
IMSA Illinois Mathematics and Science Academy | Student Inquiry and Research

April 20, 2022

Dear IMSA Students, Faculty, Staff and Friends,

Welcome to IMSAloquium 2022. This is IMSA's 35th year of leading in educational innovation, and the 34th year of the IMSA Student Inquiry and Research (SIR) Program.

This year, student presentations will again be via Zoom. Projects will be presented concurrently in virtual "rooms" over the course of three morning sessions. We are excited to bring back poster presentations, which will be in the afternoon in the main gym for the on-campus IMSA Community. We are also pleased to note that students from the IMSA Internship program will again be participating in IMSAloquium. In the spring of 2020, 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. It is clear that scientific research has indeed advanced the human condition, in terms of fighting this disease

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, many SIR students participated in on-campus SIR courses. Work from all projects from all of these venues is represented at IMSAloquium. The SIR team would 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 day 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.
Brian Trainor, 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**
Evan M. Glazer, Ph.D.

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# IMSAloquium 2022 Schedule | Zoom*

**Introduction** 8:05a.m.

**Keynote** 8:15a.m. (pre-recorded)

**Session I Project Presentations** ***(10 min. + 5 min. Q & A)***

8:50a.m. - 9:05a.m.
9:10a.m. - 9:25a.m.
9:30a.m. - 9:45a.m.

**Session II Project Presentations** ***(10 min. + 5 min. Q & A)***

10:05a.m. - 10:20a.m.
10:25a.m. - 10:40a.m.
10:45a.m. - 11:00a.m.

**Session III Project Presentations** ***(20 min. + 5 min. Q & A)***

11:25a.m. - 11:50a.m.
11:55a.m. - 12:20p.m.

**Live Poster Session** (*on-campus IMSA Community)*

1:30p.m. - 2:30p.m.
Student Inquiry and Research (SIR) – **Main Gym**
Business Internship (BizIN) – **IN2**

***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.

## IMSAloquium 2022 Keynote -

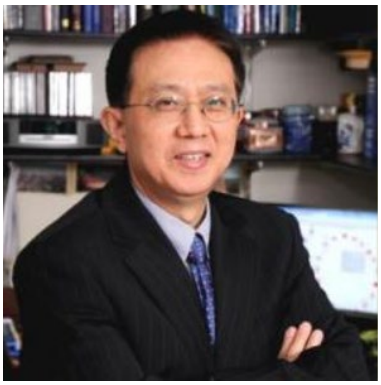
### "Cancer as a differentiation disease: Rethinking current treatment strategies"


# Tong-Chuan (T.-C.) He, MD, PhD

Associate Professor and Director of Molecular Oncology Laboratory
The University of Chicago, tche@bsd.uchicago.edu


**Credentials**

Postdoc, Cancer Biology/Genetics, HHMI/Johns Hopkins School of Medicine, Baltimore, MD
PhD, Molecular Cell Biology, The Pennsylvania State University, University Park, PA,
MSc, Biochemistry, Chongqing Medical University, Chongqing, China
B.M. (MD equivalent), Clinical Medicine, Chongqing Medical University, Chongqing, China



**Research Interests**

Dr. He has a broad range of research interests in biomedical science including:

1) to elucidate the roles of major cell signaling pathways in regulating lineage commitment and terminal differentiation of mesenchymal stem cells (MSCs);
2) to unravel the molecular and genetic links between MSC differentiation and bone tumorigenesis;
3) to uncover the essential roles of small regulatory RNAs (esp. noncoding RNAs) in the development of cancer drug resistance;
4) to develop novel and efficacious gene and/or cell-based strategies for regenerative medicine and tissue engineering; and
5) to develop innovative and enabling technologies for basic and translational research.

**Accomplishments**

Dr. He has published more than 350 peer-reviewed research articles and scientific reviews, many of which appeared in the top tier journals such as Science, Cell, Nature Genetics, Cancer Research, Genes & Development, and PNAS, with accumulative citations of over 42,000 times and an h-index of 89 (Google Scholar). Dr. He's early work led to the first identification of Wnt/β-catenin downstream targets in human cancer, and since he investigated the roles of Wnt, BMP/TGFβ, Notch, and retinoic acid signaling in other types of human cancers. His lab was the first to to identify BMP9 (aka, GDF2) as one of the most potent osteogenic BMPs in MSCs. Furthermore, his lab demonstrated that bone tumor cells are not only refractory to, but also stimulated by osteogenic factors, such as BMP9, suggesting that bone tumors may be a differentiation diseases caused by genetic and/or epigenetic disruptions of terminal differentiation. In fact, his lab has shown that non-specific differentiation agents such as retinoic acids can inhibit bone tumor growth. On the regenerative medicine front, his lab established a large panel of reversibly immortalized adult progenitors from multiple tissues and are studying candidate biofactors that will enhance bone fracture healing, wound healing, cartilage damage repair, and tendon injury healing. Lastly, Dr. He has extensive expertise in developing novel and enabling techniques to improve and facilitate biomedical research, including the widely-used AdEasy system and numerous gene expression and silencing systems delivered by viral vectors or transposon system. More recently, his lab has created first-in-the class short artificial regulatory RNA libraries for forward genomewide functional studies of human diseases.

A list of his publications and research summary can be found at:
http://www.boneandcancer.org/publications/
https://pubmed.ncbi.nlm.nih.gov/?term=he+tc&sort=date

## Abstract Titles by Category | Project ID Reference List

| Categories | Codes | Entries |
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## Behavioral and Social Sciences | BHVSO

## Biology | BIO

## Business Internship | BizIN

## Chemistry | CHEM

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| *Ancestral Sequence Reconstruction of Rubisco Activase from Zea Maize to Improve Thermal Stability*<br>Taylor Baugh, Naveena Mutharasan | CHEM 01 |
| *Ancestral Sequence Reconstruction of Rubisco Activase from Zea Maize to Improve Thermal Stability*<br>Elizabeth Alcala, Ramzi Daki | CHEM 02 |
| *Quantification of Polyreactive Antibodies in Cardiolipin Using Dinitrophenol*<br>Keira Feliciano, Vanessa Rodriguez | CHEM 03 |
| *The Molecular Interaction Between c-KIT Receptor Protein (STI-571) and Threonine*<br>Aubrey Hall, Michelle Sun | CHEM 04 |
| *Experimentation with Small Molecule Inhibitors*<br>Gabrriella Kanallakan | CHEM 05 |
| *Minimizing Harmful Emissions from Common Explosives*<br>Anthony Kholoshenko | CHEM 06 |
| *Methane Removal Using Zeolites: A Computational Analysis*<br>Aditi Kumar | CHEM 07 |
| *On the Favorability of the Initiation Reaction of Polymerization of Various Polymers*<br>William McClain | CHEM 08 |
| *Chimeric Dynorphin-Morphine and their Resulting Interactions with Kappa and Mu Opioid Receptors*<br>Matthew Torres | CHEM 09 |
| *Synthesis of Treatments for Mycetoma Disease*<br>James Anterola, Jeff Duan, Renaldo Venegas | CHEM 10 |
| *Synthesis of Fenarimol Derivatives as Potential Treatments for Mycetoma*<br>Ethan Brazelton, Avdhan Kandikattu | CHEM 11 |
| *Isolation of Extracts of Ginger and their Antimicrobial properties*<br>Jesse Park | CHEM 13 |
| *Design and Synthesis of Emtricitabine Analogs as Potential Treatments for HIV*<br>Dean Oquendo | CHEM 15 |
| *Uncovering an Improved Version of Donepezil, an Alzheimer's Treatment*<br>Amrut Pennaka | CHEM 16 |

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| *Leishmaniasis: hit to lead synthesis of treatment*<br>Mojadesola Suleiman | CHEM 18 |
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| *Water Quality Data Collection through mWater Software*<br>Erin Yoo | CMPS 03 |
| *The Construction and Evaluation of a Neural Network-Based Deep Learning Model using Transcriptomic Data to Predict Alzheimer's Disease-Related Neuropathological Indexes*<br>Elaina Xiao | CMPS 04 |
| *Using Machine Learning to Recognize CRS in Patients*<br>Irene Liu | CMPS 05 |
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| *Options Pricing with Neural Networks*<br>Marco Bravo, Daniel Ma, Philip Yi, Michael Yodovich, Edward Zhang | CMPS 09 |
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| *Performing Hypothesis Testing Involving Candidate Topological Spaces Generated by Polyominoes*<br>Akshat Gupta | *MATH 02* |
| *Approximating the Row-Wise Total Least Squares Linear Regression Solution*<br>Cole Plepel | *MATH 03* |

