the total number of COVID-19 deaths by the total number of confirmed COVID-19 cases (as of March 2021). Upon analyzing the data, we have concluded that there was no significant correlation between the socioeconomic factors previously mentioned and COVID-19 death rates.

Project ID: BHVSO 05
9:10a.m. - 9:25a.m.

Title: Influence of Felon Reenfranchisement on Party Success in State Elections
Presenter: Ella Foes
Mentor: Patrick Kearney, Illinois Mathematics and Science Academy
Abstract/Project Intention:
While America's 2020 General Election brought public scrutiny to voting rights, felon disenfranchisement remains virtually unchanged. With disparities in state priorities and political affiliations, different regions of the country are in varying stages of enfranchising felons and face varying hindrances (ACLU 2020).

This study examines political motive of politicians rushing to reenfranchise. The scope was defined as the five elections surrounding a given state's most significant change to felon enfranchisement law in the past century; Republican and Democratic voter percentages were collected for each of these elections.

Data analytics were first used to measure the change in party shares of the popular vote within a single state's elections; next, this resultant data was used to create a country-wide model describing trends in party shares of the popular vote. To account for changes in party shares of the popular vote due to shifting population compositions in relation to identity, Census data provided covariates including the population density, mean income, and percentage of the state population which: identified as white, was over 60 years old, identified as male, and was college-educated.

Project ID: BHVSO 09
9:10a.m. - 9:25a.m.
Title: The role of race, socioeconomic status, and Affirmative Action in college admissions
Presenter(s): Temi Ijisesan
Mentor(s): Patrick Kearney, Illinois Mathematics and Science Academy
Abstract/Project Intention:
My SIR project is concentrated on the effectiveness of Affirmative Action in College Enrollment and how it disproportionally disadvantages certain socioeconomic demographics in the U.S. It addresses the history of Affirmative Action and its role in the College Admissions process. This includes a chronological overview of major cases such as Brown vs. Board of Education to Fisher v. University of Texas-Austin that had lasting effects on many existing Affirmative Action policies and the way the public viewed the fairness and equity of such. I also analyze socioeconomic demographics of today and how minority populations and the education system play into that.

The question I aimed to answer through my research was whether there was a positive correlation between socioeconomic status among minority students and the percentage of students of that demographic enrolled at that institution. In my research, I analyzed the correlation between Median Household Income, Percentage of students enrolled in 2 and 4-year institutions based on race, and affirmative action policies as a function of time. This data helped me to form conclusions pointing to fluctuations in all variables considered in the college admissions process and the plateau of enrollment of impoverished minority students in public and private institutions.

Project ID: BHVSO 16
9:10a.m. - 9:25a.m.

Title: The Correlation Between Socioeconomic and Environmental Factors on Life Expectancy

Presenter: Kaylee Zhou
Mentor: Patrick Kearney, Illinois Mathematics and Science Academy

Abstract/Project Intention:
Awareness about the disparity between living in urban versus rural areas is essential when considering the parameters that influence one's longevity. There are many factors that can impact an individuals' health, such as proximity to services, access to nature, occupation opportunities, and more. It is important to understand how living in areas classified as urban, suburban, and rural can offer different variations of the elements listed above. In this research, we dive deeper into analyzing and comparing how conditions such as the population density, education, civilian labor force, poverty, mortality, public transportation, air quality, and unemployment rates influence the average life expectancies of all counties in Illinois, New York, California, Texas, and Florida. With this data, we will generate numerous econometric regression models to test for correlation between these variables and the life expectancies of urban, suburban, and rural counties in these five states. Using the quantitative results reflected in these models allows us to conclude how intensely these conditional factors affect the health and life expectancy of the citizens who live there.

Project ID: BHVSO 20
9:10a.m. - 9:25a.m.

Title: Use of Data Analytics to Spot Educational Discrimination –
Part II - A Focus on The Effect of Discipline on Test Scores
Presenter(s): Disha Dureja
Mentor(s): Dr. Angel Alvarez, Northwestern Feinberg School of Medicine
Abstract/Project Intention:
We used data analytics to find potential inequities within Chicago Public Schools (CPS) policies that negatively affect marginalized groups. Currently, there is inequity with the CPS system: there is a lack of educational opportunities for students of color and students of lower socioeconomic status. There is also an issue of heavy police involvement in schools through school resource officers (SROs). We looked into the use of police notifications in both high schools and elementary schools and found stark racial disparities in the use of police in elementary schools. This was due to the lack of SROs in elementary schools. Using publicly accessible CPS data, we analyzed data regarding police involvement and out-of-school suspensions (OSSs) per 100 students in comparison with student demographics. Schools with higher percentages of Black students have a significantly higher number of police notifications and disciplinary actions of higher severity. We analyzed the data concerning discipline in conjunction with student demographics and test scores per school. This could potentially further reveal racial disparities between predominantly White schools and predominantly Black schools. Furthermore, it could prove severe disciplinary action does not solve the problem of student insubordination, but rather criminalize them for minor misbehavior.

Project ID: BIO 01
9:10a.m. - 9:25a.m.

Title: Developing a Model for Non-Invasive Detection of Gliomas Using MicroRNA Biomarkers

Presenter: Delicia Chen
Mentor: Sowmya Anjur, Illinois Mathematics and Science Academy

Abstract/Project Intention:
Current methods of diagnosing brain tumors often include imaging tests accompanied by a biopsy involving the surgical removal of a tissue sample to determine if the tumor is cancerous. However, one area of non-invasive cancer detection that is currently undergoing research and shows great diagnostic potential are the presence of microRNA biomarkers in the blood to predict and diagnose a brain tumor before the onset of symptoms.

Through gathering and analyzing existing data on the roles of microRNA 21 (miRNA-21) in the development and detection of different gliomas, we can create a predictive model for the presence of specific types/WHO grades of gliomas based on the levels of miRNA-21 in the patient's blood, providing valuable insight into the potential diagnosis and prognosis of brain tumors using non-invasive procedures. Specifically, the model takes into account the fold-change of normal levels of miRNA-21 in the blood to predict the likelihood of the varying grades of astrocytomas accounting for these changes.

Project ID: BIO 05
9:10a.m. - 9:25a.m.

Title: A Search for Inhibitors of HGXPRT Using 3D Molecular Docking
Presenters: Akanksha Garg, Rachna Gupta, Hannah Xu
Mentor: Angela Ahrendt, Ph.D. Illinois Mathematics and Science Academy
Abstract/Project intention:
Malaria is a bloodborne disease primarily spread by mosquitoes. In 2019, there were an estimated 229 million cases of malaria worldwide, many of which were in third-world countries. Even though there are drugs that can combat malaria, they are not accessible to most consumers in need because of their high cost and, even if a consumer can access these drugs, they have low efficacy rates. HGXPRT is a purine salvage enzyme synthesized by malaria-causing parasites that is essential for their survival. Studies conducted in the past have concluded that neutralizing HGXPRT is an essential part of finding an affordable cure for malaria. This study focused on introducing different molecular compounds to HGXPRT to find a potential drug to combat malaria. Drug-like compounds from the Medicines for Malaria Venture's Malaria Box were molecularly docked with the structure 3OZF to determine the potential for binding. Factors considered were Gibbs free energy, FullFitness, and positioning of the ligand relative to the 3OZF molecule compared to the original ligand, hypoxanthine. The goal of this study was to identify and prioritize specific compounds for further testing as potential drugs to combat malaria and to provide the scientific community with this data.

Project ID: BIO 12
9:10a.m. - 9:25a.m.

Title: Effect of a loss of WRC formation on autistic behavior modulation
Presenter: Akul Prakash

Mentor: Jennifer Rakotomamonjy, Alicia D Guemez Gamboa,
Guemez-Gamboa Lab, Northwestern University: Feinberg School of Medicine

Abstract/Project intention:
It has been determined that pathological Wave Regulatory Complex (WRC) variants can result in intellectual disability with autistic features and seizures. The WRC is a five-protein complex consisting of WAVE1, CYFIP1, ABI2, NAP1, and HSPC300. The WRC mediates interactions of membrane receptors with the actin cytoskeleton to regulate crucial developmental steps such as neural adhesion and migration. The deletion of ABI2 in mice has been found to reduce actin nucleation and produce neural phenotypes that include deficits in memory and other cognitive skills. Wave1 knockout mice showed behavioral abnormalities, including impaired learning and memory. This study was focused on the Abi2 gene, where point mutations were introduced to prevent the binding of the WRC and cell membrane partners. Wild-type, heterozygous and homozygous mice for the Abi2 point mutations were observed in the nestlet shredding animal model to determine if the loss of WRC formation resulted in repetitive behavior reminiscent of obsessive-compulsive disorder or autism spectrum disorders. My results show no significant differences between genotypes, suggesting that the formation of the WRC does not play a major role in autistic behavior modulation. Further investigation is needed to explore seizure susceptibility and assess behaviors related to intellectual disability in our mouse model.

Project ID: BIO 19
9:10a.m. - 9:25a.m.

Title: Testing CO2 assimilation of Various Cultivars of Maize over Varying Temperature Levels and Light Intensities

Presenter(s): Akhil Vytla, Nathan Yuan
Mentor(s): Sarah C. Stainbrook, PhD Washington University, St. Louis, IL

Abstract/Project intention:

Photosynthesis is one of the most sensitive functions in plants: changes in temperature, or CO_2 concentration can drastically affect the efficiency of the reaction. Rubisco activase (RCA) is an important activator for Rubisco, the enzyme responsible for the carbon fixation during photosynthesis. RCA is also very sensitive to high temperature t., It is yet unknown if certain cultivars of maize would react better to changing temperatures, for example a strain from a region closer to the equator would have higher tolerance towards high temperatures.

Our research examined whether different cultivars of maize respond differently to changes in temperature

We measured CO2 assimilation vs. temperature in several cultivars of Maize obtained from various locations around the world using an LI-6000XT machine.

We found that cultivar B73 had a severe drop-off in carbon assimilation above37 degrees Celsius and there was a notable drop-off after increasing that temperature. A similar effect was seen with MR01. MR15 showed much smaller drop-offs as we increased temperature, MR19 was similar though slightly larger margins between the temperatures. Something interesting to note is that the MR15 strain and MR19 strain performed worse at their acclimated temperature than their non-acclimated temperature. Future research should examine whether the differences in assimilation are due to differences in RCA sequence or expression among cultivars.

Project ID: BizIN 05
9:10a.m. - 9:25a.m.

Title: Block Bins Website Development
Presenter(s): Seo Yeon Cho, Wesley Matthews and Tyler Smith
Mentor(s): Dane Christianson, Block Bins, LLC
Abstract/Project Intention:
Block Bins LLC is a Chicago-based composting company that offers customers accessible and inexpensive organic waste recycling options. Customers subscribe for access to shared recycling bins to drop off their compost which is collected on a weekly, biweekly, or monthly basis. For customers to use this service, they must first register through the Block Bins website where they may enter personal information to receive bins for their compost. Because a company's website is the first impression it gives to its potential customers, a quality website should be functional, easy to navigate, and clear. In the following work, a detailed approach on improving the Block Bins website will be covered. This report will focus on the methodology taken in providing an easily understandable website to boost company online presence, create a secure method of handling customer data, and improving website functionality. This report will also detail personal experiences of developing a website.

Project ID: BizIN 11
9:10a.m. - 9:25a.m.

Title: Web Development using GitHub
Presenter(s): Harshini Musku
Mentor(s): Narendhara Kancharlapalli, Impulse Institution
Abstract/Project intention:
Impulse Institution is an educational organization designed for 10th to 12th graders in India to provide a holistic education. The main focus of the business project was to rebuild the website as the previous one was hacked multiple times in the summer of 2020. The website's platform changed from WordPress to GitHub. GitHub is used for hosting software development. GitHub offers a more secure and mature platform to create a new website. GitHub is used by many renowned companies like Facebook, Google, and Microsoft. Although GitHub offers secure hosting for our repositories, my team and I opted to take additional measures to make sure our repository was fully secured. We also use GitHub's security features to analyze the vulnerability of the website. Over the six months, I worked on the application webpage, updated various other webpages, and researched the security aspects of GitHub.

Project ID: BizIN 17
9:10a.m. - 9:25a.m.

Title: Equine Therapy
Presentor(s): Abhiram Thati
Mentor(s): Kevin Kusy, Illinois Mathematics and Science Academy
Abstract/Project intention:
Equine therapy is the form of therapy that utilizes equestrian mammals to aid in a being's physical, emotional, and mental development. Historically, the treatment improves and enhances the cognitive development of humans diagnosed with mental illnesses such as autism, cerebral palsy, and behavioral issues, among various mental health issues. Usually, individuals, especially ones that are not as far along in their growing process, are prescribed equestrian therapy. The actual horse can be identified as a point of interest to catch the attention of children, which in turn will make them more prone and open to accepting the otherwise difficult to digest physical and speech therapy. Once children begin riding the equine mammal, the resulting effects are excellent. Initially, children will start to recognize the social behaviors of the animal, resulting in a connection of trust. Moreover, setting challenges for the children to accomplish by leading the horse allows them to become comfortable in new scenarios while also helping them to harbor a sense of responsibility. This review aims to delve into the intricacies of equine therapy, and by additionally using eyewitness accounts and therapists' interviews, the belief that these findings will present an overarching view of the treatments becomes solidified.

Project ID: CHEM 02
9:10a.m. - 9:25a.m.

Title: Analysis of Compounds Designed from Fragment #x0398 for SARS-CoV-2 Main Protease
Presenter(s): Morgan Johnson and Samantha Gong
Mentor(s): John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project intention:
With the current COVID-19 pandemic, the need for treatments has become one of the world's top priorities. At the time that we started this project, there were no approved treatments or vaccines to treat the virus, so our project focused on developing an antiviral for COVID-19. Using Computer Aided Drug Design programs called SeeSar and Swiss ADME, we designed new compounds from fragment #x0398. We then docked and generated different possible compounds derived from the fragment. Data has shown that several compounds have good binding affinity with the SARS-CoV-2 main protease. This means that these compounds have the potential to inhibit the COVID-19 main protease, creating antiviral drugs.

Project ID: CHEM 10
9:10a.m. - 9:25a.m.

Title: Modeling of The Oxygen Evolving Complex
Presenter(s): Resh Mukherjee
Mentor(s): Joseph Golab, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Coral reefs are an essential part of the ocean ecosystem, providing a rich habitat that supports many diverse lifeforms. Further, these reefs are important economically as they are a major draw for tourists around the world; their destruction could prove catastrophic. A rise in ocean temperatures has been linked with the bleaching of coral reefs. More specifically the temperature rise has been linked to damage of photosystem two in the dinoflagellates that maintain a symbiotic relationship with the coral. This experiment has used the Spartan Student program to create a model of the oxygen evolving complex (OEC) within photosystem two. After calculating the energy of different possible molecular combinations of the OEC, as well as all reactants and products of the photosynthesis reaction, a model was created from the lowest energy results. Moving forward this model will be used to determine the effects of a change in heat energy on the system and to calculate energy changes when calcium is replaced in the OEC.

Project ID: CMPS 03
9:10a.m. - 9:25a.m.

Title: Water Quality Data Collection through mWater Software
Presenter(s): Erin Yoo
Mentor(s): Dr. Melissa Lenczewski, Northern Illinois University
Abstract/Project Intention:
Around the world, communities aim to make water quality data publicly accessible in order to help community members recognize how local water supplies may be impacting their health and environment. This project assists with this goal by taking on the critical tasks of collecting, storing, managing, analyzing, and publishing water quality data from the Kishwaukee River Water Quality Assessment Study in DeKalb, Illinois. The previous data management system for the study involved recording measurements on paper and then transferring data onto a digital spreadsheet. Due to the error-prone and inefficient nature of this process, this project instead utilizes mWater, a robust online platform for collecting and managing water quality data, to ensure data credibility. The new data management system includes transferring historical data records into the mWater database, creating data input surveys for future data collection, producing simple data visualizations that follow color visualization theory guidelines, and making improvements based on stakeholder feedback. As a result, reliable water quality data will be easily accessible and understandable to the public. This transparency is critical because the need for straightforward scientific communication is becoming increasingly apparent in today's world with the COVID-19 pandemic and climate crisis.

Project ID: ENGN 01
9:10a.m. - 9:25a.m.

Title: Plausibility of Using Solar Energy for Water Purification
Presenter(s): Shawn Coutinho
Mentor(s): Brooke Schmidt, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Water purification has been one of the permeating questions for humanity throughout history as humans need to consume fresh water to satisfy their bodily needs hasn't matched up well with the type of water present on Earth in large quantities. In recent years, experiments have been conducted as far as efficient automation of the water purification process goes with varying results. In addition, growing renewable energy needs have sparked additional research into whether this process could be accomplished without external energy sources, leading to the niche field of solar energy-based water purification.

This experiment attempts to determine the feasibility of a low-cost solution as well as its effectiveness through applying already created designs while using cheaper and more readily available materials to determine if a setup similar to the one created in this experiment based off of reflective surfaces focusing the sun's rays onto a single tray with impure water would be capable of producing sufficient clean water, measured by pH. This experiment yielded inconclusive results as to the feasibility of this setup, though it did make significant inroads as far as suitable temperatures for this setup which can serve as the premise for future experiments.

Project ID: ENGN 04
9:10a.m. - 9:25a.m.

Title: Design and Experimental Study of Bio-Inspired Surgical Needle
Presenter(s): Rosario Picone
Mentor(s): Dr. Parsaoran Hutapea, Temple University
Abstract/Project Intention:
Brain biopsy procedures are vulnerable to complications such as tissue scarring, damage, inflammation, and deflection caused by surgical needles. A large insertion force is found in the incompatibilities with tissue properties and needle geometry design, which in return causes unintended complications to the patient. An insect's stinger is able to penetrate a wide array of tissues with minimal pain due to an abnormally low required insertion force. These traits inspire the investigation of bio-inspired needles to decrease insertion forces in surgical procedures, particularly brain biopsy procedures. This work will focus on needle geometry design inspired from mosquito and honeybee needles to create a bio-inspired needle suitable for surgical use that causes less complication than existing solutions. The mosquito-inspired needle consists of a maxilla-shaped shaft and labrum-tip design. The honeybee-inspired needle uses a unique system of barbs that easily penetrates tissue. The insertion force is measured using a force sensor, fixed at the end of the needle to measure the needle's uniaxial force in polyvinyl chloride (PVC) gels. These gels mimic the characteristics of tissue. Because insertion speed can cause discrepancies in insertion force, the needles are inserted at a constant speed using a motorized linear stage.