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| *The Search for New Antibiotics: Deriving Antimicrobials from Soil*<br>Joyce Li, Aidan Maddox, Rachel Selvaraj | MEDH 02 |
| *NSD Histone Methyltransferases drive Cell Proliferation in HPV-negative Head and Neck Squamous Cell Carcinoma (HNSCC)*<br>Ariela Asllani | MEDH 03 |
| *Key Elemental Differences causing Cisplatin Induced Hearing Loss*<br>Rujuta Durwas, Pranit Guntupalli, Faisal Patel | MEDH 04 |
| *Exploring Retinal Projection to the Medial Amygdala: Laterality, Sex, and Cell Types*<br>Shikhar Gupta, Kavin Suhirtharen | MEDH 05 |
| *Analyses of Expression Patterns of Genes Associated with Inherited Retinal Degeneration in Different Cell Types of the Human Retina*<br>Himani Kamineni | MEDH 06 |
| *Investigating the effectiveness of Metarrestin as a perinucleolar compartment inhibitor to suppress metastasis*<br>Nandana Varma | MEDH 07 |
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| *Assessing the Quality of LGBTQ+ Identity Affirming Care: Developing Recommendations for Identity-Focused Healthcare*<br>Venus Obazuaye | MEDH 12 |
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| *The Impact of CPSF6 on the Innate Immune Response to HIV Infection*<br>Kenith Taukolo | MEDH 15 |
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## Physical Science | PHYS

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| *Lepton Selection for the Doubly Charged Higgs*<br>Gautham Anne, Dean Barrow | PHYS 01 |
| *An Investigation of Triboson Decays into Four-Lepton Final States*<br>George Bayliss, Jesus Fileto, Dheeran Wiggins | PHYS 02 |
| *New Cuts on Higgs to WW Production*<br>Surya Bhamidi, Dean Cianciolo, | PHYS 03 |
| *Background and Signal Estimate Calculation for Doubly-charged Higgs Boson Production*<br>Nathaniel Graf | PHYS 04 |
| *Dark Photons with Z' Portal*<br>Kevin Huang, Jack Morby | PHYS 05 |
| *Utilizing SOFTSUSY calculations in dark sector analysis*<br>Hector Ibarra | PHYS 06 |
| *Lepton Selection for Dark Photons*<br>Rohan Jain, Zhengyu Pan | PHYS 07 |
| *Trigger Analysis with the IMSA-CMS Framework*<br>Nathan Kilmer | PHYS 08 |
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## Session I - 8:50a.m. – 9:05a.m.

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

**Title: Synthesis of Treatments for Mycetoma Disease**
**Presenters:** James Anterola, Jeff Duan, Renaldo Venegas
**Mentor:** Dr. John Thurmond, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Mycetoma is a commonly neglected tropical disease that leads to the development of tumors that may affect underlying bone (CDC, 2020). By carrying on from graduated students' research from the previous year, we have analyzed a compound, Methyl Ether 6, that they have deemed as potentially fit for the treatment of the disease. Enforcing Lipinski's rule of 5 in combination with thin-layer chromatography allowed us to establish groups of compound mixtures that could potentially be combined to treat Mycetoma. Running NMR tests on the subsequent groups revealed that there was indeed a group of compound mixtures that may be potentially effective in treating the disease.

**Project ID: CHEM 13**
**8:50a.m. - 9:05a.m.**

**Title: Isolation of Extracts of Ginger and their Antimicrobial properties**
**Presenter(s):** Jesse Park
**Mentor(s):** John Thurmond, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
The intention of this project was to find potential antimicrobial properties within ginger. This was done by isolating gingerol, shogaol, and zingiberene. These compounds are the defining components of ginger. After extraction, each compound was individually tested for antimicrobial properties. The effectiveness of the compounds was observed.

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

**Title: Performing Hypothesis Testing Involving Candidate Topological Spaces Generated by Polyominoes**
**Presenter(s):** Akshat Gupta
**Mentor(s):** Ryan Robinett, University of Chicago
**Abstract/Project Intention:**
Topological data analysis (TDA) is an approach to the analysis of datasets using techniques from topology. The main tool is persistent homology, an adaptation of homology to point cloud data. Persistent homology has been applied to many types of data across many fields. Until quite recently, the theoretical aspects of TDA and topological inference mostly relied on deterministic approaches. These deterministic approaches do not take into account the random nature of data and the intrinsic variability of the topological quantity they infer. Consequently, most of the corresponding methods remain exploratory, without being able to efficiently distinguish between information and what is sometimes called "topological noise". A statistical approach to TDA means that we consider data as generated from an unknown distribution, but also that the inferred opological features by TDA methods are seen as estimators of topological quantities describing an underlying object.

Our study aims to use percolation model where (d-1) simplices are used as edges and d simplices are used as nodes from graph theory to generate polyominoes that will produce different probability distributions of persistence diagrams, so that we can perform hypothesis tests involving candidate topological spaces, and better understand how topological noise arises through different probability distributions.

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

**Title: Ancestral Sequence Reconstruction of Rubisco Activase from Zea Maize to Improve Thermal Stability**

**Presenters:** Taylor Baugh, Naveena Mutharasan
**Mentors:** Dr. Angela Ahrendt, Illinois Mathematics and Science Academy,
Dr. Sarah Stainbrook, Washington University in St Louis

**Abstract/Project Intention:**
Rising global temperatures due to climate change threaten the productivity of key agricultural staple crops such as maize corn, thus having negative implications for food security and production. Increased heat stress impairs plant function by decreasing the efficiency of rubisco activase (RCA), a critical enzyme responsible for net photosynthesis. To address this issue, we performed Ancestral Sequence Reconstruction (ASR) on the RCA gene sequence from Zea maize to form a mutated sequence with improved thermostability. ASR is a technique which uses software to generate a most likely ancestor to a protein sequence, which is often more stable than the wild type. Through ASR, it is possible to enhance the thermostability, promiscuity, and activity of proteins. Several rounds of ASR were performed with different combinations of Archaeplastida species, including those genetically furthest and closest from maize on the phylogenetic tree. From this, two generated sequences were synthetically constructed by a commercial lab. The sequences were cloned into an expression vector, and the protein variants will be expressed, purified, and analyzed for improved heat tolerance compared to the maize wild-type RCA.

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

**Title: Background and Signal Estimate Calculation for Doubly-charged Higgs Boson Production**
**Presenter:** Nathaniel Graf
**Mentor:** Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
The purpose of this project is to automatically generate background and signal estimates for the H++. Drell-Yan is one possible path of Higgs production, but 4 lepton production at 800 GeV is quite rare, meaning the data becomes sparse near 800 due to the low probability of events generating in that range. To calculate background in this case and gain consistency, we create a fit using the more consistent lower mass ranges, and then use this fit to derive event numbers from these large mass ranges. A power law fit is used as it produces a good fit. Using this fit and values for the higher lepton bins, we can calculate a background estimate for our various production pathways. The range of the fit is the range from 150-1700 GeV, I will be presenting the final event yield in the talk.

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

**Title: Substituent Effects on Phenol**
**Presenter(s):** Elizabeth Alcala, Ramzi Daki
**Mentor(s):** Joseph Golab, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
This project focuses on how adding various substituents to the already existing phenolmolecule will influence its structure and stability. Phenol is an antiseptic often found in household cleaners and is also used in small amounts as an anesthetic. 11 non-metal substituents are added within the para location to see whether or not the said substituent will affect the molecule. Our goal is to find a substituent that will maximize the stability of the molecule, meaning having the lowest energy difference and most similar calculations to the original. The calculations for bond distances, bond angles, molecule energies, and the main dihedral angle were measured for H, CH3, NH2, OH, F, PH2, SH, Cl, CF3, CN, and CH2CH3 substituents. Following the original calculations, data will be taken to measure the effect of two substituents on the phenol.

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

**Title: Political, Racial, and Household Income Barriers for Access to Health Care**
**Presenter(s):** Kennedy Bray
**Mentor(s):** Patrick Kearney, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Access to health care impacts many people nationwide, as it restricts their ability to solve their health concerns. People who have the highest risk of a lack of access include people who are uninsured, people a part of a specific social class, a minority that lives in a poor state, or a person belonging to a specific political party. The first step in solving this problem is determining why people in certain geographical areas have such a lack to access. Learning more about the area will provide knowledge as to why resources are scarce. Another step is to look at the demographic of an area and see the people living there. When looking at the demographic, you are able to distinguish why certain people do not have access to health care while others do. These factors allow room to distinguish why there are healthcare disparities in certain places.

In my project, I decided to focus on access to healthcare by the percent of people who are insured. The data that I collected included years, race, median household income, and the political party of people living in Cook County, Illinois.

**Project ID: MEDH 27**
**8:50a.m. - 9:05a.m.**

**Title: Impact of Common Dietary Supplements on Urine Glucose Levels**
**Presenter(s):** Akash Basavaraju
**Mentor(s):** Dr. Sowmya Anjur, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
The rise of diabetes mellitus, particularly among younger people, has been a cause of public health concern recently. Many scientific studies conducted throughout the pandemic showed diabetes as being a cause for severe complications related to COVID. Current treatment for diabetes primarily consists of lifestyle changes and/or medications. Natural remedies for diabetes have been gaining more traction lately, given the high cost of insulin. We studied the effect of common dietary supplements on diabetic urine glucose levels. The dietary supplements tested include Omega-3 Fish Oil, Vitamin B2 (Riboflavin), Vitamin B12 (Cobalamin), and Vitamin D3. Known amounts of glucose were added to synthetic urine to convert the urine glucose level to the diabetic range. The typical recommended daily amount of each dietary supplement was added to the urine which was then tested for glucose concentration. It is hoped to correlate the effect of these natural compounds to a decreasing level of glucose in urine in this model of diabetes.

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

**Title: Lepton Selection for the Doubly Charged Higgs**
**Presenters:** Gautham Anne, Dean Barrow
**Mentor:** Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
The decay of the doubly charged Higgs is as follows: two quarks annihilate into a Z boson, which pair produces an H++ and H--, which both then decay into 4 final state leptons. We attempt to find more precise cuts to eliminate the most significant backgrounds – Drell-Yan, ZZ, ttbar, and QCD. We also calculate the significance. By predicting better pT (transverse momentum) cuts on the backgrounds for the different 4 leading lepton states, we maximize the significance, which makes the signal identification easier.

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

**Title: Pollinator Growth Rates in a Changing Climate**
**Presenter(s):** Catelyn Rounds
**Mentor(s):** Jessica Amacher, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
While climate change threatens extreme weather events and rising ocean levels, its effects will also impact important pollinators that we rely on for crops and native ecosystems. While the larval stages are considered to be an agricultural pest, in their adult stage, the hawk moths are important pollinators, contributing heavily to healthy, native ecosystems in the Midwest. Temperature-induced changes in hawk moth growth rates will be felt in forest preserves, prairie landscapes, and even our own gardens. This study investigated how the tobacco hornworms' life cycles change in temperatures approximating that of a century ago, conditions today, and predictions for rising temperatures fifty years in the future. We raised groups of worms from an early larval stage to adulthood, documenting their growth weekly. We found that higher temperatures increase the growth of the worms and accelerate pupation and emergence times. Pollinators living accelerated life cycles in warmer temperatures may result in far-reaching implications for the future of native pollinator-plant relationships here in our own community.

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

**Title: The Impact of CPSF6 on the Innate Immune Response to HIV Infection**
**Presenter:** Kenith Taukolo
**Mentors:** Estefany Rios Guzman, Margarita Rzhetskaya, Judd F. Hultquist,
Northwestern University, Feinberg School of Medicine
**Abstract/Project Intention:**
With no current vaccine for Human Immunodeficiency Virus (HIV), it is crucial to study what factors influence how HIV infects host cells to develop new strategies and therapies to combat this pandemic. Cleavage and polyadenylation specificity factor 6 (CPSF6) is an HIV host factor known to influence HIV infectivity and trafficking early in the infection. We hypothesize that the overexpression of CPSF6 will increase the antiviral response and decrease HIV infection in T cells. To test the hypothesis, we require a way to overexpress CPSF6 in mammalian cells to observe the antiviral response in HIV infection. To make a CPSF6-containing vector, we prepared a pLVX-TetOne-Puro-Cter3xFlag empty vector through E. coli transformation and plasmid purification, restriction enzyme digest, and then gel electrophoresis to confirm successful plasmid linearization. Post-purification, two inserts of the CPSF6 gene were then assembled into the empty vector using Gibson Assembly reactions. With this assembled construct, repetition of all of the aforementioned steps were performed to confirm the successful isolation of CPSF6 gene-containing plasmid. Plasmid amplification was then achieved using a polymerase chain reaction (PCR) to amplify the assembled construct. Further research will consist of expressing the vector in mammalian cells. These cells will be tested for their antiviral gene expression by Western blot and infectivity for HIV by flow cytometry. Ultimately, this experiment will lead to a greater understanding of CPSF6's role in the innate immune response in HIV infection.

**Project ID: CMPS 05**
**8:50a.m. - 9:05a.m**

**Title: Using Machine Learning to Recognize CRS in Patients**
**Presenter(s):** Irene Liu
**Mentor(s):** Claus-Peter Richter, Northwestern University,
Feinberg School of Medicine
**Abstract/Project Intention:**
Chronic Rhinosinusitis (CRS) is a nasal disease characterized by the inflammation of the mucosa and paranasal sinuses with a duration of at least 12 consecutive weeks. So, to diagnose CRS, one needs to keep a record of their symptoms for ~12 weeks before they are recommended to get a tomography which will allow physicians to classify them as a patient with CRS or without. This is a timely and costly process; thus, machine learning should be used to speed the process up. This project explores using Python and different machine learning algorithms to classify individuals as with or without CRS based on the way they speak. Files of individuals with and without CRS saying different words were recorded and converted to the frequency domain. These values were then analyzed by machine learning algorithms to classify whether the speaker had CRS or not. Each algorithm is evaluated based on the time it took to run, as well as how accurate its predictions were.

**Project ID: BHVSO 18**
**8:50a.m. - 9:05a.m**

**Title: The Correlation Between Socioeconomic and Environmental Factors on Life Expectancy in the United States**

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

**Abstract/Project Intention:**
There are many factors that can impact an individuals' health, such as proximity to services, access to nature, occupational opportunities, and more. It was hypothesized that factors such as population density, education, civilian labor force, poverty, mortality, public transportation, air quality, and unemployment rates differ between urban and rural areas and influence longevity in humans. However, previous research dove deeper into analyzing counties in Illinois, New York, California, Texas, and Florida and found that rather than the aforementioned factors, average income was the main determinant of longevity in individuals. With this knowledge, we will expand our data to cover all counties in the United States to examine if average income is the main determinant of longevity, or whether it was the main determinant for those fives tates. With this new data, we will generate numerous econometric regression models to test for correlation between the previously mentioned factors, average income, and the life expectancies of urban, suburban, and rural counties in all US states. Using the quantitative results reflected in these models will allows us to conclude how intensely the conditional factors and average income will affect the health and life expectancy of the citizens who live there.

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

**Title: Assessing User Feedback to Optimize the FoodSteps Mobile Health Intervention**

**Presenter(s):** Annabelle Lu
**Mentor(s):** Andrea K. Graham, Ph.D., Northwestern University, Feinberg School of Medicine

**Abstract/Project Intention:**
Mobile interventions created through research studies often have not focused on user preferences, and consequently, people are less likely to use the app once it enters the real world. FoodSteps is a mobile intervention to help users manage weight and reduce binge eating and was designed with extensive user input through user-centered design methods. In this study, 30 people with recurrent binge eating and obesity completed a 16-week clinical trial of the FoodSteps intervention and participated in semi-structured interviews following treatment regarding their experiences with FoodSteps. Interview transcripts were analyzed, and five themes emerged regarding program recommendations. Participants wanted to choose the method of delivery of auto messages (e.g., text, app notification) and review and edit past data in the eating log. Participants wanted a greater variety of goals and challenges. Participants desired a more interactive design (e.g., videos, peer competition, incentives), and recommended adding a support group. Understanding the experiences of people who have completed the intervention revealed important considerations for future versions of the mobile intervention. The FoodSteps team will continue to incorporate user feedback to improve the intervention to meet the needs and preferences of its users.