Project ID: MEDH 11
9:10a.m. - 9:25a.m.

Title: Designing Potential COVID Therapeutics Through Computer Aided Drug Design

Presenter(s): Heldanna Solomon, Sabirah Taiwo
Mentor: Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:
The COVID-19 pandemic has been extremely damaging to society and much work has been done to develop vaccines and therapeutics to prevent more such damage. The COVID Moonshot project crowdsources compound designs from worldwide sources for development into therapeutics. In order to send compounds of our own to contribute to the project, we selected the starting fragment x0995 (PDB: 5RF3) from the COVID Moonshot database and imported it into SeeSAR. We then designed new compounds based on the fragment and determined their characteristics. We used AdmetSAR and SwissADME to collect more ADME calculation data on these compounds. Using this data, we selected the five compounds we believe would be best suited for use in COVID therapeutics. These compounds were submitted to the COVID Moonshot project to be analyzed, synthesized, and tested. We believe they can potentially be used as therapeutics to combat COVID-19.

Project ID: MEDH 24
9:10a.m. - 9:25a.m.

Title: Principles and Mechanics of Nanomedicine in Aging
Presenter: Brandon Park
Mentor: Dr. Dong-Hyun Kim, Northwestern University,
Feinberg School of Medicine
Abstract/Project intention:
Nanomedicine has been continuing to develop with many advances in the biomedical field. It aims to provide novel tools for diagnosis and treatments for patients with age-related diseases, such as cancer, atherosclerosis, insulin resistance, and various cardio-metabolic and neurodegenerative diseases. Despite recent advances, there is still a lack of effective treatments to prevent age-related diseases. Nanomedicine has the capability to target aging pathways. Studies have shown that the aging process is known to be associated with heightened oxidative stress and related systemic inflammation. In order to solve this problem, Northwestern University BIGMed Lab analyzed various nanodelivery systems and determined that metallic nanoparticles, mesoporous silica nanoparticles, and other multifunctional nanoparticles have the most ideal advantages in clinical applications that include simple synthesis, easy chemical modification, biocompatibility, and adjustable biophysical properties. The project considered the benefits and drawbacks of current cancer treatments that are in the field of nanomedicine. There is great potential for multifunctional nanocarriers in medical diagnostics, therapeutics, and molecular targeting that can efficiently deliver anti-aging biomolecules. The most successful nanodelivery systems must have optimal features for loading and releasing therapeutic agents with minimal side effects, and multifunctional nanocarriers are promising applications to combat pathological conditions associated with oxidative stress.

Project ID: MEDH 30
9:10a.m. - 9:25a.m.

Title: Effect of 3-D Printable Scaffolds Hyperelastic Bone and Fluffy-PLG on Bone and Cartilage Differentiation of Mesenchymal Stem Cells

Presenter(s): Shreya Mahesh; Apurva Reddy
Mentor(s): Dr. Tong-Chuan He, Dr. Russell Reid, and Bryce Hendren-Santiago, University of Chicago, Pritzker School of Medicine

Abstract/Project intention:
Ranging from cancerous infections to severe fractures, insults to osseous tissue has the propensity to yield significant debilitative effects in an individual. Current treatments present numerous risks such as donor site morbidity and infection. Thus, bone tissue engineering serves as a promising alternative to combat the shortcomings of allograft and xenograft implementation. Fluffy-PLG is an ultraporous (>95%) polylacde-co-glycolide (PLG) copolymer that resembles cartilage tissue. Consequently, it can carry more mesenchymal stem cells (MSCs) and growth factors. With evident success in bone tissue regeneration, Hyperelastic Bone is a highly osteoinductive biomaterial consisting of 90% hydroxyapatite and 10% PLG. In this study both hyperelastic bone (HB) and fluffy-polylactide-co-glycolide (PLG) scaffolds were seeded with human urine progenitor stem cells to assess cell viability, proliferation, and differentiation in the presence of bone morphogenetic protein-9 (BMP-9) in vitro. The scaffolds' ability to facilitate cell proliferation and osteogenesis were assessed by means of confocal fluorescence microscopy, alkaline phosphatase assays, dsDNA quantification, and expression of osteogenic genes.

Project ID: PHYS 03
9:10a.m. - 9:25a.m.

Title: Efficiencies for Dark Lepton Triggers
Presenter(s): Ari Fishkin
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Since dark photons produce lepton jets with low muon energies, they are poorly accepted by the existing single muon and dimuon triggers because existing triggers fail to accept muons with low energies. To accept more dark photon events, two tri-muon triggers were created, one being a level one trigger and the other being a high-level trigger, with the level one trigger's first muon, second muon, and third muon energy being 5 GeV, 3 GeV, and 3 GeV respectively, and the high-level trigger's muon energies being 10 GeV, 5 GeV and 5 GeV. In order to measure the efficiencies for the tri muon trigger, the CMS framework was used to test the triggers on generated events and see how many events the new trigger accepts that the old ones missed. Testing and looking at how many events that the new triggers accept but the old ones miss for the missing pT trigger, which measures how much pT is being missed by the detector for each event, as well as other triggers which could be relevant to the dark photon analysis.

Project ID: PHYS 08
9:10a.m. - 9:25a.m.

Title: Creating High-Eta Dark Photons
Presenter(s): Hector Ibarra and Nathan Kilmer
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
We are using a Monte Carlo simulation to generate particle collision events which result in lepton jets. By observing the resulting lepton jets, we are able to observe the characteristics of the original collisions. The goal of these simulations is to observe evidence of a theoretical particle, the dark photon. The dark photon resides in the dark sector, and is proposed to be produced by supersymmetric particles such as neutrally charged neutralinos. Looking at the particle systems, we are examining Monte Carlo generators to create high-eta dark photons that aim near the beam axis. The goal of this is to get simulated results for what would be observed if the decay products of high-eta dark photons were created in real life, through the use of a proposed detector called TOTEM.

Project ID: PHYS 16
9:10a.m. - 9:25a.m.

Title: Lepton-Jet Background
Presenter(s): Brady Williams
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
We analyzed the contribution of potential backgrounds for lepton-jets created from the decay of dark photons. Lepton-jets are identified by the presence of at least two collimated leptons, but these jets may have significant pion contamination. Therefore, the primary lepton-jet backgrounds come from Standard Model (SM) processes that happen to contain two leptons that are close enough to fake a lepton-jet. We used the PYTHIA 8 Monte Carlo generator to generate SM events (with no lepton-jets) involving three processes most likely to result in lepton-jet fakes (based on a previous CMS dilepton study): b-bbar → leptons, ZZ → leptons, and J-Ψ decay. These events were analyzed with our lepton-jet algorithm to determine the fake rates for each process. We found bbbar events to contribute the most to the background, followed by ZZ events, with J-Ψ decay being largely insignificant.

Session I - 9:30a.m. – 9:45a.m.

Project ID: BHVSO 02
9:30a.m. – 9:45a.m.

Title: The Effect of Accessibility to Education during COVID-19 on Student Success
Presenter: Natali Chung
Mentor: Dr. Patrick Kearney, Illinois Mathematics and Science Academy
Abstract/Project Intention:
This study seeks to find if there is a correlation between accessibility to education during the COVID-19 pandemic and student academic success. As COVID-19 continues to reach across the nation, causing many school districts to turn to distance learning. It is crucial that educational systems understand how the variability of access to quality education while at home can affect students in learning, especially if virtual learning becomes integrated into normal education in the future. In this project, we will utilize data by the CRPE about multiple variables of district responses to school closings factored along with data of past and recent (2020) standardized test scores from primary and secondary schools. Using the program R, we will be able to identify if there is a significant correlation and to what degree the correlation stands by analyzing factors such as p-value. It should be noted that, as COVID-19 and distance learning is fairly new with limited data available, our conclusions could possibly be inaccurate to data released in the future. However, our analysis may give qualitative context to how successful school systems have supported education in distance learning through sufficient or lack of accessibility to school.

Project ID: BHVSO 08
9:30a.m. – 9:45a.m.

Title: An econometric analysis of suburban park access in the United States
Presenter(s): Patrick Hultquist
Mentor(s): Patrick Kearney, Illinois Mathematics and Science Academy
Abstract/Project Intention:
This project examines the correlation between economic income and park availability for suburban areas of the United States. As economic differences become more drastic, the effects of income on lives becomes increasingly important, especially for less considered, but still important and appreciated aspects of life, like park accessibility. To do this, this project uses the R programming language, data gathered from the United States census, as well as data gathered from open park datasets. Regions are divided by zip code, meaning the socioeconomic status for any zip code is an average, and data is not compiled on the individual level. Only suburban areas are used, as space for parks is a larger obstacle in cities than in suburban areas; rural areas are unlikely to have parks at all, which would skew the results. Still, there is enough socioeconomic spread in suburbs to provide legitimate and useful data. Additionally, because parks are likely built based on the number of people who would use them, population density of the area is taken into account. The purpose of this project is to reflect on the tendencies and patterns of government spending on areas with lower income levels.

Project ID: BHVSO 10
9:30a.m. – 9:45a.m.

Title: Racial, Gender, and Socioeconomic Diversity as Factors of Academic Success in Post-Secondary Institutions

Presenter(**s**): Eunice Kim
Mentor(**s**): Dr. Patrick Kearney, Illinois Mathematics and Science Academy

Abstract/**Project Intention**:
This paper recapitulates a project that investigates racial, gender, and socioeconomic diversity as factors of academic success in the largest 4-year colleges in each state. By doing so, the project strives to change public perceptions about the role that diversity plays in college admissions. If direct correlations are found, the resulting inferences could have great influence over the future of college' admissions processes. Although society is becoming more accepting towards various social groups, perspectives surrounding the consideration of diversity in college decisions are lamentably still manifold. These perspectives can be bisected into exceedingly divergent sides. One readily encourages diversity as a factor in admissions, while the other instead believes that true equality signifies being blind to any applicant's race, gender, and socioeconomic status. Those who believe in the latter believe that unqualified students from diverse backgrounds are accepted into institutions. In their view, this makes the academic performance of that institution significantly lower than what it could have been if "true equality," in their sense, was observed in the admissions process. In response, this research paper will provide a statistical approach to demonstrating whether different types of diversity hinder the academic success of an institution.

Project ID: BHVSO 18
9:30a.m. – 9:45a.m.

Title: Investigation of Student Inquiry and Research through Media
Presenter: Francesca Dumitrescu
Mentor: Bill McGrail, Illinois Mathematics and Science Academy
Abstract/Project Intention:
At the Illinois Math and Science Academy, almost everyone is familiar with the Student Inquiry and Research program (SIR). This program allows students to communicate with mentors and conduct research on topics ranging from neuroscience to psychology. However, this program had to go through many changes, especially during the COVID-19 pandemic which resulted in distance learning for the 2020-2021 academic year. Therefore, the SIR program had to adjust its internal and external projects to the online environment. The intention of this project is to highlight the development of the SIR program as well as the diversity of the projects within it. It is important to highlight the vast differences, and this is made possible through the use of media, whether it is video, audio, or written. This project uses professional video, audio, and editing to create a mini-documentary that encompasses the essence of the SIR program while putting an emphasis on distance learning.

This project involves science film journalism techniques to effectively convey the depth of the SIR program. By using film journalism to investigate student research, we can learn how to communicate science to a wider community.

Project ID: BHVSO 21
9:30a.m. – 9:45a.m.

Title: Use of Data Analytics to Spot Educational Discrimination –
Part III - A Focus on Demographics and COVID-19 Data
Presenter: Oliver Ni
Mentor: Dr. Angel Alvarez, Northwestern Feinberg School of Medicine
Abstract/Project Intention:
Chicago Public Schools (CPS) is the nation's third largest school district and serves over 350,000 students within the city limits of Chicago. Yet, CPS draws scrutiny over its treatment of marginalized minority students as well as vast discrepancies in overall school performances. In order to spot potential inequities within the CPS system, we performed statistical analyses on publicly-available data and information obtained through FOIA requests on test scores, selective enrollment schools, discipline data, demographic changes, school reopenings, and other pertinent subjects. Analyses on median family income data, when compared to the CPS' six-factor socioeconomic tier system, revealed that home ownership rates and the percentage of foreign language-speaking families were poor at determining the financial state of neighborhoods. A comparison of the percentages of students on free or reduced lunch across a four year span also echo growing trends of gentrification within Chicago. Finally, schools from more affluent, white-majority areas of the city saw much higher percentages of students returning to school following the pandemic compared to less affluent, Black/Latinx-majority areas. These trends mirror the lower vaccination percentages and higher death rates in less affluent regions, showing CPS' and Chicago's inability to effectively protect disenfranchised students.

Project ID: BIO 02
9:30a.m. – 9:45a.m.

Title: How Glioblastoma Stem-like Cells cause Brain Cancer
Presenter(s): Rujuta Durwas
Mentor(s): Dr. Sowmya Anjur, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Glioblastoma multiforme, or GBM, is a malevolent tumor that affects the spine and brain. It tends to create pressure and spreads rather quickly through the body. GBM holds a subset of cells called glioblastoma stem-like cells (GSCs). Those cells lead to tumor recurrence and are responsible for the aggressiveness, recurrence and resistance to treatments of GBM. Cancer stem cells arise out of normal stem cells and often have the ability to cause relapses in cancer and the recreation of a tumor, GBM in this case. The research study has shown that mature cancer cells go through proliferation leading to their growth and can cause the growth of the brain tumor.

Project ID: BIO 08
9:30a.m. – 9:45a.m.

Title: Effect of Knockdown Treatments on Keratinocyte Differentiation
Presenter(s): Rohit Katakam, Margaret Wei
Mentor(s): Sui Huang, Northwestern, Feinberg School of Medicine
Abstract/Project Intention:
Keratinocytes are structures in the human epidermis that highlight the differences between the basal and surface layers of the skin. In a small area, all stages of cell differentiation can be observed in a single keratinocyte sample. The treatments used were siControl Dharamcon, siControl Nitrogen, siNPM1, siRPA194, and siUTP4. For this reason, keratinocytes were used to analyze the changes in cell differentiation between various knockdown treatments. Immunofluorescence was used to obtain images of keratinocytes. For each image, data was collected both on nucleoli (TxRed channel) and centromeres (FITC channel) throughout different stages of differentiation. Each nucleus (DAPI channel), was categorized into one of four layers, with layer one being the basal layer and layer four being the surface layer. The data was then analyzed to determine the effect of treatments on differentiation as well as the role of centromeres and nucleoli in the process. The data suggested that siRPA194 greatly increased the rate of differentiation. (Results of other treatments are still being collected.)

Project ID: BIO 13
9:30a.m. – 9:45a.m.

Title: Motor Unit Firing Pattern Variation between the Upper and Lower Limbs in Humans

Presenter: Saicharan Voora
Mentors: Obaid Ul Haq Khurram, Gregory E. Pearcey, Charles J. Heckman
, Northwestern University Feinberg School of Medicine

Abstract/Project Intention:
The basic unit for motor control is the motor unit which consists of the motor neuron, its axon, the muscle fibers, the axon innervates in the target muscle. Due to the one-to-one spike ratio between motor neurons and the muscle fibers they innervate, motor unit firing patterns can be easily measured to better understand motor control mechanisms and the structure of the musculoskeletal system. An important mediator of motor unit firing patterns is the persistent inward current (PIC) which is a lasting, inward flow of ions that elucidates large magnitude changes in output from the motor neuron. An estimate of the PIC can be derived from the well-established paired motor unit analysis technique, which compares the onset and offset of a high-threshold motor unit (ΔF). Preliminary lab studies have shown that proximal muscles in the arms generate motor unit firing patterns consistent with high neuromodulatory drive (i.e. ΔF = ~4–6 spikes/s), whereas distal muscles show lower neuromodulatory drive (i.e. ΔF = ~2–3 spikes/s). However, this proximal to distal gradient is not found within the lower limbs as the activation of the quadriceps generates motor unit firing patterns consistent with moderate neuromodulatory drive (i.e. ΔF = ~3.5 spikes/s), which is similar to the more distal muscles in the upper limbs. These findings reflect the differences in motor tasks and the functional organization between the arms and legs in bipeds.

Project ID: BIO 15
9:30a.m. – 9:45a.m.

Title: Regulation of the Rubisco activase isoforms in *Zea mays* through Mg^{2+} and concentration under temperature constraints

Presenter(s): Amanda Chen, Fania Si
Mentor(s): Sarah C. Stainbrook, PhD, Washington University in St. Louis

Abstract/Project Intention:
Over the next century, higher temperatures perpetuated by global warming influence crop production in climate-change-induced yield loss. The enzyme Rubisco activase (RCA) is a key protein that removes inhibitors from Rubisco, the enzyme responsible for the carbon dioxide fixation during photosynthesis. High temperatures impede RCA's efficiency and in turn slow down the net rate of photosynthesis. In maize, two isoforms of RCA are regulated differently in regards to light.

Our research examined the differences between the α and β isoforms in maize and how they were affected by heat, concentration of RCA, and magnesium (Mg^{2+}) activation.

We harvested leaf tissue via grinding in liquid nitrogen, purified Rubisco and RCA purified, and confirmed by Coomassie stain and Western blot. We also cloned each isoform in *Escherichia coli* and expressed them for purification. All tests compared RCA purified from maize vs each isoform expressed from *E. coli*. We measured RCA activity using ATPase and 3PGA production, coupled to NADH absorption for a spectrophotometric readout.

Project ID: BizIN 06
9:30a.m. – 9:45a.m.

Title: Regulation of Vitamin D deficiency within Child PANDAS patients
Presenter: Gabe Delgado
Mentor: Dr. Dareen Siri, Midwest Allergy Sinus Asthma S.C.
Abstract/Project Intention:
Numerous studies from the National Center for Biotechnology Information (NCBI) have proven that there is an association between autoimmunity regulation and Vitamin D deficiency. Consequently, it has been theorized that improvement of Vitamin D levels will also help moderate autoimmunity levels. However, there are not many studies, if any, on the regulation of the PANDAS (Pediatric Autoimmune Neuropsychiatric Disorders Associated with Streptococcal Infections) autoimmune disease by Vitamin D in child patients. Over a 7 month period, measurement data of 91 total patients with PANDAS, including vitamin D 25-hydroxy level, gender, and age of diagnosis, were collected from the MASA (Midwest Allergy Sinus Asthma) patient database. Vitamin D categories consisted of deficiency, insufficiency, and sufficiency, with respective ranges of 0 to < 20 ng/ml, 20 to < 30 ng/ml, and 30-100 ng/ml. Patients were also categorized into two separate age groups of 11 and under and 12-17 years old. Demographic data, defined by the patient's gender, age group, and deficiency range, was then collected and formulated into three bar graphs. If there proves to be a significant association between vitamin D deficiency and the autoimmune disease PANDAS in children, the existence of this trend will serve as an indicator for PANDAS development.

Project ID: BizIN 12
9:30a.m. – 9:45a.m.

Title: Web Development and Marketing with MASA
Presenter(s): Monica Narciso
Mentor(s): Dareen Siri, Midwest Allergy Sinus Asthma S.C
Abstract/Project intention:
Midwest Allergy Sinus Asthma S.C. is a medical office (healthcare company) located in Springfield, IL. and Normal, IL which specializes in allergy and immunology medicine. Services include environmental and food allergy testing, allergy action plans, asthma care, sinusitis treatment, immunology, treatment for hives, and contact dermatitis. Up-to-date information is also found on their website, asthma2.com. The main focus of this business project was marketing by presenting resources through MASA's website. This goal has not changed since the beginning of this project. By learning more about SEO and web development techniques, my understanding of this topic has been enhanced. The goal of this project is to eventually present a full website.

Project ID: BizIN 18
9:30a.m. – 9:45a.m.

Title: Blabl Content Creation and Market Research
Presentor(s) Mark Ying
Mentor(s): Ayan Agarwal, Blabl
Abstract/Project intention:
Blabl is an app that helps kids practice their speech through stories that are child-oriented and fun as they move through levels and maps in the game. The app also has an online dashboard that allows parents and speech language pathologists (SLP's) to monitor and stay informed with their child's performance. Building upon previous market research and tasks, this project's goal was to create new content for the app. One of the most requested features requested by clients in previous pilot programs was where SLP's can focus on the "Late Eights'' sounds with their patients. By creating this feature, our app will be more appealing for more users and help us increase our customer base. Another goal was to identify specific people who work with our target audience of young children and would also want to use our app. We needed to get our app into the hands of speech language pathologists, whether they be in schools or private clinics, through free pilot programs and cold-calling. This way, we can get our product into the hands of more parents and SLP's, who would be able to recommend it to other people and help the app further expand its customer base.

Project ID: CHEM 05
9:30a.m. – 9:45a.m.

Title: COVID Moonshot Computer-Aided Drug Design of SARS-CoV-2 Oral Antivirals
Presenters: Saachi Kumar and Ruchi Patel
Mentor: John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project intention:
Through this study, ten compounds that could potentially serve as an oral antiviral for the SARS-CoV-2 virus have been submitted to the crowdsourced COVID Moonshot initiative for synthesis and lab testing. The SARS-CoV-2 virus outbreak has caused the spread of COVID-19, resulting in 2.6 million deaths worldwide since January 2020 as of March 2021. Although the availability of the Pfizer and Moderna vaccines that emerged in December 2020 is increasing, there is still a need for drug design centered around an oral antiviral to facilitate quicker distribution and administration. Targeting the main SARS-CoV-2 protease (Mpro) and the papain-like protease (PLPro) that regulates SARS-CoV-2, we started with a fragment compound from the COVID Moonshot database. Using computer-aided drug design programs including SeeSar and ADMESAR or SwissADME, we designed 368 compounds and narrowed down our selected compounds according to binding affinity, toxicity, and several other factors. Our final ten compounds held the most promise out of any of the novel compounds we designed from our initial fragment and are currently under consideration by COVID Moonshot.

Project ID: CMPS 04
9:30a.m. – 9:45a.m.

Title: A Machine Learning Approach to Predict Schizophrenia from SNP-Array Based Genomic Data

Presenter(s): Chandra Gangavarapu
Mentor(s): Jubao Duan Ph.D., NorthShore University Health System, Research Institute

Abstract/Project Intention:
Although the use of machine learning for disease detection has seen a sharp increase within the past several years, diagnostic methods for mental illnesses such as schizophrenia remain largely qualitative. This project aims to introduce a data-driven diagnosis by using genomic wide array data to predict schizophrenia. Various machine learning models using Python and TensorFlow were run on a dataset of 5334 subjects' genomes from 17262 loci provided by NorthShore University HealthSystem. A linear dimensional analysis run on the raw data revealed that variables were collinear. Various support vector machine tests were also conducted, and the radial basis function kernel resulted in an average accuracy rate of 72.97%. A convolutional neural network structured as a five-layer sequential model for binary image classification with the adaptive moment estimation optimizer is being altered to further improve accuracy. Currently, a recurrent neural network is being built to understand the efficiency and use of general neural networks. Since a target accuracy rate lies above 95%, future steps include utilizing different parameters and data formats to improve the machine learning pipeline. The future of quantitative mental illness detection remains promising, but more data and a more intricate pipeline are necessary for greater results.

Project ID: CMPS 05
9:30a.m. – 9:45a.m.

Title: Quantification of TDP-43 inclusions in images of neurons
Presenter(s): Ju-Won Park
Mentor(s): Dr. Jane Wu, Northwestern University, Feinberg School of Medicine
Abstract/Project Intention:
TAR DNA-binding protein 43 (TDP-43) accumulates in the neurons and glia and has been linked to neurodegenerative diseases like frontotemporal dementia, amyotrophic lateral sclerosis (ALS), and Alzheimer's disease. The project aims to quantify immunostaining signals of TDP inclusions for the nuclear position, type of staining patterns (homogeneous or granular/punctate), and subcellular distribution patterns in neurons. A library of images of neurons was compiled from neuronal morphology textbooks with immuno-histochemical or hematoxylin and eosin (H&E) staining at different magnifications. These images will be used to roughly estimate the precision of the algorithm. The algorithm is being developed with Image J, a Java-based image processing program. In the future, a machine learning model can be trained to recognize immunostaining signal types and distribution patterns. This will allow quantitative analysis of neuronal images and high-throughput quantification of TDP inclusions for future studies involving this protein.

Project ID: ENGN 03
9:30a.m. – 9:45a.m.

Title: Water Purification for the Developing World
Presenters: Grace Smith and Arthur Wang
Mentor: Mark Carlson, Illinois Mathematics and Science Academy
Abstract/Project Intention:
In many communities around the world, people have no option but to drink from contaminated water sources, resulting in 3.4 million deaths annually. Our goal was to reduce this number by creating filters to eliminate 99.9% of bacteria while maintaining a 2L/hr filtration rate to sustain a family in the developing world. Sections of white pine boughs, approximately 2.5-4 cm in diameter, were secured into the necks of 500-700mL plastic water bottles. Flow rates were extrapolated from the time taken to collect 300 mL, with initial reservoir heights ranging from 10 to 18 cm. When supplied with clean water, the wood filters were capable of meeting the 2L/hr requirement (with flow rates ranging from 1.6L/hr to 6L/hr), but the xylem appeared to clog when particulates were introduced. A stainless steel mesh pre-filter was added to remove larger particles and it reduced the overall particle load, a result confirmed both visually and quantitatively via spectroscopy. The future direction of this project would involve bacterial testing, filter lifespan evaluation, and automation of the filtration process.

Project ID: MEDH 01
9:30a.m. – 9:45a.m.

Title: Research and analysis of compounds designed to aid in treatment for SARS-CoV-2

Presenters: Elizabeth Alcala, Nadia Ludwig, and Sabrina Zhang
Mentor: Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:
At the beginning of the school year in August 2020, the COVID-19 pandemic was still ongoing, resulting in a surge of formulating treatments for the disease. In early 2020, a project called COVID Moonshot was launched in the hopes of scientists sharing their findings and synthesizing compounds to formulate COVID therapeutics. As student researchers, compounds were designed along with other scientists' work around the world through COVID Moonshot, using Computer-aided drug design programs such as SwissADME and SeeSAR. Specifically, the fragment x0397 was focused on, in which the fragment was designed into new compounds in SeeSAR and ran through SwissADME to determine whether or not they were usable by seeing whether or not Lipinski's rules of 5 were violated. Eventually, the selected compounds will be synthesized for further development. Overall, the new compounds have a decent candidacy for the COVID Moonshot program because of the promising binding affinity values as well as passing Lipinski's rules. After undergoing further testing, the compounds and information are hoped to be exercised in a way that further pushes the world into recovery from the COVID-19 pandemic.

Project ID: MEDH 26
9:30a.m. – 9:45a.m.

Title: Determining the Physiological Effects of Opioid Addiction through the Application of Spared Nerve Injury Model of Neuropathic Pain on the Morphine Self-Administration Rodent Model

Presenter(s): Hiteshi Patel
Mentors(s): Maria Virginia Centeno, A. Vania Apkarian,
Northwestern, Feinberg School of Medicine

Abstract/Project Intention:
The aim of this project is to determine whether morphine reinforcement and seeking behavior in enhanced in SNI mice trained to self-administer morphine. Testing was completed by examining behavioral approaches of both SNI and sham lesioned mice, with a focus in MSA. Mice were tested 2 months after catheter implantation, with active doses of 0.1/mg/kg/infusion. An FR1, 13 days training procedure was used, with each level press triggering illumination of the cue light for 6 seconds and the in-house light for 20 seconds to indicate a timeout period. To determine the reinforcing capacity of the morphine, a progressive ratio schedule was used to quantify seeking behavior extinction and reinstatement through drug-primed and pain-induced reinstatement, which showed a clear distinction between SNI and Sham addiction patterns. These results can be used to guide chemogenetic manipulation of key nodes in the VTA-NAc circuitry in an attempt to reverse SNI-induced changes in drug seeking behavior; particularly regarding the VTA DA neurons that intersection the shell and core as well as investigating if the MSA alters the SNI induced adaptations.

Project ID: MEDH 31
9:30a.m. – 9:45a.m.

Title: Sex-Specific Changes in Brain Amyloidosis and Microglia Phenotype in Germ-Free APPPS1-21 Alzheimer's Transgenic Mice
Presenter(s): Siva Nalabothu
Mentor(s): Dr. Sangram Sisodia, University of Chicago, Dept. of Neurobiology
Abstract/Project Intention:
Recent evidence suggests that gut microbiota play a critical role in regulating innate immunity and influencing brain function. Clinical studies revealed an association between brain amyloidosis and the presence of pathogenic bacteria in the gut of cognitively impaired patients. Our previous study concluded that an ABX-perturbed microbiome has selective, sex-specific influences on brain amyloid (Abeta) amyloidosis and microglial homeostasis. The actual mechanism by which the gut microbiome influences Alzheimer's pathogenesis has yet to be identified. Here, we explored germfree (GF) Alzheimer's transgenic APPPS1-21 mice for amyloidosis and microgliosis phenotype. Both GF male and female mice showed significantly larger ceca compared with specific-pathogen free (SPF) mice. Cerebral amyloidosis was quantified using 3D6 marker and immunohistochemistry. Data from this study strengthen our previously established microbiota-brain axis results. Upcoming experiments exploring cortical transcriptome profiles will shed light on the neuro-immune interaction in this GF APPPS1-21 mouse model.

Project ID: PHYS 01
9:30a.m. – 9:45a.m.

Title: Expected production cross sections for doubly charged Higgs bosons in photon collisions
Presenter(s): Balaji Balachandran and Alexander Zhang
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
We present the results of our analysis of the expected production cross sections for doubly charged Higgs bosons in photon-photon collisions. We use PYTHIA software to generate collision events and calculate cross sections under a variety of conditions. This analysis allows us to study the possible prospects of photon-photon colliders, which have been a topic of interest among physicists for many decades, and we probe their potential in exploring left-right symmetric models that extend on the Standard Model. The data produced from this experiment can serve to inform the prospects of future experiments analyzing photon-photon collisions.

Project ID: PHYS 05
9:30a.m. – 9:45a.m.

Title: Limit setting and coverage checks in a search for contact interactions
Presenter(s): Ysabel Guan
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
When analyzing data in particle physics there are two different statistical lenses that people use: Bayesian and frequentist. The core of Bayesian statistics is the subjective belief that a certain result is true or falls within a certain interval while the core of frequentist statistics is the frequency, or amount of times, that the experiments show a result to be true or to fall within a certain interval. Because of how different they are, in order for both Bayesians and frequentists to agree upon the results, there must be a way to reconcile the two--which comes in the form of coverage checks. Throughout the past year I have been finding how good the coverage is for our method of limit setting while searching for contact interactions as a model of quark-lepton compositeness, and with a beta of 0.000558 and beta = 1/lambda^2, the coverage is 99.8% and the median interval of the limit is 33.3 TeV < Lambda < 50.8 TeV.

Project ID: PHYS 17
9:30a.m. – 9:45a.m.

Title: Restructuring CIAnalysis Code
Presenter(s): Sameer Komoravolu & Liam Nelson
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Produce Efficient Histograms to display particle data.

We have restructured parts of a common code base to make it easier and more efficient for IMSA researchers to perform systematic studies. For one, the existing histogram pathing results in connection errors when the researcher tries to view the root file. We fixed this, and we continued to change the code to output all AnalysisModule data to a root file so that all potentially important data—such as the output of the mass reconstruction analysis—is readily available for researchers.

Session II - 10:05a.m. - 10:20a.m.

Project ID: BHVS 03
10:05a.m. - 10:20a.m.

Title: How Does Access to Public Transit Affect Quality of Life
Presenter(s): Luke Davis
Mentor(s): Patrick Kearney, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The goals of my project have been to find the value of public transportation as it relates to quality of life. Public transit is an expensive piece of many cities, and the people who pay for it are the taxpayers, using income. I am hoping to see my data as clear visual representations of this relation. My data and the perspective from which I am analyzing it can be seen many different ways, as the amount of data the APTA reports yearly is more than abundant. Thus far, the Metrics that are best suited for my research are the availability of public transit in relation to the population using it comparatively to the Metropolitan data on income. Currently, I am getting percentage of people using the public transit compared to the population, this singular number makes it easier to compare to the singular number that is population. The end goal is to synthesize my understandings I've gotten through research into a format that is easily communicable.

Project ID: BHVS 11
10:05a.m. - 10:20a.m.

Title: The Effect of Household Income on the Outcome of Gubernatorial Elections in the Midwest

Presenter(s): Peter Leahy
Mentor(s): Patrick M. Kearney, Illinois Mathematics and Science Academy

Abstract/Project Intention:
There are a variety of internal and external factors that can possibly affect the decision a voter makes on Election Day. The purpose of this research is to identify if there is a correlation between household income (among other variables) and gubernatorial elections in the Midwest, which could be useful for evaluating potential outcomes of an election in a given year. I collected data from the US census and state election commission websites and compiled it all into a format where I used the language "R" to analyze it. R analyzed the election data and variables from 3 election cycles. My research found that counties in the Midwest tend to vote more for Democratic candidates. Counties with more college educated individuals, fewer white people, and with higher-aged populations also tend to vote more liberally. My results are fairly consistent with past research, indicating that voting trends in the Midwest are similar to trends found at a national level.

Project ID: BHVS 12
10:05a.m. - 10:20a.m.

Title: Correlation Study of Basic Psychological Need Support and Self Efficacy on Student Performance in College
Presenter(s): Samuel Lee
Mentor(s): Patrick Kearney, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Self-determination theory (SDT) is a mega-theory about motivation. Basic Psychological Need Theory (BPNT), a sub-theory of SDT, claims that motivation is fostered when all three basic psychological needs - autonomy, competence, and relatedness - are satisfied. Need-Based Teaching is a theory that aims to furnish these needs by producing autonomy support, structure, and involvement. Furthermore, self-efficacy is defined as the individual's belief in their capacity to execute behaviors necessary for specific personal attainments (Bandura).

Ayllon, Alsina, and Colomer gathered a dataset of 86,000 teaching evaluations by students in a University in Spain over three years in six subject domains. The survey asked the extent of the teacher providing autonomy support, structure, involvement, and self-efficacy, as well as the student's performance in the class, on a five-point scale. Since the researchers of the dataset did not give a justification for using a normal linear regression model, I hypothesized that there might be interaction effects between the need supports and self-efficacy. I divided the dataset into year and subject, then applied a multilinear regression with interaction effects.

Project ID: BHVS 22
10:05a.m. - 10:20a.m.

Title: An Alternative Approach to Educational Neuroscience and Investigative Neurology

Presenter(s): Jayavignesh Ganesan, Niyati Kapadia, Pranav Manoj
Mentor(s): Dr. Angel Alvarez, Northwestern University, Feinberg School of Medicine

Abstract/Project Intention:
This paper aims to present a comprehensive view of the widely acknowledged correspondence between educational neuroscience and investigative neurology, introducing a systematic study by which the unanswered questions of its contemporary research may be thoroughly explored. Researchers strive to identify the biological structures that underlie classical cognition, and to, in a novel fashion, develop an efficient methodology and practice by which such evaluation is regularly feasible. Subsequent development and advancement in neurological disciplines permits further empirical study of the seemingly metaphysical properties that govern biological thought, and resultant innovation is thereby increasingly attainable. In the current context, researchers strive to demonstrate the implications of educational inquiry in sustainable academic advancement and engender a series of modular lesson plans and inquiry-based experiments by which summative conclusions as to the nature of foundational neuroscience may be perceived and drawn. Data representative of a plethora of biological systems, e.g., sensorimotor, visual, and perceptual pathways will be collected following student completion of the aforementioned educational investigations, and subsequent analyzation and consolidation permits an enhanced understanding of neurological phenomena while simultaneously enabling school-age students to collaboratively pursue distinctive intellectual interests by means of an inquiry-based and interdisciplinary attitude towards learning.