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

**Title: Engineering a Compact Wind Turbine**
**Presenters:** Kevin Lemus, Ilan Lunken
**Mentor:** Dr. Mark Carlson, Illinois Mathematics and Science Academy
**Abstract/Project Intentions:**
In the United States, electricity production from fossil fuels accounts for nearly 25% of greenhouse emissions. The impact of this problem inspired us to construct a lightweight, compactable wind turbine that could give users renewable energy wherever they go. Our current design includes an 8.5 x 8.5 x 2-inch plastic base. This houses the electronics which include five small generators in series and a charging voltage regulator. It also secures the mechanical hardware consisting of the generator cases and sprockets, chain, central sprocket with sleeve adapter, and mast bearings. A lightweight removable hex shaft mast engages the central sprocket and supports a large collapsible S-shaped blade. Currently, our device is capable of generating 1.2 volts in winds exceeding 4 m/s. Our ultimate goal is to charge 4 AAA batteries which can be used to produce 5 volts when configured in series. To facilitate this, we aim to increase the output voltage in our final design of the wind turbine to charge the batteries more quickly. Our hope for the future of this project is to produce a renewable energy source that is able to charge USB devices directly.

**Project ID: BIO 12**
**8:50a.m. - 9:05a.m**

**Title: Phage Discovery: Isolating bacteriophages capable of infecting either *Arthrobacter globiformis, Gordonia rubripertincta or Microbacterium foliorum* from soil samples collected at the Illinois Mathematics and Science Academy**

**Presenters:** Edwin Alcantara, Sage Owen, Makayla Zheng
**Mentor:** Dr. Crystal Randall, Illinois Mathematics and Science Academy

**Abstract/Project Intentions:**
Over the last few decades, research has been conducted on bacteriophages, viruses that infect bacteria, and the potential of phage therapy to serve as an alternative to antibiotics. Phage therapy has high specificity, lower chance of resistance, and minimal disturbance to "good" bacteria, making it a worthy alternative. However, more research is needed to identify candidates for phage therapy. This research project specifically seeks to isolate and characterize novel phages from soil samples. Here we describe our efforts to refine the process involved in collecting and isolating a phage from a soil sample. Engaging in the phage isolation protocol serves to create a better understanding of how phages are collected. Isolation is the first step in learning more about the potential phages held in the world of medicine. As new diseases arise and the effectiveness of antibiotics becomes challenged, increased knowledge regarding phages and their potential is crucial.

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

**Title: Fidget Toys as a Method of Classroom Management**

**Presenter(s):** Nathan Brodsky, Jonah Fisher, Kaz Isibue, Rachael Koterba,
Adriana Rodriguez, Patrick Tenedor
**Mentor(s):** Sowmya Anjur, David Lundgren,
Illinois Mathematics and Science Academy

**Abstract/Project Intention:**
Our overall goal for this project is to assess the effectiveness of 3D printed fidget toys in the classroom as a method of cost effective classroom attentiveness management. Our goal this school year was to assess which 3D printable fidget toys, among those that are freely available online, were the most effective in terms of cost, material requirement, time to manufacture and durability. We tested a variety of fidget toys, where each had a different action. We did this in order to create a stock of durable fidget toys for next year's research group to use in their pursuit of our overall goal.

**Project ID: CMPS 12**
**8:50a.m. - 9:05a.m**

**Title: Using agent-based computational modeling to stimulate the mechanic stress responses of specific communities**

**Presenters:** Elizabeth Nyamwange
**Mentor:** Kiarri Kershaw, Katharine Harrington, Northwestern University, Feinberg School of Medicine

**Abstract/Project Intentions:**
Research shows that people with low incomes and racial/ethnic minority populations experience greater levels of stress than their more affluent, white counterparts. This can lead to significant disparities in both mental and physical health that ultimately affect life expectancy and shows correlation with a reduction in household SES as paired with mental and physical health barriers. To learn more about stress responses and their direct implications in diverse communities, a microscale model was built to stimulate the simultaneous operations and interactions of multiple agents to re-create and predict the appearance of this complex phenomena. This model analyzed and visualized the complex dynamic systems of stress to understand how individual environment interactions influence decisions with the mesa documentation in python. The adaptive behavior of the model and its complex systems allows for non-linear causality: an environmental variation prompts the agents' behavioral responses, which then feed back into additional environmental variations, and so on.

This project anticipated to be part of a step in a larger research agenda enabling local Chicago families to make healthier decisions, and enforcing public health departments across the country to give communities the resources to make positive changes.

**Project ID: MEDH 37**
**8:50a.m. - 9:05a.m**
**Title: Discovery and Synthesis of Novel Inflammation Reducing Drug for Atopic Dermatitis**
**Presenters:** Natali Chung
**Mentor:** John Thurmond, Illinois Mathematics and Science Academy
**Abstract/Project Intentions:**
Atopic dermatitis (AD) is a non-contagious chronic inflammatory skin disease. AD is associated with allergies such as those that pertain to food or dust, allergic asthma, and anaphylaxis. These reactions start a complex interaction of various pathways involving skin barrier function and immune deviation, developing an itchy inflammation on the contacted skin. Topical treatments such as topical steroids and PDE4 inhibitors are the most common medication for immediate, on-site treatment of AD to reduce inflammation. However, the Janus-kinase signal transducer was discovered in recent years as a regulator of inflammation and myeloproliferation and may be more effective than current medication in treating inflammatory diseases. Therefore, JAK inhibitors are now being studied, such as baricitinib, ruxolitinib, and tofacitinib. Using the active site of the baricitinib inhibitor, we use the digital drug design platform SeeSAR by BioSolveIT to find possible new structures and sort them by effective ADME data. After review and selection of structures, a synthesis route for a structure most feasible to synthesize for this research project was created in reference to baricitnib. This hypothesis will test if the synthesis of our discovered drug is possible and efficiently reproducible, and if properties effective to the treatment of AD are retained.

**Project ID: MEDH 26**
**8:50a.m. - 9:05a.m**

**Title: In vitro analysis of an ultraporous synthetic scaffold's ability to promote mesenchymal stem cell survival and chondrogenesis**

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

**Abstract/Project Intention:**
Articular cartilage is a vital connective tissue in the musculoskeletal system. Because articular cartilage is avascular in nature, effective repair of cartilaginous defects remains a challenge. Dimension Inx (Chicago, IL), recently developed a novel ultraporous scaffold: Fluffy polylactide co-glycolide (FPLG). It is capable of being 3D printed to precisely adhere to irregular contours present in cartilaginous surfaces. This study evaluated the chondrogenic potential of FPLG; specifically, its ability to promote viability and adhesion of four immortalized mesenchymal stem cell lines at different stages of differentiation. Immortalized murine embryonic fibroblasts (iMEF), immortalized human urine progenitor cells (iHUP), immortalized murine articular chondrocytes (iMAC), and immortalized multipotent adipose-derived (iMAD) stem cells were infected with recombinant adenovirus GFP and placed onto a 5mm x 5mm x 1mm mesh of FPLG. Cell viability was then measured over 7 days. Fluorescence microscopy imaging showed that the cell lines remained adherent on FPLG, but the cell densities did not increase. Instead they stayed constant for 2 days and decreased thereafter. qPCR analysis demonstrated constant Sox9 expression, an indicator of chondrogenesis. Further tests are warranted to evaluate the chondrogenic potential of FPLG in vitro.