Project ID: BIO 07
10:05a.m. - 10:20a.m.

Title: The role of Amyloid-beta oligomers in the developing CNS
Presenter(s): Ashley Koca, Shreya Pattisapu
Mentor(s): Samuel Bartley, Northwestern University
Abstract/Project Intention:
The buildup of Amyloid-beta oligomers (AβOs) is regarded as a central toxic event in Alzheimer's disease (AD) development. Recently, AβOs have been found in the developing chick retina but do not cause a disease state. Conserved by evolution, the functional role of these AβOs in retinal development is not currently known. Our team in the Klein Lab has found that these AβOs are transiently expressed, appearing in retinal layers associated with nerve cell death as well as synapse formation. Using an ex-ovo culture method and intravitreal injections, we can manipulate the expression of AβOs in the chick retina to observe developmental changes. Chick embryos are grown outside of the egg shell to E9 and receive an intravitreal injection of either a BACE-1 inhibitor or an AβO antibody. The eyes are then dissected at E15 and stained with antibodies for fluorescence microscopy. Our team has found that inhibiting AβO function between E9-E15 induces significant disruptions in retina lamination, forming omega and polyp-like protrusions dubbed "gibba". Our current project focuses on the function of NaK-ATPase and its relation to AβOs in two competing outlooks: whether AβOs are inhibiting the enzymatic activity of the NaK-ATPase or are disrupting the localization of NaK-ATPase on cellular membranes.

Project ID: BIO 16
10:05a.m. - 10:20a.m.

Title: Investigating plastome expression of Rubisco Activase in Chlamydomonas reinhardtii as a platform for directed evolution
Presenter(s): Adam Daki, Kevin Qu, Rishik Ummareddy
Mentor(s): Sarah Stainbrook, Washington University, St. Louis
Abstract/Project Intention:
Rising temperatures due to global warming spur concerns over whether plant life will be able to feed the rapidly growing global population. One solution is to improve the resilience of plants to climate change through genetic modification. Rubisco activase (RCA) is a particularly important target because it loses efficiency rapidly at high temperatures, impairing photosynthesis. Our goal is to engineer a system for expressing Rubisco Activase variants from the chloroplast genome in Chlamydomonas reinhardtii. We can characterize the effects of these variants on assimilation and cell growth at various temperatures. Ultimately, this system will enable directed evolution of RCA isoforms for improved thermotolerance. To do this, we have built plasmids with several different promoters using Golden Gate cloning, integrated them into the Chlamydomonas plastome, and characterized gene expression from each promoter by measuring the expression of the mVenus fluorescent protein. In this work we compare the growth of RCA-knockout strains vs. the wild-type in multiple media types. We plan to use the data of this experiment in next year's research, where we will investigate whether different RCA types can be used to characterize heat tolerance of algal photosynthesis in order to improve the heat tolerance of RCA via directed evolution.

Project ID: BizIN 01
10:05a.m. - 10:20a.m.

Title: Significance in Preparation
Presenter: Anne Marie Bacon
Mentor: Paula Quinn, Technexus
Abstract/Project Intention:
Technexus is a venture investment company that connects leading corporations with ventures in an effort to create potential growth opportunities. Over the last six months, various teams within the company provided insight into how venture investment companies such as Technexus find, connect, nurture, and assist start-ups in an effort to help ensure their success in their field. One of the most significant factors to ensuring success includes extensive research on entire genres of companies prior to the formation of connections to ensure that values, expectations, and goals are agreed upon before the construction of a relationship between corporations and ventures. Doing so ensures that no time is spent creating an unhelpful connection.

Project ID: BizIN 07
10:05a.m. - 10:20a.m.

Title: Analyzing and Predicting hydrogen capacity for the future energy ecosystem
Presenter(s): Minseo "Emily" Jung
Mentor(s): Alan Ahn, Global America Business Institute
Abstract/Project intention:
Impacts of climate change are becoming more evident across the world and expecting to become increasingly disruptive in just a few decades. To prevent the global temperature from rising, using cleaner energy is becoming significantly important. Advancements in hydrogen solution, one of the cleanest energy available, can increase renewable energy sector efficiency by strategizing new clean solutions for the future. The research aims to determine whether there is a correlation between dependence on energy imports and hydrogen production to predict hydrogen production across countries in the future. This project also attempts to predict the degree of hydrogen production from the panel regression model across 25 countries. It is rational to assume that the higher the dependence on energy import, the more hydrogen energy will generate, reducing the reliance on imported non-renewables. Furthermore, more technology and infrastructure related to the hydrogen economy will lead to higher hydrogen production efficiency. The research will explore a relationship between hydrogen production and the degree of energy import after controlling for other factors such as GDP, GDP per capita, and energy R&D expenditures through panel regression analysis.

Project ID: BizIN 13
10:05a.m. - 10:20a.m.

Title: Business Development with Speeko
Presenter(s): Eric Pan
Mentor(s): Nico Aguilar, Speeko
Abstract/Project intention:
Speeko is an application on iPhones and iPads that aims to improve public speaking skills through the use of artificial intelligence. Users are able to record their voice, which the app then gives immediate feedback and tailored lessons to refine their speech. The focus of the business project is to increase Speeko's market prevalence and digital footprint through an affiliate program. Leveraging the existing followings of social media influencers, Speeko will able to gain traction more quickly than its current social media strategy. With this project, Speeko has benefited by pushing customers towards the BOTF, or the bottom of the funnel.

Project ID: BizIN 19
10:05a.m. - 10:20a.m.

Title: Sales and Financial Management with Siesta Wrap
Presentor(s): Edward Zhang
Mentor(s): Pinakini Thakkar, Siesta Wrap
Abstract/Project intention:
Deriving its name from the Spanish definition of "Short Afternoon Nap", the Siesta Wrap offers the comfortable support of a traditional pillow, and the warmth of a full-size blanket, in one product. The Siesta Wrap can fold into a compact design using a built-in pouch in the back of the pillow. Currently, Siesta Wrap is a growing startup and plans to break into several major avenues of sales. The focus of the current project is to analyze the different ways of selling traditional retail products and the optimal financial structure to optimize growth and profit. In addition, financial projections were used in this project to determine investment needs and other costs. Over the course of the previous year, Siesta Wrap gave opportunities to work with clients to make sales through retail and online platforms. There were many opportunities to contact and form partnerships with manufacturers and contractors. Siesta Wrap was able to benefit from this project by exploring different sales channels and financial strategies to determine the optimal pricing and sales structure moving forward

Project ID: CHEM 01
10:05a.m. - 10:20a.m.

Title: Design of COVID-19 Antivirals Using Computer Modeling
Presenter(s): Isabella Chen, Lethzeylee Gutierrez, Andrea Torres
Mentor(s): John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The discovery and development of effective antiviral drugs for COVID-19 are urgent and ongoing. An initiative to contribute to this process is COVID Moonshot project. The aim of the project is to rapidly develop easily manufacturable antiviral drugs that can inhibit the SARS-CoV-2 main protease. To provide leads for the intractable biological target in COVID, we used fragment-based drug discovery which identifies low-molecular weight ligands that bind to biologically important macromolecules. Our group started with the fragment x1086 from the COVID Moonshot Consortium and successfully designed new molecules in SeeSAR, a 3D modeling software platform. We designed the molecules from different bonds from the fragment and calculated their estimated affinities and other physicochemical properties. We selected the compounds with the best estimated affinities from the 341 compounds we designed in SeeSAR from each bond and entered them into swissADME and ADMETSAR, websites that predict physicochemical descriptors and absorption, digestion, metabolism, excretion, and toxicity (ADMETox) parameters. These websites allowed us to see if our best binding affinity molecules were druglike and had good ADMETox properties. Specifically, we looked at Lipinski's rules and human ether-à-go-go related genes (hERG inhibition). We submitted our best eight compounds, which demonstrated the best affinity and drug-like properties, from the 341 molecules that were designed to the COVID Moonshot Initiative for further testing and drug development.

Project ID: CMPS 02
10:05a.m. - 10:20a.m.

Title: Evaluating Machine Translation in Natural Language Processing
Presenter(s): Gloria Wang
Mentor(s): Ashique KhudaBukhsh; Zirui Wang, Carnegie Mellon University
Abstract/Project Intention:
Human evaluation of machine translation is extensive, but expensive and inefficient, thus, automated evaluation metrics were created. Yet despite recent advances in the field of machine translation, there has been little changed about standard automated evaluation metrics such as BLEU. As the quality of machine translation systems has dramatically improved over the past decade, evaluation becomes an increasingly challenging— and important— problem. The standardized use of automated evaluation metrics in machine translation assumes not only that the automated evaluation correlates strongly with human evaluation, but also that they are language independent. Yet recent research has shown that metrics such as BLEU may correlate poorly with human evaluation. Thus, the question arises that if such metrics correlate poorly with human evaluation in multilingual settings, do different languages need different evaluation metrics?

Project ID: CMPS 08
10:05a.m. - 10:20a.m.

Title: Generating and Analyzing High-Resolution Structural Connectomes for Breast Cancer Patients to Assess Cognitive Impairment

Presenter(s): Rachna Gupta
Mentor(s): Lei Wang, PhD, Northwestern University

Abstract/Project Intention:
Breast cancer patients have reported symptoms such as fatigue, insomnia, and depression while undergoing adjuvant therapy. Previous research has found that chemotherapy, a treatment for breast cancer, can lead to cognitive decline. However, the neurologic effects of other adjuvant therapies, such as hormone therapy, have yet to be fully explored. The objective of this study was to use diffusion tensor imaging (DTI) to assess structural connectivity changes through a wholebrain analysis and identify mechanisms of cognitive impairment in breast cancer patients receiving hormone treatment. High-resolution structural connectivity analysis was applied to the DTI scans from two groups: breast cancer patients who were undergoing hormone therapy at the time of study and healthy controls without a history of cancer. The incidence matrices were processed according to high-resolution structural connectivity analysis and converted into connectivity matrices, which quantify the connectivity between each neuron using individual network nodes. Group analysis was conducted using individual correlations between subject-specific degree maps and a population average degree map. Identifying the effects of hormone therapy on brain structural connectivity in breast cancer patients is vital to the development of future treatments to improve the quality of life for patients.

Project ID: ENGN 02
10:05a.m. - 10:20a.m.

Title: Designing a Virtual Shopping Robot
Presenters: Tanav Karnik; Grayson Pacourek
Mentor: Matthew McCutcheon, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The COVID-19 Pandemic has created opportunities for the development of new approaches to routine activities. Even after the pandemic ends, virtual alternatives to past in-person chores and errands will prove efficient and time saving. With robots becoming more and more advanced, they can be used to replace in-person activities that could be potentially dangerous or less favorable to the participants. One specific area for improvement is shopping. Due to the pandemic, many older, or potentially at risk, individuals struggle to find a safe way to shop. The purpose of this paper is to discuss a concept for a virtual shopping robot that aims to take the place of a person in a store. This robot can grab items that a user requires and gives the user an in-depth look at the products they are searching for. The robot is made of a rectangular 6' by 4' base that is driven by six omnidirectional wheels, providing for movement in cardinal directions and rotation. On the base is a storage system and an elevator with a grabbing mechanism to allow for the intake of items. Such a robot would allow for a safe and efficient purchasing of store items.

Project ID: MEDH 07
10:05a.m. - 10:20a.m.

Title: Designing Methotrexate Analogs to Improve Efficacy in Rheumatoid Arthritis
Presenter: Julianna Padilla
Mentor: John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The most commonly prescribed disease-modifying antirheumatic drug (DMARD) is methotrexate (MTX) because it is one of the most effective treatments for inflammation and it is relatively safe. Because it is taken at a low dose, it must be taken with other DMARDs to control the disease progression. To improve the efficacy of MTX in rheumatoid arthritis, its structure was modified in SeeSAR and analyzed on Swiss ADME. Six modified MTX analogs were selected from SeeSAR to be analyzed on SwissADME, and three of those compounds have the potential to be more effective than the current DMARD.

Project ID: MEDH 13
10:05a.m. - 10:20a.m.

Title: The Effectiveness of a Cultural Competency Curriculum Taught to Middle School Students, Social Media's Correlation with Mental Health, and the Future of Customizable 3D Printed Hands

June's Learning Lab (JLL) Part 1 – Social Media
Presenters: Annabelle Lu and Adriana Rodriguez

JLL Group: Thavaisya Ananth, Rowan Eggert, Zachary Eness, Jonah Fisher, Lily Isibue, Rachel Koterba, Annabelle Lu, Lucienne Petit, Megan Ptak, Adriana Rodriguez, and Christin Sanchez
Mentor(s): Mr. David Lundgren and Dr. Sowmya Anjur,
Illinois Mathematics and Science Academy

Abstract/Project Intention:
June's Learning Laboratory (JLL) has developed a cultural competency curriculum to educate middle school students about the cultures and experiences of those around them and their role in the world. We will conduct research testing the effectiveness of this newly constructed curriculum by comparing the data collected from the surveys given to the participants before and after being taught the curriculum. In recent years, the number of individuals interested in owning a cost-effective, multi-use prosthetic has grown. JLL is currently working towards creating inexpensive, customizable designs for future prosthetic hands to aid in a variety of daily activities. Unfortunately, due to the disruption caused by COVID-19, JLL possesses no feedback from prosthetic wearers on how to improve the design of the hand. Social media continues to grow as a platform, allowing individuals to share their lives with others; however, with the abundance of information available through such platforms, the mental health of individuals of all ages has been affected either positively or negatively. To determine the relationship between students and the effects of social media on their mental health, we developed a survey which has yet to be sent out and data is to be collected.

Project ID: MEDH 17
10:05a.m. - 10:20a.m.

Title: Evaluation of Cancer Antigen 125 and as Biomarkers and Therapeutic Targets

Presenter(s): Katelyn Ingles
Mentor(s): Dr. Sowmya Anjur, Illinois Mathematics and Science Academy

Abstract/Project Intention:
Ovarian cancer has the fifth lowest survival rate by cancer type at 48% after 5 years, however in earlier stages ovarian cancer has a lower mortality rate. This makes the use of biomarkers useful for tracking the progression of ovarian cancer and as a therapeutic target. In this research project two biomarkers were studied, CA-125 and MR-1, to form a hypothesis on which biomarker was better at tracking Ovarian cancer. A literature review was done to get an understanding of the biomarkers and open-source data was used to analyze the expression of the biomarkers in Ovarian Cancer. Data from CA-125 showed a correlation of higher CA-125 expression with a higher probability of Ovarian cancer. While current data and literature on MR-1 show it is a potential biomarker and target, however this data is still limited. While CA-125 is overexpressed in Ovarian cancer, it is also overexpressed in other common diseases as well, which limits its abilities as a diagnostic. While MR-1, while overexpressed in multiple cancer types, may show to be a better diagnostic.

Project ID: MEDH 19
10:05a.m. - 10:20a.m.

Title: Designing a multi-material nerve graft utilizing novel biofabrication techniques to promote peripheral nerve regeneration in injuries greater than 5.0 centimeters in length
Presenter(s): Cayleigh O'Hare
Mentor(s): Caralynn Collens, Dimension Inx
Abstract/Project Intention:
Over 20 million people in the United States have peripheral nerve injuries, which result in approximately $150 billion spent in annual health-care dollars in the United States. For those living with peripheral nerve injuries spanning over 5 centimeters, treatment options can be especially elusive. With a nine-month literature review spanning hundreds of journal articles as well as interviews with multiple experts, a novel theoretical peripheral nerve conduit was designed. Market requirements for an optimal nerve conduit include that it must promote neural regeneration, be surgically friendly, have a broad availability in a consistent form, be biocompatible, and eliminate donor site pain. Based upon the literature review and expert interviews, the following design inputs were established. Outer material of the conduit would be comprised of polycaprolactone (PCL), extruded through a 3-D printer into a scaffold. PCL is biodegradable and has been demonstrated to not trigger an immune response in the body. The unique nanostructure of the conduit would contribute to its high porosity; elevated porosity has been shown to promote cell adhesion, viability, and proliferation. Graphene would comprise the inner layer of the conduit, as it's highly electroconductive properties are conducive to better neural cell communication and has demonstrated biocompatibility.

Project ID: MEDH 32
10:05a.m. - 10:20a.m.

Title: Role of Estrogen Receptor in Breast Cancer Stem Cells
Presenter(s): Shreenithi Palamuthy
Mentor(s): Dr. Jonna Frasor, University of Illinois at Chicago
Abstract/Project Intention:
In general, estrogen receptor positive breast cancers (ER+ BC) have a high treatability. However, these tumors often recur following endocrine therapy due to breast cancer stem cell (BCSC) activity. BCSC are a group of cells that possess numerous properties, such as self-renewal and the ability to survive independently in the circulation and contribute to breast cancer relapse. Many studies have attempted to understand the activity of BCSC in ER+ BC. However, the role that the active ER plays in regulating BCSC activity is not well established. Studies have arrived at different conclusions on the impact that ER has on BCSC. This review will discuss the different findings of studies that describe the different roles that the ER plays in breast cancer stem cell activity.

Project ID: PHYS 06
10:05a.m. - 10:20a.m.

Title: Long-lived Dark Photons: Generation, Triggering, and Reconstruction
Presenter(s): Ellyn Hu
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Long-lived dark photons decay away from the initial particle collision location; thus, they fail all regular triggers, which dismiss vertices a certain distance from the center of the beam pipe. Since the resulting lepton jets are grouped closely together, we cannot perform isolation cuts either. To trigger the displaced lepton jets, we wrote a missing transverse energy trigger module with a threshold of >120 GeV, which finds the vertices from which the displaced lepton jets originate. We tracked the crossing between the helix of a lepton track and concentric cylinders of varying sizes around the beam pipe and calculated where the particles were closest to locate the displaced vertices. The overall trigger efficiency was 72.94%. We further examined what triggers produced the greatest acceptance by testing additional single, double, and triple muon and electron triggers on the lepton jet data samples.

Project ID: PHYS 10
10:05a.m. - 10:20a.m.

Title Estimating Acceptance for Multilepton Events as a Function of Invariant Mass
Presenter(s): Reese Ramos and Eric Shackelford
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
This analysis focuses on genera ng a histogram which records the rate of acceptance as a function of invariant mass. This entails developing two distinct histograms: one which records the total number of generated events within certain invariant mass ranges and a second which only counts events which successfully reconstruct two leptons of transverse momentum at least 50 GeV. The final histogram is calculated by dividing the bins of the second histogram by those of the first.

Project ID: PHYS 18
10:05a.m. - 10:20a.m.

Title: A Comprehensive Look at Nucleon Decay Modes for the DUNE Experiment
Presenter(s): Diego Michel
Mentor(s): Maury Goodman, Argonne National Laboratory
Abstract/Project Intention:
In the past, nucleons (protons and bound neutrons) were thought to have been absolutely stable; however. Since the 1970s, there have been a variety of theories in the form of Grand Unified Theories (GUTs) suggesting that they are not stable. Since then, various experiments have tried and failed to find solid evidence for this proton or nucleon decay, but DUNE seeks to change this, or to at least establish improved lifetime decay limits. Our current project focuses on the use of 100 decay modes on the decay of protons and nucleons, and compiling a list of comparisons for use for the DUNE Experiment. After this, we would calculate the efficiency of decaying particles to come out of the nucleus in the modes, and assuming they did get out, the possibility of reconstructing them. After this, we would compare it to the Super-K Experiment. After this, we are taking estimates of reconstruction efficiencies in a liquid argon detector, and attempting to recalculating our ability to see these mods in DUNE, and comparing that to Super-K.

Session II - 10:25a.m. - 10:40a.m.

Project ID: BHVSO 06
10:25a.m. - 10:40a.m.

Title: Influence of Foreign-Language Speakers on Party Success in Presidential Elections
Presenter(s): Caroline Hall
Mentor(s): Patrick Kearney, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Many factors contribute to the success of presidential candidates. Variations in racial diversity, immigrant demographics, and financial status have all been found to play a role in how any given community decides to cast their ballots. However, one factor that continues to be overlooked is the population of foreign-language speakers within a region. This study aims to find if that demographic has any significant impact on whether a county swings Democratic or Republican in elections.

In order to measure the amount of foreign-language speakers in a community, data was taken from the United States Census Bureau, measuring the percentage of individuals who speak a language other than English at home within several counties in Illinois. This was then compared against the percentage of individuals within the county who voted for Democratic or Republican candidates. A significant correlation between these two factors would indicate that either those who speak foreign languages tend to be more supportive of one party, or that the presence of foreign-language speakers influences party support for others in the same community.

Project ID: BHVSO 13
10:25a.m. - 10:40a.m.

Title: COVID-19 and Global Freedom
Presenter(s): Bhargav Sampathkumaran
Mentor(s): Mr. Patrick Kearney, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The aim of this study is to answer the following question as thoroughly as possible: how has the COVID-19 pandemic effected the global standing of both personal and political freedom? To do this, the study uses the Freedom in the World Index (FIW) scores for 2020 and the trends that the new scores show compared to previous years. The FIW scores and their change from the respective 2019 scores for each country will be analyzed based on several different factors, including severity of the pandemic in different countries (measured in cases per 100,000), a government stringency index based on how strict responses from different countries were in 2020, and GDP per capita to examine if the varying economic capabilities of countries and how that may have effected pandemic severity and stringency in government response (and how it may have affected the FIW scores indirectly through both factors). All analyses were conducted through the programming language R and the text editor R Studio.

Project ID: BHVSO 14
10:25a.m. - 10:40a.m.

Title: The Impact of Women on Annual Household Income per County
Presenters: Cordelia Sirais, Shivani Venkatraman
Mentor: Patrick Kearney, Illinois Mathematics and Science Academy
Abstract/Project Intention:
In the United States, gender roles have always played a large part in economic growth. However, to what extent do they still affect the modern world, and how does it affect financial wellbeing? This project will explore if there is a correlation between the ratio of women to men and average annual income on a county-level, and examine possible trends that develop, on a local (individual state) and national (state-by-state) level. In order to determine if there is a significant relationship, datasets in both areas will be compiled and studied using various graphical methods and statistical tests—examining for patterns and correlations. The current results of data analysis will show that, within Illinois, the closer the ratio is to an even distribution, or 1:1, the higher the average annual household income. This data will also be looked at in conjunction with the average annual income rates of breadwinning mothers, who still "consistently earn less than their male counterparts at all income levels" (Glynn 2019). The data for this project illustrates that, economically, counties seem to do best with an even split of male and female residents, and examines possible reasons behind this relationship.

Project ID: BIO 10
10:25a.m. - 10:40a.m.

Title: CRF Input to the External Globus Pallidus
Presenter(s): Ahana Narayanan
Mentor(s): Qiaoling Cui, Northwestern University
Abstract/Project Intention:
Stress results in fight or flight responses. Corticotropin-releasing factor (CRF) is a peptide hormone involved in the stress response, thus, CRF neurons are highly activated by stress. However, it is unclear how CRF neurons are involved in stress-evoked movement. The external globus pallidus(GPe), a nucleus in the basal ganglia that critically controls movement, expresses high levels of the primary receptor for CRF, suggesting that it is an entry point for stress-relevant information to reach basal ganglia circuits, gating motor output (Hunt et al., 2018). The paraventricular nucleus of the hypothalamus (PVN) represents a major source of CRF in the brain. To study the PVN CRF input to the GPe, anatomical, electrophysiological, and behavioral approaches were employed. We found that axons from PVN CRF neurons are present in the GPe. Stimulation of these axons induced inward currents and changed the firing rate selectively in PV+ GPe neurons. Stimulation of PVN CRF axons in the GPe did not appear to regulate movement while striatal inputs, the predominant input to the GPe, play a significant role. Further studies are needed to examine if PVN CRF input is involved in regulating other functions mediated by the GPe.

Project ID: BIO 14
10:25a.m. - 10:40a.m.

Title: Overview of Breast Cancer Stem Cell Methods
Presenter(s): Utsa Bhattacharyya
Mentor(s): Jonna Frasor, University of Illinois at Chicago
Abstract/Project Intention:
Out of all breast cancer (BC) cases, approximately 70% are estrogen-receptor-positive (ER+) which means that estrogen receptor (ER) is present in tumors and drives proliferation. As ER+ BC is reliant on ER for growth, development, and survival, targeting ER with drugs like tamoxifen suppresses its activity and reduces tumor growth. However, approximately 40% of women relapse. BC stem cells (BCSCs) are thought to be the reason behind these deadly relapses. These cells have the ability to survive therapy and contribute to the recurrence of more aggressive and resistant tumors as a result. Therefore, understanding and targeting BCSCs is fundamental to the treatment of patients who might relapse. There is a variety of assays used to characterize BCSC properties in tumors. The aim of this paper is to examine three such methods: the mammosphere assay, fluorescence activated cell sorting (FACS) for common stem cell markers, and limiting dilution assay. Each of these identifies a different subpopulation of BCSCs, and the advantages and disadvantages of each method will be discussed.

Project ID: BIO 17
10:25a.m. - 10:40a.m.

Title: Computational Prediction of Mutagenesis in Soybean *Rubisco Activase* Monomer for Increased Thermal Stability

Presenter(s): Hamza Haq, Vas Ramesh; Jaden Wang
Mentor(s): Dr. Sarah Stainbrook, Washington University in St. Louis;
Dr. Angela Ahrendt, Illinois Mathematics and Science Academy

Abstract/Project Intention:
Due to the onset of climate change, measures must be taken to circumvent the decreased rate of net photosynthesis of *Glycine max* (soybean) under high temperatures. Although the decreased rate is due to a myriad of factors, one promising avenue to a solution is the enzyme rubisco activase (RCA). At higher temperatures, RCA is unable to activate Rubisco to fix carbon dioxide as quickly, leading to a decreased rate of net photosynthesis. We have attempted to improve the thermostability of RCA through computationally predicting the effects of single point mutations. Several computational tools were tested for accuracy utilizing experimental data previously obtained from Argonne National Laboratory. The tool PremPS was eventually selected since it was most accurate. Through PremPS, we tested a total of 399 mutations, of which 32.33% were predicted to be stabilizing. Mutagenic primer designs will allow the most successful theoretical mutations to be evaluated *in vitro*.
Using the strategies of mutating non-conserved residues, hexamer formation, monomer interaction, intramolecular bonds, Pymol location and bond identification, and hydrophobic properties in conjunction with single-point mutagenesis led to promising theoretical results of a more thermally stable RCA.

Project ID: BizIN 02
10:25a.m. - 10:40a.m.

Title: **Story Development with Blabl**
Presentor(s): Melena Braggs
Mentor(s): Ayan Agarwal, Babl
Abstract/Project intention:
Babl is an app that offers stories to aid children in speech therapy. The focus of the business project mainly consisted of creating stories to address the greatest speech concerns for children. Over the course of six months, the project allowed many opportunities to create imaginative stories as well as delve into the study of speech pathology. In the beginning, there was heavy collaboration between the business mentor and the interns. Inquiring about the target demographics for the story as well as the data collection process done by the application painted a better picture of what the end product would be. Interns were tasked with creating stories that integrated various phonetic sounds. Aside from the number of stories, the constraints put on the stories made writing them more challenging. The focus was on creating stories that contained the late eight sounds. These sounds are integral for improving someone's speech. This project was focused on addressing that.

Project ID: BizIN 08
10:25a.m. - 10:40a.m.

Title: IT Intern
Presentor(s): Rohit Kartha
Mentor(s): Brian Irving, Joseph Daniels
Abstract/Project intention:
The Illinois State Treasurers Office is a state government agency responsible for the management and protection of state funds. The Illinois State Treasurers ensures the liquidity of all the state's investments and aims to produce a consistent return on the state's capital. Over the course of six months, the company provided numerous opportunities to work with employees and gain insight on practical development structure. The focus of the business project is to analyze the different approaches to project development. After providing a brief explanation of each, the business project will then go into depth on what approach is best fit for the characteristics of a certain project. Over the course of the business project, the company will be benefited with a simple guide to approaches of code development that might lead to changes in the current procedure if necessary. The project will also serve as a useful guide in anyone entering development fields, as it will highlight all the common development approaches and practical uses of each.

Project ID: BizIN 14
10:25a.m. - 10:40a.m.

Title: Culture and Mental Health
Presenter(s): Haley Rodriguez
Mentor(s): Kevin Kusy, Illinois Mathematics and Science Academy
Abstract/Project intention:
Mental health can be affected by a combination of biological, environmental and psychological factors. This paper is a literature review focusing on if and how culture affects the mental health of those between the ages of thirteen and nineteen in the United States. There are many ways in which culture shows its influence. In some cultures, there are certain stigmas about mental health so people within that culture do not seek help. Additionally, cultures differ in the level of concern they give to mental illness. Every culture has its own way of making sense of an understanding of one's mental health. Each has its opinion on whether mental illness is real or imagined, who is at risk for it, what might cause it, and the level of stigma surrounding it. Cultural factors often determine how much support people have from their families and communities in seeking help. This paper will explore the different factors that contribute to a teen's mental health as well as the stigma surrounding mental health in different cultures.

Project ID: CMPS 07
10:25a.m. - 10:40a.m.

Title: Contrastive Multi-Modal Video Transformer
Presenter(s): Dev Singh
Mentor(s): Ismini Lourentzou, Virginia Tech; Chengxiang Zhai, UIUC
Abstract/Project Intention:
Transformer networks have shown great promise in video classification and understanding tasks by reducing the dependency on recurrent networks, and instead using self-attention techniques. Recurrent techniques are often not suitable for videos/data with long-term temporal dependencies due to the vanishing gradient problem, as well as the inability to fully backpropagate due to computational power restrictions. By using self-attention, a neural network can learn long-term dependencies with lower computational requirements and higher accuracy. We aim to increase the performance of self-supervised video transformer networks by contrasting frame-level local representations with the video-level global representations and determining how contrasting different representations from different data modalities may increase accuracy.

Project ID: ERSP 01
10:25a.m. - 10:40a.m.

Title: Estimating the Number of Earth-Sized Habitable Planets in our Galaxy
Presenters: Liam Archer, James Johnston, Evelyn Lee, Alice Li, Advait Patel, Shambhavi Raj, Manaal Shamsi, Kyler Yu
Mentor: Eric Hawker, Illinois Mathematics and Science Academy
Abstract/Project Intention:
NASA's Kepler Space Telescope was designed to determine the frequency of Earth-sized planets orbiting sun-like stars, and while the number of these planets detected by Kepler is already known, the efficiency and accuracy of the telescope's instruments are not extremely clear or precise. Using planetary transits accessed from Kepler lightcurve data, one can apply machine-learning methods for detecting transits and then run simulated transits through the model to find planets that failed to be spotted previously. Here, we utilize the Box Least Squares Method (BLS) alongside the Transit Least Squares Method (TLS) to search for transit-like features while taking into account features such as stellar limb darkening, orbital radii, transit depths, and planetary ingress and egress. Once the transits are detected, we can then calculate the efficiency of the telescope using the simulated transits, and this probability can be used in proportion to the number of Earth-sized habitable exoplanets in the Milky Way Galaxy.

Project ID: MATH 03
10:25a.m. - 10:40a.m.

Title: Self-Dual Bases for Self-Dual Hopf Algebras
Presenter(s): Patrick Borse
Mentor(s): Dr. Aaron Lauve, Loyola University Chicago
Abstract/Project Intention:
We consider when a graded, self-dual Hopf algebra $A = A_0 \oplus A_1 \oplus A_2 \oplus \ldots$, with graded isomorphisms $\Phi_n: A_n \to A_n^*$, has a self-dual basis. Motivated by the example of SSym over the reals, a self-dual algebra with no self-dual basis, we do this by analyzing the qualities of the map Φ_n. In particular, we have the general result that if this restricted map defines a real, symmetric, positive definite matrix, then A has a self-dual basis over C. We extend this to algebraically closed base fields, and show that SSym has a self-dual basis over C as a corollary.

Project ID: MEDH 04
10:25a.m. - 10:40a.m.

Drug Repurposing of Potential Inhibitors to Two Proteases of the Novel Coronavirus
Presenter(s): Joyce Li and Aidan Smith
Mentor(s): John Thurmond, Illinois Math and Science Academy
Abstract/Project Intention:
As the SARS-CoV-2 global pandemic rages on with new variants on the rise, rapid and effective therapeutic developments are needed more than ever before. Analyses that the repurposing of already approved FDA drugs has the potential to quickly showcase on the market drugs that can inhibit the replication of new viruses. Repurposing is especially helpful for SARS-CoV-2 considering the nature of the virus to rapidly develop mutations that lead to new variants. In addition to inhibiting the virus' main protease, the rationale of our study also depended on a drug's ability to inhibit the replicase polyprotein complex of SARS-CoV-2 as well. Our study consisted of antivirals that treated illnesses that shared symptoms and virus activity like SARS-Cov-2. Our docking of twelve FDA approved antiviral drugs showed that all of them were able to bind to one of our two target complexes, some which had high affinity and good medicinal chemical properties, suggesting their potential to be further analyzed and utilized to treat SARS-Cov-2 and its variants by computer aided drug design.

Project ID: MEDH 14
10:25a.m. - 10:40a.m.

Title: The Effectiveness of a Cultural Competency Curriculum Taught to Middle School Students, Social Media's Correlation with Mental Health, and the Future of Customizable 3D Printed Hands

June's Learning Lab (JLL) Part 2 – Curriculum / Website
Presenters: Zachary Eness, Lucienne Petit, Megan Ptak

JLL Group: Thavaisya Ananth, Rowan Eggert, Zachary Eness, Jonah Fisher, Lily Isibue, Rachel Koterba, Annabelle Lu, Lucienne Petit, Megan Ptak, Adriana Rodriguez, and Christin Sanchez
Mentor(s): Mr. David Lundgren and Dr. Sowmya Anjur,
Illinois Mathematics and Science Academy

Abstract/Project Intention:
June's Learning Laboratory (JLL) has developed a cultural competency curriculum to educate middle school students about the cultures and experiences of those around them and their role in the world. We will conduct research testing the effectiveness of this newly constructed curriculum by comparing the data collected from the surveys given to the participants before and after being taught the curriculum. In recent years, the number of individuals interested in owning a cost-effective, multi-use prosthetic has grown. JLL is currently working towards creating inexpensive, customizable designs for future prosthetic hands to aid in a variety of daily activities. Unfortunately, due to the disruption caused by COVID-19, JLL possesses no feedback from prosthetic wearers on how to improve the design of the hand. Social media continues to grow as a platform, allowing individuals to share their lives with others; however, with the abundance of information available through such platforms, the mental health of individuals of all ages has been affected either positively or negatively. To determine the relationship between students and the effects of social media on their mental health, we developed a survey which has yet to be sent out and data is to be collected.

Project ID: MEDH 18
10:25a.m. - 10:40a.m

Title: Effect of Ayurvedic Herbs on Glioblastoma Multiforme

Presenter(s): Monika Narain and Prarthana Prashanth
Mentor(s): Sowmya Anjur, Illinois Mathematics and Science Academy

Abstract/Project Intention:
Glioblastoma multiforme (GBM) is a stage IV astrocytoma, accounting for over 60% of all brain tumors in adults and a very poor prognosis of just 14-15 months. Despite numerous current treatment options, GBM recurs 90% of the time. With barriers in affordability and hesitance toward synthetic medicines, many people have turned to natural treatments for GBM. Last year, we tested the cytotoxicity of the U118 GBM cell line when treated with the common Ayurvedic herbs, hing, triphala, and coriander. With our initial testing, we found that the optimal concentration of triphala is 8 µl to induce cytotoxicity. This year due to the COVID-19 pandemic and lack of access to a lab, we shifted to conducting a meta-analysis of existing literature instead. We expanded our focus from three herbs, to a broader range of Ayurvedic herbs and their effects on not only Glioblastoma but on all types of cancers. For each herb, we have studied the structural compound and referenced existing studies on cancer cells to determine how these compounds would behave on GBM. Using these studies, we have also drawn conclusions on how the herbal compounds can be used as anti-inflammatory and antioxidative compounds to treat side effects of GBM.