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

**Title: BlockBins Intern Abstract**
**Presenter(s):** Ela Gadi
**Mentor(s):** Dane Christianson, BlockBins
**Abstract/Project Intention:**
BlockBins is a composting company that provides shared compost bins at low prices. The focus of the business project for BlockBins is to compile a detailed composting and recycling guide and to further solidify their brand image through social media presence. These projects have had many positive impacts. The compost guide gives BlockBins' target market important information which makes composting less intimidating to potential customers, increasing the likelihood that they will use BlockBins services. Additionally, the clear instructions listed in the guide, prevent BlockBins' compost from being contaminated from incorrectly composted items. BlockBins has been using social media to post clarifying graphics for items with complex composting instructions. This has a similar impact to that of the guide. They have also used their social media to post composting quizzes. This increases user engagement, therefore increasing BlockBins' social media presence and brand identity.

## Session I - 9:10a.m. – 9:25a.m.

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

**Title: Design and Synthesis of COVID-19 Antivirals Using Computer Modeling**
**Presenter(s):** Isabella Chen, Lethzeylee Gutierrez
**Mentor(s):** John Thurmond, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
The development of effective antiviral drugs for COVID-19 is ongoing. COVID Moonshot is an initiative that contributes to this goal. We aim to develop easily manufacturable antiviral drugs that can inhibit the SARS-CoV-2 main protease, Mpro. Using fragment-based drug discovery, which identifies low-molecular-weight ligands that bind to biologically important macromolecules, leads for the biological target were identified. We designed new molecules from our COVID Moonshot starting fragment, x1086, through modification of its bonds in SeeSAR, a 3D modeling software platform. Compounds with the best-estimated affinities from the 341 designed compounds were selected and data on their druglikeness and ADMETOX properties were gathered through swissADME and ADMETSAR, websites predicting physicochemical descriptors and ADMETox parameters (absorption, digestion, metabolism, excretion, and toxicity). We looked at Lipinski's rules and human ether-à-go-go related genes (hERG inhibition), BBB permeability, CYP3A4 inhibition, and bioavailability. We submitted our best eight compounds to the COVID Moonshot Consortium for further testing and drug development and one was modified for synthesis. Additionally, an unsubmitted molecule was also synthesized with modifications. Their molecular structures were confirmed through Nuclear Magnetic Resonance (NMR) and their data was gathered though swissADME and ADMETSAR. Further synthesis of our other designed molecules are in progress.

**Project ID: MEDH 35**
**9:10a.m. - 9:25a.m.**

**Title: Synthesizing and Cost Evaluating Tiopronin**
**Presenter(s):** Ayati Lala, Miles Massey
**Mentor(s):** John Thurmond, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Tiopronin is a prescription thiol drug used as medication to treat severe homozygous cystinuria. Although not an immediate threat it contains the risk of the formation of kidney stones. Tiopronin is used as a second-line therapy to control the rate of cysteine precipitation and excretion. The price of tiopronin has recently exploded from $1.50 to $30 per pill, a 1,900% increase in cost. The intent of our project is to make this drug for ourselves, and cost evaluate it to see if the price charged by pharmaceutical companies is fair. By following the instructions of a pre-existing patent, we conducted various steps to synthesize this drug. After distilling the solution, combining it with other chemical compounds, the 2- chloropropionic acid ended as an organic material. The NMR shows similarities between tiopronin and the organic material we made. Our findings indicate that tiopronin cost $2.38 to make 100 mg, a substantial decrease from the $30 per 100mg.

**Project ID: MATH 03**
**9:10a.m. - 9:25a.m.**

**Title: Approximating the Row-Wise Total Least Squares Linear Regression Solution**
**Presenter(s):** Cole Plepel
**Mentor(s):** Dr. Evan Glazer, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Motivated by applications as a kernel of nonlinear regression algorithms, the row-wise weighted total least squares regression problem is examined to find a consistent and accurate estimator. Specifically, the estimator will have a time complexity linear in the number of observations and a space complexity constant in the same value, as the number of observations can be quite large in many modern applications, often many orders of magnitude larger than the number of input and output features. Further, to accommodate large data sets, an algorithm is sought to update an intermediate representation from each observation, allowing for parallelization of the necessary computation. The proposed method is based on approximating the noncentral second moment of the underlying data by a precision-weighted mean, requiring only linear time in the number of observations. Initial findings show the proposed algorithm to be less accurate than existing methods intended to solve other variants of the Total Least Squares problem. Directions for continued iteration and further investigation are proposed as next steps in developing a better algorithm.

**Project ID: ENVR 02**
**9:10a.m. - 9:25a.m.**

**Title: Alternatives to Animal Leather for Fashion Industry Using Bacterial Cellulose Sheets**
**Presentor:** Gabriela Georgieva
**Mentor:** Dr. Angela Ahrendt, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Leather production from bacterial cellulose (BC) is one of the many vegan leather options explored through scientific research in response to the animal welfare in, and the environmental impact of, the fashion industry. This study attempted to replicate BC production using *Komagataeibacter hansenii* and *Komagataeibacter xylinus*. Groups of BC were then impregnated with differing amounts of Downy softener and either dodecanol or stearic acid to lend them flexible and hydrophobic qualities that mimic those of animal leather. The chemicals used are inexpensive alternatives to chemicals found in other papers. Dodecanol and stearic acid were studied specifically as potential substitutes for perfluorocarbons (PFCs), hydrophobic and lipophobic compounds with negative environmental side effects. Due to supply chain back-up, both bacterial strains were activated, but only *k.hansenii* has been incubated to produce BC, although it did not form an interlaced, patty-like structure. Instead, only bits of BC were formed on the surface of the growth media. *K. xylinus* BC is now being incubated; this should provide better results as it is the bacteria used in the replicated study. If successful, this study will provide alternative impregnation chemicals that are both cheaper and more environmentally friendly, minimizing the effects of BC leather production.

**Project ID: PHYS 06**
**9:10a.m. - 9:25a.m.**

**Title: Utilizing SOFTSUSY calculations in dark sector analysis**
**Presenter:** Hector Ibarra
**Mentor:** Dr. Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
We are utilizing the program SOFTSUSY (based on the minimal supersymmetric standard model (mssm)) for dark sector analysis of dark photons. We have automated the external program with Python to give us cross-sections of dark photons while also automating the C++ graphing program to plot these data points. The two variables that are changed throughout automation are the m0 (unified soft scalar mass) and m12 (unified soft gaugino mass) variables. This allows us to continue researching potential cross sections for lepton-jet production in the SUSY portal as well as further researching supersymmetry-dark sector connections. With streamlined automation, we can also explore other variables that can affect the cross-sections calculated by the Monte Carlo simulation.

**Project ID: CHEM 04**
**9:10a.m. - 9:25a.m.**

**Title: The Molecular Interaction Between c-KIT Receptor Protein (STI-571) and Threonine**
**Presenter(s):** Aubrey Hall, Michelle Sun
**Mentor(s):** Dr. Joseph Golab, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
STI-571's role in the medical field is not as significant as other proteins, so we are interested in the logistics of its interaction with amino acids, such as Threonine. We applied the SPARTAN software to model the STI-571 molecule and Thr. We then made atomic substitutions, including changing a few Nitrogen atoms to Carbon atoms. Despite such changes, the distance between the Thr gatekeeping residue and the STI-571 protein stayed within 0.6 angstroms, suggesting that the molecule change did not make much of an effect on the distances of the model. When atoms farther away from Thr are changed, it has less impact on the length of the hydrogen bonding between the Oxygen on Thr and the Hydrogen on STI-571, but when it's closer, it has more impact. The changes made to the base case of the protein increased the overall energy change, indicating the atom change is not favorable for the orientation and structure of the protein. By modeling the STI-571 protein, we will not only have a better understanding of how such a protein functions but will also be able to discover more regarding its role in the treatment of certain cancers.

**Project ID: BHVSO 13**
**9:10a.m. - 9:25a.m.**

**Title: Income and Access to Healthcare's Impact on Longevity throughout Illinois Counties**
**Presenter(s):** Rebecca Pae
**Mentor(s):** Patrick Kearney, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Across the United States, there is a twenty-year life expectancy difference between the county with the highest longevity and the county with the lowest longevity (USC). Income is a major factor with wealthier regions having some of the highest longevity. However, there are many more external factors, especially those relating to healthcare, that shorten the longevity of those residing in a particular region. This project determines the extent to which higher income and better access to healthcare, measured as the percentage of uninsured residents and the percentage of licensed physicians and surgeons in each region, affects the average life expectancy for each county in Illinois. These hypotheses will be tested using OLS regression analysis. These conclusions will inform further research and actions to be implemented to address the factors that are correlated with shorter life expectancies in order to decrease the gap between longevity within Illinois.