Project ID: MEDH 21
10:25a.m. - 10:40a.m

Title: The Role of Kinetochore-Microtubule Functions in Cancer-Initiating Chromosomal Missegregation

Presenter(s): Ariela Asllani; Rishitha Boddu
Mentor: Dr. Dileep Varma, Northwestern University, Feinberg School of Medicine

Abstract/Project Intention:
Over the past few decades, one of the largest improvements in cancer therapeutic agents has been the use of mitotic poisons. However, as substantially effective as they are, mitotic poisons' non-selective involvement in other pivotal physiologic processes entail the necessity of carrying out perturbations to novel components that are explicit to the cell cycle/division pathway. Chromosomal abnormalities, known as aneuploidy, is due to a deterioration of mitotic fidelity resulting in chromosomal instability (CIN): a hallmark of cancer. The primary defect behind these abnormalities are improper kinetochore-microtubule (kMT) attachments and the dysfunction of the proteins involved in this process. Therefore, the underlying biological and mechanistic nuances of kMT attachments in mitosis serve as an appealing therapeutic target in light of their central role in accurate, proportionate chromosome segregation. We find that kinetochore/centromere structure and distribution is impeded when the nuclear envelope function is compromised. We computed the centromere intensity and distribution using software Fiji/ImageJ under different conditions, which is expected to reveal defects in centromere function and will translate to deficiencies in kinetochore efficiency in coupling the centromeric DNA to the plus ends of spindle microtubules. Our findings have advanced our understanding in this complex physiological process to a great extent and may lead to further optimization of anticancer therapeutics in a mitotic-orientated perspective.

Project ID: MEDH 22
10:25a.m. - 10:40a.m

Title: The Potential Application of Fuzzy Mathematics to Understanding Transcriptomic Changes in Dementia.

Presenter(s): Aryan Gandhi
Mentor(s): Jane Wu, Northwestern University

Abstract/Project Intention:

With our rapidly progressively aging society, neurodegenerative diseases including dementia have become one of the leading health challenges in our society. Significant advances have been made in our understanding of neuropathology and clinical manifestations of dementia. A vast amount of data has come from genetic, pathologic and molecular studies of brain samples from dementia patients and control subjects, however the underlying pathobiology and neural damage in dementia remain unclear. Researching this connection and developing a more lenient scale of diagnosing dementia through Fuzzy Mathematics would enable treatment for Dementia patients to improve. Fuzzy Mathematics enables it's classifiers to have degrees of membership, as in normal sets a value either belongs or does not, but in fuzzy mathematics there is a range of values that can fit. Diagnosing dementia is not straightforward, as if it were there would be a single test out there capable of determining whether a patient has it. Doctors use medical history, physical examinations, laboratory tests and many other methods in order to determine if a person has Dementia. The goal is to decide if it is possible to use Fuzzy Mathematics to label how the transcriptomic changes affect Dementia, and through this work on creating a better system to diagnose it.

Project ID: MEDH 28
10:25a.m. - 10:40a.m

Title: Improving Hypertension Control Rate: An intervention study in a cohort of Hypertensive patients of the Southern Illinois University School of Medicine
Presenter(s): Kosisochi Onwuameze
Mentor(s): Dr. Bemi Adekola, Southern Illinois University, School of Medicine
Abstract/Project Intention:
Hypertension continues to be a public health crisis in the United States because it carries a significant risk of contributing to cardiovascular diseases which leads to disability, death, and high healthcare expenditure. Nationally, Hypertension control rates are 32% in white adults, 25% in black adults, 19% in Asian adults, and 25% in Hispanic adults. There is a search to approach the management of Hypertension differently to result in better control rates. Measure accurately, Act rapidly, and Partner with patients, (M.A.P) is a framework intervention that has been tested in primary care centers and found to improve Blood pressure control (<140/<90 mm Hg) from 61.2% to 89.8% in a 6-month pilot study. The M.A.P framework was created by American Medical Association and John Hopkins University collaboration. It is based on this high success rate, that two departments from SIU are implementing the framework into their hypertension care workflow. SIU School of Medicine's current Hypertension control rate is about 52% and the goal is to improve to 75%, following adaptation of the MAP framework. This intervention is ongoing. Improving Hypertension control rates is critical to addressing the public health issue of cardiovascular disease.

Project ID: PHYS 07
10:25a.m. - 10:40a.m

Title: Lepton Jet Generation and Reconstruction at Generator Level
Presenter(s): Ming Huang
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
I used PYTHIA 8, a Monte Carlo generator for particle physics, to simulate lepton-jet-producing events. These lepton jets are produced by squarks which produce neutralinos which create dark photons that undergo a dark sector cascade decay into detectable lepton jets.

These events were examined for information about the particles that were produced. Triggers, which determine whether an event is recorded or not in the particle accelerator, were simulated. The number of events passing the trigger and the total number of events were compared, resulting in a trigger acceptance that will inform future studies. Number of jets produced based on information about the leptons was calculated. This was then compared with the actual number of jets there were, giving the reconstruction efficiency.

Exact properties of theoretical particles are unknown, so I generated samples with varying conditions, to gain knowledge of what the events may be like. Notably, reconstruction efficiency is ~70% for all samples and triggers. The three-muon trigger, which we hope to have running on the real particle accelerator next year, shows much higher trigger acceptance over other triggers which are being used.

Project ID: PHYS 11
10:25a.m. - 10:40a.m

Title: Examination of extraneous leptons in simulated doubly charged Higgs events
Presenter(s): Zoie Sloneker and James Tan
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
This analysis examines the extraneous leptons that have been simulated in reconstructed doubly-charged Higgs events. When the code that simulates these events is run, some of the produced events have five leptons indicating an extra lepton. This is an issue because doubly charged Higgs bosons decay into two leptons each, which creates a total of four leptons per event. We present our analysis of how and where these extraneous leptons are being added, and then fix this in order to produce accurate data and histograms. This is significant because it provides an understanding of the signal sample of our analysis.

Project ID: PHYS 19
10:25a.m. - 10:40a.m

Title: Categorizing Neutrino Detector Research and Development Efforts for Snowmass 2021

Presenter(s): Alana Rock
Mentor(s): Maury Goodman, Argonne National Laboratory

Abstract/Project Intention:
Within the broad field of particle physics in the United States, many decisions must be made about the collective goals of respective subfields in order for progress in findings and research to efficiently develop. The Snowmass 2021 process plays a significant role in such decisions. Hosting meetings regarding different interests within each field of particle physics to be covered, an overall proposal for the projection of particle physics over the next decade or so is made through this process, which is eventually presented to the American Physical Society. Grants are then requested from the government to pursue research and development (R&D). The Neutrino Frontier and Instrumentation Frontier are two broad frontiers within this Snowmass 2021 process that have specific, yet important, overlap. Proposals and general interest is congregated via Letters of Interest (LOIs) that describe different proposals either in progress or still in theory. Within my research, I have categorized key attributes of LOIs that have overlap between both the Neutrino Frontier and the Instrumentation Frontier to begin to reach some suggestions regarding investments in neutrino detector R&D over the next decade or so. I have categorized these LOIs on three levels: general status, relevance to current detector technology, and overall neutrino physics goals. Ultimately, within my research and by consulting with experts in the fields of particle physics, decisions based on practicality may not always be the best for discovery, although more cost-effective. Ultimately, it is no easy decision to decide what projects to pursue in the realm of particle physics detector R&D.

Session II - 10:45a.m. – 11:05a.m.

Project ID: BHVSO 15
10:45a.m. - 11:05a.m.

Title: Statistical Analysis of Homelessness in U.S. Cities as a Result of Policy Choices
Presenter(s): Ben Weber
Mentor(s): Patrick Kearney, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Cities across the United States face severe challenges in housing all of their residents. Hundreds of thousands of people face homelessness throughout the US. It is well known and understood that there are four main contributing factors to homelessness: lack of affordable housing, unemployment, poverty, and mental illness and substance abuse. While these causes are well known, solutions vary wildly across different cities. Different policies, or lack of policies, are in place in cities across the country in order to fix these causes of homelessness and raise people out of homelessness. This study investigates those different policies in order to determine which policies have the greatest effects upon homelessness within cities in the United States. To test these policies, a statistical analysis was run using the programming language R. This tested many different housing, education, mental health/substance abuse, etc. policies against homelessness in each city to determine which policies had the greatest effects on homelessness. The results show that certain policies worked to a greater effect in lowering the rate of homelessness in cities than others.

Project ID: BHVSO 17
10:45a.m. - 11:05a.m.

Title: Alteration of the Linguistic Educational System for Korean Immigrant Students in the United States
Presenter: Minju Oh
Mentor: Devon Madon, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Korean immigrant students frequently face a prejudiced education system, as they are learning English. Many pedagogical researchers claim that non-native accents are understood as less accurate, and their stigmatized dialects are often misunderstood, misheard, and mistranscribed. When students transition into their new school, classmates, teachers, and a new language, they may face a segregated and un-equitable education system that lacks the essential resources such as ESL classes, family liaisons, or social support. If they are exposed to negative feedback or judgments from their teachers and American-born peers, they may easily absorb a deficit mindset that leads to an ignorance of their potential academic abilities. Furthermore, students often feel that they must give up their native languages and cultures to adapt to their new cultural environment.

This project will analyze and propose pedagogical changes in the teaching of English for Korean immigrant students. My project encourages educational leaders to support immigrant students by the teaching of English beyond an extension of verbal communications. Rather than forcing adaptation of English and Westernization, opening the equal value of speech is essential in all of its forms of empowering self-esteem and cultural values of Korean immigrant students.

For this purpose, this research will be focused on: identities, inclusivity and authenticity, cultural diversity and social equality, and linguistic inclusion through Korean immigrants' native language. This research aims to enhance self-esteem, cultural values, and multilingualism of Korean immigrant students beyond speech-based prejudice, discriminative class environments, and linguistic assimilation in the global hegemony of English.

Project ID: BIO 03
10:45a.m. - 11:05a.m

Title: Correlation of Glioblastoma Occurrences and Geographical Location
Presenter(s): Abhi Pasupula
Mentor(s): Sowmya Anjur, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Glioblastoma is the most common and aggressive primary brain tumor in adults. Defining histopathologic features are necrosis and endothelial proliferation, resulting in the assignment of grade IV, the highest grade in the World Health Organization (WHO) classification of brain tumors. The classic clinical term "secondary glioblastoma" refers to a minority of glioblastomas that evolve from previously diagnosed WHO grade II or grade III gliomas. Specific point mutations of the genes encoding isocitrate dehydrogenase (IDH) 1 or 2 appear to define molecularly these tumors that are associated with younger age and more favorable outcome; the vast majority of glioblastomas are IDH wild-type. Typical molecular changes in glioblastoma include mutations in genes regulating receptor tyrosine kinase (RTK)/rat sarcoma (RAS)/phosphoinositide 3-kinase (PI3K), p53, and retinoblastoma protein (RB) signaling.

Standard treatment of glioblastoma includes surgery, radiotherapy, and alkylating chemotherapy. Promoter methylation of the gene encoding the DNA repair protein, O(6)-methyl guanyl DNA methyltransferase (MGMT), predicts benefit from alkylating chemotherapy with temozolomide and guides choice of first-line treatment in elderly patients. Current developments focus on targeting the molecular characteristics that drive the malignant phenotype, including altered signal transduction and angiogenesis, and more recently, various approaches of immunotherapy.

Project ID: BIO 06
10:45a.m. - 11:05a.m.

Title: Relatedness of Bacteriophages Infecting Mycobacterium Smegmatis
Presenter: Makayla Zheng
Mentor: Dr. Crystal Randall, Illinois Mathematics and Science Academy
Abstract/Project Intention:
In the last few decades, more research has been conducted on bacteriophages, viruses that infect bacteria, and the potential of phage therapy to serve as an alternative to antibiotics. Because phage therapy has high specificity, lower chance of resistance, and minimal disturbance to "good" bacteria, it appears to be a worthy alternative. However, greater research must be conducted in order to determine their effectiveness. Areas for research on phages include proper dosage, immune system reactions, and efficiency. This research project specifically examines mycobacteriophages and mycobacterium which can cause leprosy and tuberculosis. A deeper examination of mycobacteriophages and their protein sequences, virulence, and relationships with mycobacterium and other phages will serve to create a better understanding of how these phages can fight against infectious diseases. Phage and bacteria sequences are obtained from the NCBI and Actinobacteriophage database and compared via platforms including T-Coffee and BoxShade. This project examines the tRNA found in phages and their hosts to better understand their virulence and evolutionary changes. As new diseases arise and the effectiveness of antibiotics becomes challenged by various factors, increased knowledge regarding phages and their potential is crucial.

Project ID: BIO 11
10:45a.m. - 11:05a.m.

Title: Computational Approaches to Detection of Mosaic Variants in Patients with Epilepsy
Presenter: Krisha Patel
Mentor: Dr. Gemma L. Carvill, PhD, Northwestern University, Feinberg, School of Medicine
Abstract/Project Intention:
Approximately 70-80% of epilepsy cases are likely caused by genetic variants. Somatic variants are mutations with low allele fractions that occur in only a portion of a patient's cells, often because of somatic mosaicism. Given these variants' low read counts in sequenced DNA, they are frequently missed. In our project, we compared the sensitivity of variant callers, MuTect and Mosaic Forecast. We also used MELT to detect mobile element insertions. We built multiple-sample pipelines and applied them to the whole exome and/or genome sequencing data of a cohort of epilepsy patients collected for a national and international collaboration. Candidate somatic variants detected using these methods were then validated with PCR amplification and Sanger Sequencing or targeted NGS of the patients' DNA samples. In our initial analysis of the cohort, MuTect identified a candidate somatic variant in the gene *GLUL* (p.M1V).

Project ID: BIO 18
10:45a.m. - 11:05a.m.

Title: The Effects of Redox Regulation on RCA Isoforms
Presenter(s): Emily Johnson; Laila Walton
Mentor(s): Dr. Sarah Stainbrook, Washington University of St. Louis
Abstract/Project Intention:
As global temperatures continue to rise, food security has become more of a problem for scientists to solve, and one approach is to improve photo-synthesis production in plants. Photosynthesis in many plant species is limited when temperatures increase past their optimal range. As a result, research has been geared toward how to improve Rubisco Activase (RCA), a key enzyme in photosynthesis which is also redox-regulated. We investigate whether *Sorghum bicolor* and *Setaria viridis* RCA-α and -β isoforms expressed from *Escherichia coli* respond to redox regulating elements in the same way as isoforms purified from the plants. We analyze whether reducing agents glutathione and thioredoxin-f affect ATPase activity and RuBisCO activation of each RCA isoform for both species. Furthermore, we examine how these results change *in vitro* when heat increases. Our preliminary results from Western blotting of isoform expression differ from those recently published by Kim *et al.* and indicate that further study is needed.

Project ID: BizIN 03
10:45a.m. - 11:05a.m.

Title: Creating a Brand Manual with Design Thinking
Presentor(s): Saanvi Chelikani
Mentor(s): Britta W. McKenna, Encore Batavia
Abstract/Project Information:
Encore Batavia is a social venture initiative launched in 2020 by founder, Britta McKenna, after her 2019 personal research, "69 Cups of Coffee: Caffeinated Insights About Batavia," identified community needs. The goal of this internship was to address the following question: How do you create a brand manual using design thinking? The manual includes a variety of information regarding branding standards, such as a logo mark, colors, typography, website, and extension/publication materials. This project discusses the methods used to collect data, for both research and revision, in order to develop the manual, which outlines how the Encore Batavia brand should be used for both external and internal purposes. It also covers steps involved in the design thinking process, and how that methodology was used in order to center the brand around Encore Batavia's mission and vision. The outcome of this project creates a framework for this start-up social venture to establish their identity and streamline their marketing e□orts to help Encore serve their mission, "Weaving our community together through experiences fostering purpose and connection"

Project ID: BizIN 09
10:45a.m. - 11:05a.m.

Title: Website Intern with CourseStars
Presenter(s): Hari Krishnan Kumarakrishnan
Mentor(s): Jill Ko, CourseStars LLC
Abstract/Project intention:
At CourseStars, I have been working with my business mentor to increase the overall efficiency of the company's website on WIX over the past 5 months. More specifically, the focus of my project is to improve the tutor profile creation process. Before my internship, tutors had to fill out a google form with all their information, which had to be manually inputted into the website. During my internship, I created a form page that tutors can fill out within the company's website itself. In addition, I created a script that automatically stores the tutor's information in a database and uses this data to create a profile page for the tutor. Through this project, I was able to help my mentor grow her business without being restrained due to technical problems.

Project ID: BizIN 15
10:45a.m. - 11:05a.m.

Title: Using 3D printing to develop a personalized solution for COPD patients and CPAP users
Presentor(s): Rushil Sambangi
Mentor(s): Dima Elissa, VisMed3D
Abstract/Project Intention:
Millions of people suffer from sleep apnea and resort to Continuous Positive Airway Pressure (CPAP) machines to provide relief while asleep. However, many experience discomfort and functionality issues with their standard equipment. The goal of the business project was to devise a personalized and 3D printable solution for current CPAP users that would improve compliance with their machines. To identify the critical problems faced by CPAP users, online interviews and survey polls were utilized alongside external research. With this information, further research on viable materials, 3D printing and scanning methods, and design requirements were conducted to produce an effective solution. Over the course of the business project, it was found that 3D scanning patients and resin 3D printing an elastic add-on to exisiting CPAP mask frames would be the most viable solution for users and VisMed3D. The project's results would be beneficial to the business in developing a new product for consumer purchase and also in addressing the evergrowing compliance issues CPAP users face with their masks.

Project ID: CMPS 01
10:45a.m. - 11:05a.m.

Title: Shadows of the System: An Econometric Analysis of Race in America
Presenter: Len Washington III
Mentor(s): Patrick Kearney, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The intent of this project is to examine explicit and implicit biases within the United States law enforcement and justice systems and how they can be impacted by race. It shows differences in all aspects of life, including birth, socio-economic statuses, education, adulthood and death. Specifically, it will review data about government spending per state's education spending, as well as police violence and differences in treatment for similar crimes.