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

**Title: The Effect of Vitamin D on Glioblastoma *Multiforme* T98G Cells**
**Presenter(s):** Serena Gacek
**Mentor(s):** Dr. Sowmya Anjur, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Vitamin D has been proven to have anti-proliferative effects on several different types of cancer, including *Glioblastoma multiforme* (GBM). The use of supplemental Vitamin D has demonstrated a reduced mortality rate in GBM patients, and the expression of the Vitamin D Receptor may be associated with a better prognosis for GBM patients. To further establish the tumoricidal efficacy of Vitamin D, GBM was cultured in Vitamin D solutions of varying concentrations. We anticipate proving that Vitamin D induces apoptosis of GBM T98G cells and also confirming the proper concentration(s) of Vitamin D that may be expected to inhibit GBM cell growth.

**Project ID: PHYS 02**
**9:10a.m. - 9:25a.m.**

**Title: An Investigation of Triboson Decays into Four-Lepton Final States**
**Presenter(s):** George Bayliss, Jesus Fileto, Dheeran Wiggins
**Mentor(s):** Dr. Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
The doubly charged Higgs boson ($H^{\pm\pm}$) is a theoretical non-Standard Model scalar boson with both Drell-Yan and vector boson fusion production mechanisms. The dark photon ($\gamma_d$) is a theoretical dark matter non-SM gauge boson in the dark sector with Higgs and SUSY production mechanisms. We present our findings on triboson background events for doubly charged Higgs bosons and dark photons in four-lepton final state event signatures ($l^{\pm} l^{\pm} l^{\pm} l^{\pm} l = e, \mu$). We analyze triboson behavior from PYTHIA models of triple vector boson scatterings and their prevalent decay channels (VVV $\rightarrow$ $l^{\pm} l^{\pm} l^{\pm} l^{\pm}$, V = W,Z). The triboson background events exhibit a frequency that is relatively constant over increasing values of $p_T$, displaying a different behavior from the other sources of background. Our research provides insight into future, more efficient, $p_T$ background cuts in searches for dark photons and doubly charged Higgs bosons.

**Project ID: BIO 06**
**9:10a.m. - 9:25a.m.**

**Title: Continuous Temperature Measurements in Donor Hearts during Organ Procurement**
**Presenter(s):** Siddarth Bangaru
**Mentor(s):** Daniel Rodgers, David Onsager, Valluvan Jeevanandam
University of Chicago
**Abstract/Project Intention:**
In-the-current standard-of-care mechanism for donor heart transport, the organ is immersed in preservation solution inside of a sterile plastic jar, triple-bagged, and placed inside a cooler filled with ice. Literature describing the relationship between transport conditions and post-transplant outcomes is very limited. Therefore, we aimed to investigate the relationship of donor heart temperature with major elements of post-transplant success.

This pilot study utilizes a proprietary-continuous-temperature-monitoring (TAG) prototype-placed-inside the organ transport device during procurement (Gate Scientific, Los Angeles, CA). There was no-direct organ-TAG contact during Phase I, during which the conditions of the surrounding environment were assessed (ambient temperature and ice). Phase II of the study will investigate the temperature conditions associated with direct organ contact, which will be evaluated to see if optimal hypothermic temperatures (4-8°C) are achieved.

The ambient-temperature recordings of the organ cooler, prior to adding the ice, was on average 21.5 ± 1.67°C over 1 hour. The average temperature of the ice in the organ cooler was -0.43 ± 2.06°C over 3 hours with $R^2 = 0.3109$.

The TAG successfully measured continuous temperature readings of ambient and internal-transport-conditions inside a standard-of-care organ-transport-device. TAG technology in conjunction-with Phase II investigations may provide insight into the relationship of hypothermic organ transport conditions and clinical outcomes.

**Project ID: CHEM 18**
**9:10a.m. - 9:25a.m.**

**Title: Leishmaniasis: hit to lead synthesis of treatment**
**Presenter:** Jadesola Suleiman
**Mentor:** John Thurmond, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Leishmaniasis is a parasitic disease that is characterized by fevers, enlarged spleens, weight loss, and swollen glands. It primarily affects the tropical and subtropical regions of Earth, and is also classified as a neglected tropical disease. This study was done in collaboration with the Drugs for Neglected Diseases Initiative (DNDi) and the University of Otago. The goal of this project is to synthesize potential treatments for Leishmaniasis. One compound was synthesized and the structure was confirmed by nuclear magnetic resonance (NMR). This compound, and any others that are synthesized, will be sent to the University of Otago for biological testing and the results will be used to design more potent compounds.

**Project ID: CMPS 07**
**9:10a.m. - 9:25a.m.**

**Title: Semantic Contrastive Multi-Modal Video Transformer**
**Presenter(s):** Dev Singh
**Mentor(s):** ChengXiang Zhai, University of Illinois;
Ismini Lourentzou, Virginia Tech
**Abstract/Project Intention:**
We present an architecture for learning semantic multi-modal video representations to learn semantic representations of videos from unlabeled data with transformer architectures. While multi-modal transformer architectures have been shown to increase accuracy of video classification and feature learning tasks, these techniques do not incorporate semantic information. Our Semantic Contrastive Multi-Modal Video Transformer (SCMMVT) takes raw video, audio, and text data and generates semantic multi-modal representations that represent connections and relations between portions of the video. We integrate multiple pre-trained architectures and evaluate feature extraction performance with video action recognition downstream tasks.

**Project ID: BHVSO 09**
**9:10a.m. - 9:25a.m.**

**Title: Postgraduate employment and wage disparities by Race**
**Presenter(s):** Temi Ijisesan
**Mentor(s):** Patrick Kearney, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
My SIR project analyzes the ways in which race intersects with and determines postgraduate success of young adults in the U.S. Previously, I studied the ways that Affirmative Action, Affirmative Action Bans, HBCUs and other factors affect the overall percentage of African American Students (Black) attending 4-year public institutions in America. I found that most of these variables had no statistically significant effect on the overall percentage of students attending these universities and colleges that are black (from overall student population). My current research takes my previous inquiries a step further and looks at the monetary and academic success of minority (Black) students at these institutions by comparing them to employment rates and post-graduate wages of their white peers. By considering all these factors, I am able to get a clearer understanding of whether Affirmative Action policies and other programs set in place to help minority students are truly effective in ensuring their success in the academic sphere, corporate world and beyond.

**Project ID: MEDH 12**
**9:10a.m. - 9:25a.m.**

**Title: Assessing the Quality of LGBTQ+ Identity Affirming Care: Developing Recommendations for Identity-Focused Healthcare**

**Presenter:** Venus Obazuaye
**Mentors:** Will Dunne, Nihmotallahi Ayomipo Adebayo; Northwestern University, Feinberg School of Medicine, Center for Health Equity Transformation

**Abstract/Project Intention:**
Recently, the practice of patient-centered health care has emerged as one possible strategy to reduce health disparities experienced by marginalized communities. Despite this trend, limited research has been conducted to measure the impact of patient-centered health care, or identity and gender-affirming care, on members of the LGBTQ+ community and potential improvements.

This study first analyzed differences in participants' responses to four measures of patient-centered care by demographics such as race and gender in 13,501 adults from the 2017 National Healthcare Quality and Disparities Report (NHQDR). Our study team then designed a Likert-style and free-response survey that could be used to capture the specific perspectives of LGBTQ+ patients, their medical providers, and future medical students on the impact and importance of identity and gender-affirming care.

Analysis of the 2017 NHQDR indicated differences in participants' experiences with patient-centered care depending on their unique identities. Our survey has four parts that ask providers, patients, and caregivers about the quality of the LGBTQ+ oriented care they receive in order to create recommendations for providers.

Ultimately, this research highlights the disparities present for LGBTQ+ patients and the potential the created survey holds if implemented and used to guide change at various healthcare institutions.