Project ID: CMPS 06
10:45a.m. - 11:05a.m.

Title: Monitoring and Correcting HPV Vaccine Misinformation on Social Media
Presenter(s): Emilia Daniels and Ava Puchitkanont
Mentor(s): Vijayakrishna (V.K.) Gadi, University of Illinois at Chicago,
Ming (Bryan) Wang, University of Nebraska-Lincoln
Abstract/Project Intention:
Vaccine misinformation is widely disseminated on social media, and it is often difficult to correct. Social media posts that contain vaccine misinformation have been found to generate high engagement among social media users, and the spread of misinformation can be harmful to society. This project focuses on monitoring and analyzing sources and types of HPV vaccine misinformation on different social media platforms. In order to collect data on misinformation on different social media platforms, and to analyze the gathered data, R was used. During the data analysis process, non-vaccine related videos were left out, and vaccine sentiment, either pro-, neutral, or anti- vaccine, was determined. Image elements in the misinformation such as whether the vaccine, health professionals, or parents were shown, were analyzed, as well as the misinformation domain of the data, focusing on concealment, distortion, ambivalence, and falsification. The topics that were focused on were conspiracy theories, vaccine inefficiency, civil liberties, and alternative medicine. The evidence provided for the misinformation was also looked into, and data was collected on the health beliefs related to the HPV vaccine.

Project ID: MATH 04
10:45a.m. - 11:05a.m.

Title: Hopf Algebra of k-Schur Functions and its Self-Duality
Presenter(s): Rajan Patkar
Mentor(s): Dr. Aaron Lauve, Loyola University Chicago
Abstract/Project Intention:
The k-Schur functions can be defined using several different methods, including using k-tableaux, weak tableaux, and strong tableaux (Lam et. al. 2013). They can be generated by a function derived from the weak Pieri rule for Schur functions, by summing over k-bounded partitions. These k-Schur functions also reside in a subring of the symmetric functions. The dual k-Schur functions can be generated using a weak Pieri rule on affine Grassmannian polynomials within the affine symmetric group, summing over cyclically decreasing reduced words. They are equivalent to Schur functions under certain conditions (k is greater than lambda's absolute value and t = 0).

We intend to connect the self-duality of the Hopf algebra of k-Schur functions to unsolved problems in the fields of mathematics, including representation theory. The self-duality of the kSchur functions opens all its definitions to be linked together, allowing for a wider range of possibilities when solving for open questions in the fields, including finding a k-MurnaghanNakayama rule, coefficients on the coproducts of symmetric functions, a model of k-Schur functions, and more (Lam et. al. 2013).

Project ID: MEDH 03
10:45a.m. - 11:05a.m.

Title: Fragment-Based Drug Discovery of SARS-CoV-2 Therapeutics
Presenter(s): Emma Darbro, Vivian Hedican, and Hannah Johnson
Mentor(s): Dr. John Thurmond Illinois Mathematics and Science Academy
Abstract/Project Intention:
The usual drug development timeline has been substantially condensed as the number of global COVID cases rise in order to allow for a safe and effective therapy to be discovered as soon as possible. Moreover, the COVID Moonshot open-sourced initiative has allowed the development of a COVID antiviral to accelerate. After the published fragment screening on the main protease (MPro) of SARS-CoV2 yielded 66 fragment hits, a fragment was selected to build novel compounds. SeeSAR was used to gather preliminary knowledge of the three-dimensional structure of the biomolecular targeted protein and selected compound interaction. SeeSAR analysis features allowed for the visualization of the ligand-protein structure and identification of key interactions driving binding affinity. Over three hundred possible compounds were produced from the chosen fragment to investigate ADME properties further. The compiled data showed great promise with no Lipinski rule violations, high GI absorption levels for all compounds, no PAINS violations, and very few CYP inhibitors. The most promising compounds designed from the above data and overall research were submitted for further analysis through our collaboration with the COVID Moonshot consortium towards possible preparation and distribution for assays against the MPro.

Project ID: MEDH 06
10:45a.m. - 11:05a.m.

Title: Computer Aided Drug Design of Emtricitabine Derivatives for HIV
Presenter: Sarah Oquendo
Mentor: John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Emtricitabine is a drug used to treat Human Immunodeficiency Virus Infection by slowing the progression of the virus in the body. The goal of this study was to start with the structure of the drug emtricitabine and design new compounds to achieve a better binding affinity. By achieving a better binding affinity, the usefulness of the drug in the body will be increased. The tools used to research these new structures were SeeSAR, admetSAR, and SwissADME. These programs were used to look at the interactions in the molecule, absorption, metabolism, toxicity and the synthetic accessibility. The newly designed drugs showed better binding affinity than emtricitabine and could lead to development of new HIV drugs.

Project ID: MEDH 15
10:45a.m. - 11:05a.m.

Title: The Effectiveness of a Cultural Competency Curriculum Taught to Middle School Students, Social Media's Correlation with Mental Health, and the Future of Customizable 3D Printed Hands

June's Learning Lab (JLL) Part 3 – Engineering
Presenters: Thavaisya Ananth, Rowan Eggert, Jonah Fisher, Lily Isibue, Rachel Koterba, and Christin Sanchez

JLL Group: Thavaisya Ananth, Rowan Eggert, Zachary Eness, Jonah Fisher, Lily Isibue, Rachel Koterba, Annabelle Lu, Lucienne Petit, Megan Ptak, Adriana Rodriguez, and Christin Sanchez
Mentor(s): Mr. David Lundgren and Dr. Sowmya Anjur, Illinois Mathematics and Science Academy

Abstract/Project Intention:
June's Learning Laboratory (JLL) has developed a cultural competency curriculum to educate middle school students about the cultures and experiences of those around them and their role in the world. We will conduct research testing the effectiveness of this newly constructed curriculum by comparing the data collected from the surveys given to the participants before and after being taught the curriculum. In recent years, the number of individuals interested in owning a cost-effective, multi-use prosthetic has grown. JLL is currently working towards creating inexpensive, customizable designs for future prosthetic hands to aid in a variety of daily activities. Unfortunately, due to the disruption caused by COVID-19, JLL possesses no feedback from prosthetic wearers on how to improve the design of the hand. Social media continues to grow as a platform, allowing individuals to share their lives with others; however, with the abundance of information available through such platforms, the mental health of individuals of all ages has been affected either positively or negatively. To determine the relationship between students and the effects of social media on their mental health, we developed a survey which has yet to be sent out and data is to be collected.

Project ID: MEDH 23
10:45a.m. - 11:05a.m.

Title: Understanding Molecular Pathways Underlying Axonal Degradation in Painful Diabetic Neuropathy

Presenter(s): Shikhar Gupta, Kavin Suhirtharen
Mentor(s): Dr. Daniela Menichella, Dr. Dale George, Northwestern University, Feinberg Medical School

Abstract/Project Intention:

Painful Diabetic Neuropathy (PDN) affects 25% of diabetic patients and is a chronic disorder with a major effect on quality of life and health care costs. It can be characterized by dorsal root ganglion (DRG) nociceptor hyperexcitability, calcium overload, axonal degeneration, and loss of cutaneous intervention. Currently, the molecular mechanisms contributing to neuropathic pain in PDN are still unclear. We have shown a path forward for improving treatments.

Through quantitative proteomic analyses, we discovered that in mice with PDN induced by a high fat diet (HFD), mitochondria proteins are expressed differentially in DRG nociceptor. Electron microscopy indicated mitochondrial fragmentation and *In vivo* calcium imaging indicated elevated calcium signaling. Particularly, when the mitochondrial calcium uniporter (MCU) was removed from the neurons, axonal degeneration was reversed, mechanical allodynia was prevented, and normal mitochondrial morphology was restored. These findings point to a molecular pathway that connects neuropathic pain to axonal degeneration in PDN patients. Specifically, increased calcium penetration into mitochondria mediated by the MCU complex, resulting in increased calcium-dependent mitochondrial fission and eventually leading to axonal degeneration and neuropathic pain in PDN, may be a result of nociceptor hyperexcitability and the subsequent increased intracellular calcium concentrations.

Project ID: MEDH 27
10:45a.m. - 11:05a.m.

Title: Is "Percent Pain Reduction" a Valid Metric of Clinical Pain Improvement?
Presenter(s): Siddharth Tiwari
Mentor(s): Dr. A. V. Apkarian; Northwestern University, Feinberg School of Medicine, Andrew Vigotsky; Northwestern University, Departments of Biomedical Engineering and Statistics
Abstract/Project Intention:
Chronic pain is the most prevalent health condition in the United States, affecting over 116 million Americans, and therefore is the focus of many clinical trials. Studies on chronic pain treatment commonly report improvements in pain as a percent reduction from an initial value. Importantly percent reduction implies that improvements in pain are multiplicative. Although percent reductions are conceptually simple, empirically, it is unclear whether changes are truly multiplicative in nature. We assessed the validity of this assumption using longitudinal data from multiple randomized controlled trials. In each dataset, we assessed the presence of two hallmarks of a multiplicative effect: (1) whether the decrease in pain scales with initial pain; and (2) whether the residual error scales with greater pain ratings. The data did not meet either of these conditions. Since (1) changes in pain did not correlate with pre-intervention pain ratings and (2) residual error did not scale with post-intervention pain, pain reductions do not exhibit multiplicative properties. Instead, the data appear additive rather than multiplicative. Thus, reporting percent reductions in pain may be misleading. Instead, researchers and clinicians should report differences in pain, which more appropriately, represents the nature of changes in clinical pain.

Project ID: MEDH 33
10:45a.m. - 11:05a.m.

Title: The Effect of COVID-19 on Medical Students' Fields of Interest
Presenter: William McCarthy
Mentor: Dr. Jeffrey Paul Faragher, University of Washington
Abstract/Project Intention:
The COVID-19 pandemic has had one of the greatest effects on educational institutions in recent history. With Classes becoming virtual and many activities not being possible because of CDC guidelines and social distancing, it is obvious that this pandemic has greatly changed students' learning. One type of education has experienced some of the largest changes, Medical Education, as it is so heavily based on hands-on teaching methods and collaboration with others. Medical students have had to face major issues in their pursuit to become medical specialists, but how have these issues affected what kind of specialty the students decided to pursue? This study looks at how medical education, students, and specifically their choice of specialty has changed throughout this pandemic. By using an online surveying platform and asking fourth year medical students how they see different aspects of the medical fields popularized by the media during the pandemic, we can see how students have changed their choice of specialty from it. After analyzing the data from the survey, we will be able to see if this major event has swayed medical students towards or against specific fields.

Project ID: PHYS 12
10:45a.m. - 11:05a.m.

Title: Doubly charged Higgs mass reconstruction efficiency and background estimate
Presenter(s): Kodai Speich
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The doubly charged Higgs is a scalar boson with +2 or -2 charge, characteristic of the left-right symmetric model. These particles are pair-produced in a quark-antiquark annihilation, and decay to two leptons (electrons, positrons, muons, or anti-muons) of the same charge. In a search for these doubly-charged Higgs, which decay rapidly, and therefore cannot be easily found by the detector, the lepton pair products' invariant mass instead is measured. The mass reconstruction efficiency -- the percentage of reconstructed doubly charged Higgs bosons whose mass falls within a certain range of the expected Higgs mass -- of the generated samples was checked, and background Standard Model processes, like Drell-Yan, ttbar, ZZ, and WZ processes, which also result in lepton products, were also considered.

Project ID: PHYS 13
10:45a.m. - 11:05a.m.

Title: Cross Section Analysis for Doubly Charged Higgs Bosons from Muon-Muon Collisions
Presenter(s): Robert Zhu and Andy Tang
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
We present our work on the analysis of the cross-section for doubly-charged Higgs production from muon-muon collisions. To facilitate this, the researchers have been utilizing PYTHIA software to simulate these collisions. This analysis allows us to study the predicted results that can be obtained from an experimental muon collider, which has been a topic of interest scientifically for some time. The results of this study help to determine the viability of using a muon-muon collider to search for the doubly-charged Higgs.

Project ID: PHYS 20
10:45a.m. - 11:05a.m.

Title: Scintillation Light Data from the ProtoDUNE Dector
Presenter: Smriti Shankar
Mentor: Zelimir Djurcic, Ph.D, Argonne National Laboratory
Abstract/Project Intention:
The Deep Underground Neutrino Experiment (DUNE) is a neutrino experiment where neutrino beams from Fermilab are to be sent to liquid argon particle detectors at Sanford Underground Research Facility in South Dakota, approximately 1,300 kilometers away. Before the DUNE detectors could be built, a prototype of a single-phase (SP) time projection chamber (TPC) called ProtoDUNE was built. This is currently the largest liquid argon TPC to have been built, at around 750 tonnes of liquid argon, and began taking data as of October 2018. In this research, we took data from photon detectors of the ProtoDUNE TPC. We analyzed this data using a script written in ROOT/C++ analysis package to search for a correlation between the light waveforms from the argon atoms and the particle that excited the atoms, with the goal to identify particle species. From the currently available data, it can be preliminarily concluded that there is a separation power between the ratio of prompt vs. delayed scintillation light within liquid argon at high energies for beam electrons and cosmic ray muons. In the future, this process should be repeated for more particle species in order to better identify particle species in the DUNE detector and the ProtoDUNE detector, and this research should be combined with existing research efforts to combine the scintillation light information with collected time-projection-chamber charge for more accuracy in event identification.

Session III - 11:25a.m. - 11:50a.m.

Project ID: BIO 09
11:25a.m. - 11:50a.m.

Title: Immediate Early Gene Expression in D1-SPNs and D2-SPNs During a Striatum-dependent Reinforcement Learning Task
Presenter(s): Cynthia Mu, Emily Shao
Mentor(s): Dr. Jones G. Parker, Department of Psychiatry, Northwestern Feinberg School of Medicine
Abstract/Project Intention:
Dopamine signaling is thought to alter the excitability of the striatum's principal neurons (D1- and D2-SPNs). We used immunohistochemistry to quantify the expression of Fos, a marker of neural activity, in mice trained in a head-fixed fear conditioning task that requires dopamine signaling in the striatum. We observed a relative increase in Fos-expressing D1- vs D2-SPNs, which may indicate how activity in these neurons facilitates motor learning. This learning dependent change in the levels of Fos expression in D1- and D2-SPNs may have occurred due to running in response to an aversive cue in our task. These changes may correspond to fluctuations in neural plasticity that may contribute to the changes in neural calcium activity previously observed by others in our laboratory. Our findings have implications for understanding disease processes that affect the dopamine system, such as Parkinson's disease and schizophrenia.

Project ID: MATH 02
11:25a.m. - 11:50a.m.

Title: Counting the Generalized and Extended Symmetric Spaces of SO(3,F*q*)
Presenters: Raman Aliakseyeu, Nat Oliven, and Ethan Thieme
Mentor: Dr. Ellen Ziliak, Benedictine University
Abstract/Project Intention:
In this paper we will provide a count for the size of both the generalized and extended symmetric spaces of SO(3,Fq) for all involutions when the characteristic is not equal to two. In addition we will explicitly describe the elements in the extended symmetric space and the fixed point group for both involutions.

Project ID: MEDH 20
11:25a.m. - 11:50a.m.

Title: Role of the Basal Ganglia in Primary Progressive Aphasia

Presenter: Sri Lalana Appasani
Mentor: Borna Bonakdarpour MD, Northwestern Feinberg School of Medicine, Mesulam Center for Cognitive Neurology and Alzheimer's Disease

Abstract/Project Intention:
Primary progressive aphasia (PPA) is a neurological syndrome in which there is a progressive decline in language processing. It results from the degeneration of brain tissue important for speech and language. Functional and structural neuroimaging techniques have discovered the major sites of atrophy (brain volume loss) and reveal patterns of language network abnormalities in each of the subtypes: PPA-G (agrammatic), PPA-L (logopenic), PPA-S (semantic). Patients' diagnoses of variants are determined through behavioral analyses.

Resting-state fMRI (functional magnetic resonance imaging) is sensitive to polysynaptic pathways in the brain and helps explore the anatomy and connectivity of neurocognitive networks. Most rs-fMRI studies have focused on cortical connectivity patterns in PPA. However, there has been a paucity of research studies investigating the role of basal ganglia in PPA. Basal ganglia have been proven to have a role in the underlying causes of neurodegenerative disease closely related to PPA. Therefore, this study used structural and functional imaging techniques to examine the connectivity between basal ganglia and the cortical regions involved in language processing in PPA. The study compares patients of all three variants of PPA and non-affected healthy individuals to identify differences in basal ganglia and cortical connectivity in variants of PPA.

Project ID: PHYS 09
11:25a.m. - 11:50a.m.

Title: Lepton Jet Reconstruction, Matching, and Resolution in the SUSY Portal
Presenter(s): Sreyansh Mamidi
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
In the supersymmetry portal for dark photon productions, each lepton jet is associated with an underlying neutralino. To reconstruct these jets, we first gathered samples of the dilepton decay of dark photons from the Monte Carlo generator PYTHIA 8. For each event, we found leptons with the highest transverse momenta to consider additional leptons within $\Delta R < 0.5$. After the lepton jets were successfully reconstructed, we created an algorithm to match the jets to the generated neutralino pairs. When these matches were found, the difference in ΔR between every neutralino pair and its corresponding lepton jet was calculated. We then used histograms of differences in ΔR, pT, Φ, and η to determine the resolution of the reconstructed lepton jets, which can help us understand the behavior of dark photons.

Session III - 11:55a.m. – 12:20p.m.

Project ID: BHVSO 23
11:55a.m. – 12:20p.m.

Title: Forming Diverse Teams Based on Members' Social Networks: A Genetic Algorithm Approach
Presenter(s): Archan Das
Mentor(s): Diego Gomez-Zara, Dr. Noshir Contractor, Northwestern University
Abstract/Project Intention:
Previous research shows that diverse teams in background and skills can outperform homogeneous teams. However, people often prefer to work with others who are similar and familiar and fail to assemble teams with high diversity levels. We propose a team formation algorithm that suggests diverse teams based on individuals' social networks, allowing them to keep high familiarity levels. Our novel algorithm is based on the NSGA-II genetic optimization that splits students into well-connected and diverse teams within an organizational network. It optimizes measures of team communication cost and diversity in O(n2) time. The optimization finds Pareto optimal solutions that optimize both metrics, returning teams that have both diversity in member attributes and previous connections between members. We tested the algorithm on real team formation data collected from the MyDreamTeam platform. The solutions provided by the algorithm are superior to the teams assembled by the students, in both diversity and communication cost measures.