**Project ID: ENGN 02**
**9:10a.m. - 9:25a.m.**

**Title: Using Design Thinking to explore Opportunities, Feasibility, and Experiences**
**Presenter(s):** Saanvi Chelikani
**Mentor(s):** Stacy Benjamin, Northwestern University
**Abstract/Project Intention:**
Design Thinking is a problem solving process used for innovation and when creating something new. A five step iterative process - empathize, define, ideate, prototype, test - it allows designers to make successful products that satisfy user needs. In this project we explore the process of design thinking through different lenses and contexts. The first context was an environmental setting - working with Fresh Water Life, an organization trying to preserve the beauty of Lake Michigan. We explored opportunities around new creative uses for discarded microplastics and the related technical feasibility. The second context was an educational setting, redesigning an exhibit station at a children's museum to better engage and educate younger audiences. In both contexts, we applied the design process, including secondary research, interviewing target users, creating mockups and models, gathering feedback from users through testing, and interviewing experts. Although the process steps were similar for both cases, the findings and insights were dependent on specific context.

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

**Title: Elimination of Background in the Lepton Jet Analysis through the Application of Relative Isolation Cuts**
**Presenter(s):** James Tan
**Mentor(s):** Dr. Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
We look through data generated from a Monte-Carlo simulation in order to analyze exotic interactions, meaning those outside of the standard model. Our analysis is divided into two primary searches, with one focused on the doubly-charged Higgs boson, and the other examining dark photon decay. This project focused primarily on the dark photons, specifically the lepton jets that result from their decay. I worked to decrease the background of the lepton jet analysis, which consists of lepton jets resulting from hadronization and other processes unrelated to dark photon decay. The analysis focused on two potential variables that had could be used for cuts to eliminate background, namely hadronic energy and relative isolation. While hadronic energy did not yield any noticeable results, with different values of it being dispersed rather equally throughout the background and the signal, relative isolation showed a positive correlation with our signal. Thus, any lepton jets below a certain relative isolation could successfully be eliminated.

**Project ID: BHVSO 21**
**9:10a.m. - 9:25a.m.**

**Title: The Atlas of Knowledge: A look into the capabilities of the IMSA YouTube Channel**
**Presenter(s):** Jessica Lyseng, Gabriella Velazquez
**Mentor(s):** Kevin Broy, William McGrail,
Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
After noting a lack of engagement and representation on the IMSA YouTube channel and researching existing science content, we produced an educational video segment for the channel about the brain, based on student surveys. After capturing analytics before and after, we analyzed the change in the channel and denoted this change to the topic, format, and production of our content. Our results will demonstrate how successfully the elements of our video performed as well as the platform of the IMSA YouTube channel.

**Project ID: PHYS 20**
**9:10a.m. - 9:25a.m.**

**Title: The Relationship Between Overlapping Resonances and Chaos in Planetary Systems**
**Presenters:** Jayant Kumar
**Mentor:** Yoram Lithwick, Northwestern University
**Abstract/Project Intention:**
Studies have been conducted to determine the role overlapping resonances have on the chaos within planetary systems, primarily our own. Most studies prove that overlapping resonances are the cause of chaotic orbits, as is evidenced by the Kirkwood gaps, however, it is not understood which resonances are primarily responsible for chaotic orbits. Our project investigates the relationships of overlapping first-order and second-order resonances with chaos, within our own solar system, as well as other Kepler systems. Our investigation uses simulations, using an n-body integrator package called REBOUND, to understand the resonances found among the planets. Through simulating hundreds of thousands of systems with slight variations in orbital periods, we can understand the relationship between the resonances and chaos shown in the system. The results of our surveys will determine what factors play into the magnitude of a resonance's role in the chaotic orbits of its affected planets.

**Project ID: PHYS 12**
**9:10a.m. - 9:25a.m.**

**Title: Particle Physics Project**
**Presenter:** Liam Nelson
**Mentor:** Dr. Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Current models occasionally misinterpret particle charges due to high transverse momentum. To this end, we designed a module that, when implemented, matches generated particles to reconstructed ones and logs the number of incorrect signs in the reconstruction. We further divide these sign flips between high pT and low pT, based off a momentum cut specified in the module. Further, our current model does not account for particle decay events away from the primary vertex, as the module previously created for locating displaced vertex events did not function properly. We fixed previous errors and made the module more reliable and accurate to simulated particle events. We added functionality to test several different cylinder radii to propagate tracks to, making the estimated displaced vertex location more accurate.

**Project ID: BIO 14**
**9:10a.m. - 9:25a.m.**

**Title: JAG1 Role in the Extravasation of Metastasized TNBC**
**Presenter(s):** Bhavya Vegesna
**Mentor(s):** Benjamin Gordon, University of Illinois at Chicago
**Abstract/Project Intention:**
Breast cancer is the second leading cause of cancer death in women. Triple negative breast cancer (TNBC) is an aggressive subclass defined by its lack of hormonal receptors and HER2 amplification. Although TNBC only accounts for 15% of all invasive breast cancers, there are limited therapeutic options for patients with TNBC. Although breast cancer patients have a favorable prognosis if their tumor is detected early, patients with TNBC are prone to earlier recurrence and local/distant metastasis. Consequently, patients with metastatic TNBC have <15% relative 5-year survival rate. The development of metastasis in TNBC is a complex and poorly understood process that includes multiple steps such as genetic and epigenetic alterations, angiogenesis, epithelial-to-mesenchymal transition (EMT), intravasation, and extravasation. Expression of JAGGED-1 (JAG1), a Notch ligand, correlates with metastatic status and poor survival in clinical data. However, the exact mechanism in which JAG1 increases metastasis is unknown. We hypothesize that JAG1 increases metastasis by interacting with endothelial cells. In order to test this idea, we generated JAG1-knockout cells using CRISPR/Cas9 technologies and then modeled the extravasation of these cells compared to JAG1-positive cells. Specifically, we interrogated lung capillary extravasation after intravenous injection of TNBC cells. The lung was chosen due to the propensity of TNBC cells to invade the lung. Preliminary data demonstrates that JAG1 presented in tumor cells acts as a signaler to permit and promote extravasation and metastasis of the cancer cells. For further studies, the long term effects of tumor derived JAG1 will be studied to understand the consequences of JAG1 mediated extravasation on metastatic burden and survival.

**Project ID: BizIN 02**
**9:10a.m. - 9:25a.m.**

**Title: TurnUp Activism Inc. Graphic Design Projects**
**Presenter(s):** Esther Im
**Mentor(s):** Paulina Cano, Training Program Manager, TurnUp Activisiam
**Abstract/Project Intention:**
TurnUp Activism Inc. is a 501(c)(3) non-profit that strives to foster a new wave of youth voters and activists. In the TurnUp app, users are able to find and post events, scroll through their newsfeed, access resources, and participate in civic engagement. On their social media platforms, TurnUp posts about volunteer opportunities, current news, and other resources, and during my internship I focused on the unique overlap between graphic/informational design and activism on these applications. Throughout my internship I focused on different elements of design (e.g. space, value, and contrast) to create aesthetically pleasing posts that still relayed information in an accurate setting and manner.

**Project ID: BizIN 08**
**9:10a.m. - 9:25a.m.**

**Title: Information Technology with the Illinois State Treasurers Office**
**Presenter(s):** Revanth Poondru
**Mentor(s):** Daniels Joseph, Chief Information Officer,
Illinois State Treasurers Office
**Abstract/Project intention:**
AgInvest is a program developed by the Illinois State Treasurers Office that streamlines the process that banks go through to request loans on behalf of farmers. It has been available for Illinois for over 39 years. It provided basic loans with a variety of approved financial institutions to start, expand, or addvalue to farm operations. It has loaned billions of dollars out to farms since it has been in existence. Thefast-track program that was introduced shortened the necessary time for a loan to be approved tremendously. A bank would be able to easily log onto the platform and fill out various fields which would then allow them to request loans much faster. The program automatically takes the responses given by the banks and proceeds to autofill various PDFs and send them off to be signed. After everything is signed, the program verifies it all and the money can be given on a loan to the banks. This program will be getting implemented within the coming year and is a huge benefit to farms and banking institutions across the state.