Project ID: MATH 01
11:55a.m. – 12:20p.m.

Title: An Application of Compartmental Disease Modelling
Presenters: Madhav Parthasarathy, Aidan Stueck
Mentor: Dr. Patrick Davis, Illinois Mathematics and Science Academy
Abstract/Project Intention:
As the coronavirus continues to plague the world, researchers are constantly working to model the spread of the disease and determine optimal means of containing the pandemic. Using a compartmental framework, we created a transition model that, by using available resources and ongoing research, was tailored to the COVID-19 pathogen. We classified the US population into different age groups and level of risk, along with how individuals transfer between different states of infection. By utilizing differential equations, we modelled the flow at which the members of the population exit their respective compartments and transition into the next, with the compartments being S (susceptible), I (infectious), Y (symptomatic), R (removed), and V (vaccinated). To create these differential equations, we included several parameters which account for various behaviors of the population members and characteristics of the disease. To analyze the model, we constructed the next generation matrix to systematically determine the value of the basic reproduction number $R0_0$. $R0_0$ is defined as the average number of new cases of an infection caused by one typical infected individual in a population consisting of only susceptibles; and it can be calculated by evaluating the dominant eigenvalue of the next-generation matrix of the linearized infected subsystem. If $R0_0 > 1$, an epidemic will occur; and if $R0_0 < 1$, then it will not. In addition to calculating $R0_0$, we proved the existence, uniqueness and non-negativity of a solution to our model given appropriate initial conditions. Finally, we simulated several scenarios with varied parameter values in order to observe changes in the rate that individuals moved from each compartment.

Project ID: MEDH 25
11:55a.m. – 12:20p.m

Title: Effect of Systemic Sclerosis on Myocardial Function, Fibrosis, and Blood Flow Measured by Stress Perfusion Cardiovascular Magnetic Resonance Imaging
Presenter: Manasvi Thumu
Mentors: Daniel C. Lee, MD, Brandon Benefield, MS, Northwestern University Feinberg School of Medicine
Abstract/Project Intention:
Systemic sclerosis (SSc) is a disease that causes multisystem fibrosis and has a 10-year survival of 50-84%. Death is 5-15 times more likely when the heart is affected. Myocardial fibrosis in SSc may interfere with heart muscle contraction, relaxation, and microvascular function, resulting in heart failure, ischemia, and arrhythmias. We sought to quantify the effects of SSc on the heart using cardiac magnetic resonance imaging (CMR). In 11 SSc patients and 11 patients with normal clinical stress perfusion CMR, we measured myocardial perfusion reserve (MPR, ratio of blood flow at stress versus rest), extracellular volume fraction (ECV, a measure of myocardial fibrosis), and left ventricular ejection fraction (LVEF, a measure of systolic function). Transmural analysis was done to analyze subendocardial perfusion. ECV was significantly higher (29.3±3.7% vs. 23.6±2.8%, $p<0.001$), the subendocardial MPR (1.5±0.6 vs. 2.6±1.6, $p=0.06$) and subepicardial MPR (1.7±0.7 vs. 2.9±1.7, $p=0.05$) trended towards being significant, and the whole heart MPR (1.6±0.6 vs. 2.3±1.2, $p=0.10$) and LVEF (60.1±8.1% vs. 56.3±5.1%, $p=0.12$) were similar in SSc patients compared to controls.

Project ID: PHYS 14
11:55a.m. – 12:20p.m

Title: Doubly Charged Higgs Boson Generation
Presenter(s): Teodor Tchalakov
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
I present a detailed high-level analysis of previous searches for doubly charged Higgs bosons at lower energies and luminosities by CMS and ATLAS. I compare these analyses with simulation results of our own for the currently higher 137 fb^{-1}LHC luminosity with a look at expectations from future higher-energy colliders. The four-lepton signal for doubly charged Higgs events is the chosen signal because it best decreases SM background. I cover doubly charged Higgs production and our focus on the Drell-Yan process instead of others. I generate doubly charged Higgs boson samples with PYTHIA8's left-right symmetry model package at 13 TeV with $B(H^{\pm\pm}\rightarrow e^{\pm}e^{\pm}) + B(H^{\pm\pm}\rightarrow \mu^{\pm}\mu^{\pm}) = 100\%$ to identify the characteristics of four lepton doubly-1 charged Higgs events and measure the expected number of events at 137 fb^{-1}. I estimate the capacity for the CMS detector to identify the four lepton signals based on the 850 GeV ATLAS lower limit and calculate lepton efficiencies of 90+% for muons and 75+% for electron 800+GeV. Most reconstructed events are found to have all four leptons. Using a mass window for reconstruction efficiency it is shown that approximately 15 doubly charged Higgs events at 800 GeV are expected to be detected at CMS.

Presentation Schedule Reference List | IMSAloquium 2021

Student		Session	Time	Project ID
Elizabeth	Alcala	I	9:30 AM	MEDH 01
Raman	Aliakseyeu	III	11:25 AM	MATH 02
Thavaisya	Ananth	II	10:45 AM	MEDH 15
Sri Lalana	Appasani	III	11:25 AM	MEDH 20
Liam	Archer	II	10:25 AM	ERSP 01
Ariela	Asllani	I	8:50 AM	CHEM 03
Ariela	Asllani	II	10:25 AM	MEDH 21
Anne Marie	Bacon	II	10:05 AM	BizIN 01
Balaji	Balachandran	I	9:30 AM	PHYS 01
Akash	Basavaraju	I	9:10 AM	BHVSO 01
Jade	Bates	I	8:50 AM	MEDH 16
Utsa	Bhattacharyya	II	10:25 AM	BIO 14
Shouri	Bochetty	I	8:50 AM	MEDH 29
Sai Rishitha	Boddu	II	10:25 AM	MEDH 21
Patrick	Borse	II	10:25 AM	MATH 03
Melena	Braggs	II	10:25 AM	BizIN 02
Saanvi	Chelikani	II	10:45 AM	BizIN 03
Amanda	Chen	I	9:30 AM	BIO 15
Delicia	Chen	I	9:10 AM	BIO 01
Isabella Chen	Chen	II	10:05 AM	CHEM 01
Gnandeep	Chintala	I	8:50 AM	BizIN 04
Seo Yeon	Cho	I	9:10 AM	BizIN 05
Brenna	Christoffel	I	8:50 AM	BIO 04
Natali	Chung	I	9:30 AM	BHVSO 02

Shawn	Coutinho	I	9:10 AM	ENGN 01
Adam	Daki	II	10:05 AM	BIO 16
Emilia	Daniels	II	10:45 AM	CMPS 06
Emma	Darbro	II	10:45 AM	MEDH 03
Archan	Das	I	8:50 AM	PHYS 02
Archan	Das	III	11:55 AM	BHVSO 23
Luke	Davis	II	10:05 AM	BHVSO 03
Gabriel	Delgado	I	9:30 AM	BizIN 06
Matthew	Dinwiddie	I	8:50 AM	BHVSO 04
Francesca	Dumitrescu	I	9:30 AM	BHVSO 18
Disha	Dureja	I	9:10 AM	BHVSO 20
Quadri	Durojaiye	I	8:50 AM	BIO 04
Rujuta	Durwas	I	9:30 AM	BIO 02
Rowan	Eggert	II	10:45 AM	MEDH 15
Zachary	Eness	II	10:25 AM	MEDH 14
Jonah	Fisher	II	10:45 AM	MEDH 15
Ari	Fishkin	I	9:10 AM	PHYS 03
Isabella	Foes	I	9:10 AM	BHVSO 05
Aryan	Gandhi	II	10:25 AM	MEDH 22
Jayavignesh (Jay)	Ganesan	II	10:05 AM	BHVSO 22
Chandra	Gangavarapu	I	9:30 AM	CMPS 04
Akanksha	Garg	I	9:10 AM	BIO 05
Samantha	Gong	I	9:10 AM	CHEM 02
Nathaniel	Graf	I	8:50 AM	PHYS 04
Jackson	Grotke	I	8:50 AM	CHEM 03
Ysabel	Guan	I	9:30 AM	PHYS 05
Rachna	Gupta	I	9:10 AM	BIO 05

Rachna	Gupta	II	10:05 AM	CMPS 08
Shikhar	Gupta	II	10:45 AM	MEDH 23
Lethzeylee	Gutierrez	II	10:05 AM	CHEM 01
Caroline	Hall	II	10:25 AM	BHVSO 06
Hamza	Haq	II	10:25 AM	BIO 17
Vivian	Hedican	II	10:45 AM	MEDH 03
Ellyn	Hu	II	10:05 AM	PHYS 06
Ming	Huang	II	10:25 AM	PHYS 07
Natalie	Hulseberg	I	8:50 AM	BHVSO 07
Patrick	Hultquist	I	9:30 AM	BHVSO 08
Hector	Ibarra	I	9:10 AM	PHYS 08
Temilolu	Ijisesan	I	9:10 AM	BHVSO 09
Matthew	Illimoottil	I	8:50 AM	CHEM 09
Katelyn	Ingles	II	10:05 AM	MEDH 17
Lily	Isibue	II	10:45 AM	MEDH 15
Emily	Johnson	II	10:45 AM	BIO 18
Hannah	Johnson	II	10:45 AM	MEDH 03
Morgan	Johnson	I	9:10 AM	CHEM 02
James	Johnston	II	10:25 AM	ERSP 01
Nathan	Joseph	I	8:50 AM	BIO 04
Minseo	Jung	II	10:05 AM	BizIN 07
Avdhan	Kandikattu	I	8:50 AM	CHEM 04
Niyati	Kapadia	II	10:05 AM	BHVSO 22
Tanav	Karnik	II	10:05 AM	ENGN 02
Rohit	Kartha	II	10:25 AM	BizIN 08
Rohit	Katukam	I	9:30 AM	BIO 08
Nathan	Kilmer	I	9:10 AM	PHYS 08

Eunice	Kim	I	9:30 AM	BHVSO 10
Ashley	Koca	II	10:05 AM	BIO 07
Sameer	Komoravalu	I	9:30 AM	PHYS 17
Rachael	Koterba	II	10:45 AM	MEDH 15
Saachi	Kumar	I	9:30 AM	CHEM 05
Hari Krishnan	Kumarakrishnan	II	10:45 AM	BizIN 09
Peter	Leahy	II	10:05 AM	BHVSO 11
Evelyn	Lee	II	10:25 AM	ERSP 01
Samuel	Lee	II	10:05 AM	BHVSO 12
Alice	Li	II	10:25 AM	ERSP 01
Joyce	Li	II	10:25 AM	MEDH 04
Daniel	Liu	I	8:50 AM	CHEM 06
Annabelle	Lu	II	10:05 AM	MEDH 13
Nadia	Ludwig	I	9:30 AM	MEDH 01
Cameron	Magana	I	8:50 AM	MEDH 05
Shreya	Mahesh	I	9:10 AM	MEDH 30
Sreyansh	Mamidi	III	11:25 AM	PHYS 09
Pranav	Manoj	II	10:05 AM	BHVSO 22
Tony	Martin	I	8:50 AM	BizIN 10
Wesley	Matthews	I	9:10 AM	BizIN 05
William (Liam)	McCarthy	II	10:45 AM	MEDH 33
Karrick	McGinty	I	8:50 AM	PHYS 04
Diego	Michel	II	10:05 AM	PHYS 18
Cynthia	Mu	III	11:25 AM	BIO 09
Rena Reshmi	Mukherjee	I	9:10 AM	CHEM 10
Harshini	Musku	I	9:10 AM	BizIN 11
Naveena	Mutharasan	I	8:50 AM	CHEM 06

Siva	Nalabothu	I	9:30 AM	MEDH 31
Monika	Narain	II	10:25 AM	MEDH 18
Ahana	Narayanan	II	10:25 AM	BIO 10
Monica	Narciso	I	9:30 AM	BizIN 12
Liam	Nelson	I	9:30 AM	PHYS 17
Oliver	Ni	I	9:30 AM	BHVSO 21
Minju (Cindy)	Oh	II	10:45 AM	BHVSO 17
Cayleigh	O'Hare	II	10:05 AM	MEDH 19
Natalie	Oliven	III	11:25 AM	MATH 02
Kosisochi	Onwuameze	II	10:25 AM	MEDH 28
Sarah	Oquendo	II	10:45 AM	MEDH 06
Grayson	Pacourek	II	10:05 AM	ENGN 02
Julianna	Padilla	II	10:05 AM	MEDH 07
Paola	Padilla	I	8:50 AM	BHVSO 19
Shreenithi	Palamuthy	II	10:05 AM	MEDH 32
Eric	Pan	II	10:05 AM	BizIN 13
Brandon	Park	I	9:10 AM	MEDH 24
Ju-Won	Park	I	9:30 AM	CMPS 05
Madhav	Parthasarathy	III	11:55 AM	MATH 01
Abhiram	Pasupula	II	10:45 AM	BIO 03
Advait	Patel	II	10:25 AM	ERSP 01
Hiteshi	Patel	I	9:30 AM	MEDH 26
Krisha	Patel	II	10:45 AM	BIO 11
Pranav	Patel	I	8:50 AM	MEDH 08
Ruchi	Patel	I	9:30 AM	CHEM 05
Rajan	Patkar	II	10:45 AM	MATH 04
Shreya	Pattisapu	II	10:05 AM	BIO 07

Philip	Paulson	I	8:50 AM	MEDH 09
Lucienne	Petit	II	10:25 AM	MEDH 14
Rosario	Picone	I	9:10 AM	ENGN 04
Jack	Pinto	I	8:50 AM	MEDH 08
Akul	Prakash	I	9:10 AM	BIO 12
Prarthana	Prashanth	II	10:25 AM	MEDH 18
Megan	Ptak	II	10:25 AM	MEDH 14
Ava	Puchitkanont	II	10:45 AM	CMPS 06
Shambhavi	Punjala (Raj)	II	10:25 AM	ERSP 01
Kevin	Qu	II	10:05 AM	BIO 16
Ashwath	Ramesh	I	8:50 AM	MEDH 10
Vasanth	Ramesh	II	10:25 AM	BIO 17
Reese	Ramos	II	10:05 AM	PHYS 10
Apurva	Reddy	I	9:10 AM	MEDH 30
Alana	Rock	II	10:25 AM	PHYS 19
Adriana	Rodriguez	II	10:05 AM	MEDH 13
Haley	Rodriguez	II	10:25 AM	BizIN 14
Rushil	Sambangi	II	10:45 AM	BizIN 15
Bhargav	Sampathkumaran	II	10:25 AM	BHVSO 13
Christin	Sanchez	II	10:45 AM	MEDH 15
Eric	Shackelford	II	10:05 AM	PHYS 10
Manaal	Shamsi	II	10:25 AM	ERSP 01
Smriti	Shankar	II	10:45 AM	PHYS 20
Emily	Shao	III	11:25 AM	BIO 09
Fania	Si	I	9:30 AM	BIO 15
Dev	Singh	II	10:25 AM	CMPS 07
Cordelia	Sirais	II	10:25 AM	BHVSO 14

Zoie	Sloneker	II	10:25 AM	PHYS 11
Aidan	Smith	II	10:25 AM	MEDH 04
Grace	Smith	I	9:30 AM	ENGN 03
Tyler	Smith	I	9:10 AM	BizIN 05
Heldanna	Solomon	I	9:10 AM	MEDH 11
Kodai	Speich	II	10:45 AM	PHYS 12
Storm	Stern	I	8:50 AM	BizIN 16
Aidan	Stueck	III	11:55 AM	MATH 01
Kavin	Suhirtharen	II	10:45 AM	MEDH 23
Sabirah	Taiwo	I	9:10 AM	MEDH 11
James	Tan	II	10:25 AM	PHYS 11
Andy	Tang	II	10:45 AM	PHYS 13
Teodor	Tchalakov	III	11:55 AM	PHYS 14
Abhiram	Thati	I	9:10 AM	BizIN 17
Ethan	Thieme	III	11:25 AM	MATH 02
Manasvi	Thumu	III	11:55 AM	MEDH 25
Siddharth	Tiwari	II	10:45 AM	MEDH 27
Andrea	Torres	II	10:05 AM	CHEM 01
Eva	Tuecke	I	8:50 AM	PHYS 15
Rishik Reddy	Ummareddy	II	10:05 AM	BIO 16
Shivani	Venkatraman	II	10:25 AM	BHVSO 14
Quinn	Verdeyen	I	8:50 AM	CHEM 07
Saicharan	Voora	I	9:30 AM	BIO 13
Akhil	Vytla	I	9:10 AM	BIO 19
Laila	Walton	II	10:45 AM	BIO 18
Arthur	Wang	I	9:30 AM	ENGN 03
Gloria	Wang	II	10:05 AM	CMPS 02

Jaden	Wang	II	10:25 AM	BIO 17
Len	Washington III	II	10:45 AM	CMPS 01
Ben	Weber	II	10:45 AM	BHVSO 15
Margaret	Wei	I	9:30 AM	BIO 08
Brady	Williams	I	9:10 AM	PHYS 16
Kristina	Williams	I	8:50 AM	CHEM 08
Hannah	Xu	I	9:10 AM	BIO 05
Philip	Yi	I	8:50 AM	ENVR 01
Mark	Ying	I	9:30 AM	BizIN 18
Erin	Yoo	I	9:10 AM	CMPS 03
Kyler	Yu	II	10:25 AM	ERSP 01
Nathan	Yuan	I	9:10 AM	BIO 19
Alexander	Zhang	I	9:30 AM	PHYS 01
Edward	Zhang	II	10:05 AM	BizIN 19
Sabrina	Zhang	I	9:30 AM	MEDH 01
Makayla	Zheng	II	10:45 AM	BIO 06
Kaylee	Zhou	I	9:10 AM	BHVSO 16
Robert	Zhu	II	10:45 AM	PHYS 13

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