## Session I - 9:30a.m. – 9:45a.m.

**Project ID: MEDH 31**
**9:30a.m. - 9:45a.m.**

**Title: Synthesis of 2-aminothiazole derivatives as potential treatments of Mycetoma**
**Presenter(s):** Sammuel Go, Sumedha Surbhotla
**Mentor(s):** Dr. John Thurmond, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Fungal mycetoma is a neglected tropical disease that destroys skin, subcutaneous, and bone tissues in the limbs, causing deformity and physical disability. The disease spreads after contamination of wounds, typically on the feet or legs of a patient. There are over 70 identified fungal species that can cause fungal mycetoma after infecting humans. The disease is most prevalent in arid, tropical regions of Venezuela, Chad, Ethiopia, India, Mauritania, Mexico, Senegal, Somalia, Sudan, Thailand, and Yemen. Despite its effects, fungal mycetoma is still poorly understood and no treatments have been found for the disease. In order to combat this disease, an open-source project has been opened in order to find drug lead compounds that impact the disease. In our research, we synthesized different 2-aminothiazole analogs that can be sent to our collaborators for further testing to determine their biological efficacy against fungal mycetoma.

**Project ID: MEDH 02**
**9:30a.m. - 9:45a.m.**

**Title: The Search for New Antibiotics: Deriving Antimicrobials from Soil**
**Presenter(s):** Joyce Li, Aidan Maddox, Rachel Selvaraj
**Mentor(s):** John Thurmond, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
The prevalence of antibiotic-resistant infectious diseases has been on the rise, staging a major threat to the key role antibiotics play a key role in disease management. This global public health problem has reignited many discussions of finding new antibiotic resistance genes, revealing antimicrobial impacts and potential of soil bacteria in fighting these pathogens. Antibiotic residues in soil vary depending on the characteristics of the soil and climatic factors. Our study focuses on ESKAPE pathogens, whose antibiotic-resistant properties have been on the rise for over 50 years. We collected over 50 soil samples for serial dilution and spread plating in order to isolate multiple colonies of soil bacteria to test against ESKAPE pathogens. After reserving the pathogens in glycerol stocks, we PCR tested to genetically determine and verify whether or not these pathogens are new discoveries. We currently have 25 isolates being investigated, all of which were active against at least one of the ESKAPE pathogens.

**Project ID: CMPS 01**
**9:30a.m. - 9:45a.m.**

**Title: Data Augmentation Frameworks in Natural Language Processing**
**Presenter(s):** Gloria Wang
**Mentor(s):** Ashique KhudaBukhsh, Carnegie Mellon University;
Zirui Wang, Google Brain
**Abstract/Project Intention:**
Data augmentation is an important component in the robustness evaluation of models in natural language processing (NLP) and in enhancing the diversity of the data they are trained on. In this paper, we present NL-Augmenter, a new participatory Python-based natural language augmentation framework which supports the creation of both transformations (modifications to the data) and filters (data splits according to specific features). We describe the framework and an initial set of 117 transformations and 23 filters for a variety of natural language tasks. We demonstrate the efficacy of NL-Augmenter by using several of its transformations to analyze the robustness of popular natural language models. The infrastructure, datacards an robustness analysis results are available publicly on the NL-Augmenter repository (https://github.com/GEM-benchmark/NL-Augmenter).

**Project ID: BIO 08**
**9:30a.m. - 9:45a.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 in St. Louis
**Abstract/Project Intention:**
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: PHYS 08**
**9:30a.m. - 9:45a.m.**

**Title: Trigger Analysis with the IMSA-CMS Framework**
**Presenter(s):** Nathan Kilmer
**Mentor(s):** Dr. Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
In a collider, particle collisions create around 2TB of data every second, with most of this data being useless to the actual study. To help sift through this data on the fly, "triggers" are used to quickly determine what events should be recreated and kept, based on several parameters. In the IMSA-CMS framework we used predetermined triggers alongside our own workarounds, without much of an option for implementing typical triggers. We created new section of code to handle custom trigger implementations, using a TriggerSimModule object. This was then used to analyze the efficiency of different triggers. Additionally, an implementation was made for the use of triggers as filter objects for the purpose of making histograms.

**Project ID: CHEM 05**
**9:30a.m. - 9:45a.m.**

**Title: Experimentation with Small Molecule Inhibitors**
**Presenter(s):** Gabriella Kanallakan
**Mentor(s):** Joseph Golab, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
In the field of drug discovery, the use of small molecule inhibitors have become a prevalent strategy when developing drugs. In the p53-MDM2 protein-protein interaction, many novel small molecule inhibitors in the past 10 years have entered clinical trials to inhibit this protein interaction. There are many different types of small molecule inhibitors for this inhibitor such as MDMX or MDMX/MDM2, where different combinations of inhibitors have been used together to regulate the protein interaction. This study specifically focuses on a single Nutlin-3a inhibitor that is currently going through clinical trials to determine how it could be improved to receive more information as to how to construct an effective small molecule inhibitor. The study uses a molecular modelling approach through a program called SPARTAN to determine molecular weights and energies of small molecule inhibitors and determining which factors are the most important when developing inhibitors. This study breaks down the Nutlin-3a inhibitor and focuses on small parts on the molecular level to observe how the molecule interact with each other and seeing the effect of changing a small part of the protein. Combinatorial and molecular mechanic methods are used to predict how the model affects the function of the inhibitor.

**Project ID: BHVSO 14**
**9:30a.m. - 9:45a.m.**

**Title: Data Analytics: The Relationship Between Race and Disparities in Educational Attainment**
**Presenter(s):** Nikita Rudrapati
**Mentor(s):** Dr. Patrick Kearney, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
The purpose of this research paper is to identify the role of the racial makeup in American public schools has on educational outcomes. Current literature explains how low socioeconomic and academic resources create a negative compounded effect. Due to systematic disadvantages, minorities are less likely to graduate from high school and attend college. This project hypothesizes that even when controlling for socioeconomic factors, race still plays a role in economic outcomes. Using data from Chicago Public Schools (CPS) on both race and socioeconomics over the past ten years, this paper hopes to demonstrate the role that race continues to play in education outcomes. In doing so, it highlights the continued need to not only focus on economic policy issues but also on broader institutional reform as it applies to minority students' academic success.

**Project ID: MEDH 28**
**9:30a.m. - 9:45a.m.**

**Title: Identification of the biomarker IL-23 in Glioblastoma multiforme cell line T98G using ELISA**
**Presenter(s):** Katelyn Ingles
**Mentor(s):** Dr.Sowmya Anjur, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
The prognosis for patients with Glioblastoma multiforme is about 6% within 5 years of diagnosis. However, if caught earlier, the astrocytes that form glioblastoma can be detected in order to treat and prevent the spread of the cancer. This makes the use of biomarkers useful for diagnosis and tracking the progression of Glioblastoma multiforme. ELISA tests were done to test Glioblastoma cell line T98G cell cultures for the IL-23 antigen, to identify its effectiveness as a biomarker. The concentration of IL-23 in the cells was read at 450 nm with a plate reader and quantified using known standards. Current testing indicates that the IL-23 biomarker will either be present in low amounts or be absent in the tissue samples studied.

**Project ID: PHYS 03**
**9:30a.m. - 9:45a.m.**

**Title: New Cuts on Higgs to WW Production**
**Presenter(s):** Surya Bhamidi, Dean Cianciolo
**Mentor(s):** Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
We present results of new selection cuts in doubly charged Higgs to WW events. This search is performed using data generated from Monte Carlo simulations using leading lepton transverse momentum, same-sign invariant mass, opposite-sign invariant mass, and missing transverse energy. Monte Carlo simulations about each of these properties were analyzed for each significant background of the doubly charged Higgs: QCD multijet events, Drell-Yan processes, top pair production, and diboson production. The Monte Carlo simulation for each background, along with the Higgs events, used to find the most efficient cuts. The significance of each cut is calculated, and we present cuts optimized to maximize significance.

**Project ID: ENVR 01**
**9:30a.m. - 9:45a.m.**

**Title: Analysis of the Shinnery Oak Shrub Using High Resolution Unmanned Aerial Vehicle Imagery**
**Presenters:** Lily Song and Reyna Duffy
**Mentor:** Chuck Cannon, Morton Arboretum
**Abstract/Project Intention:**
The Shinnery Oak (Quercus havardii) is a low clonal deciduous shrub native to the Great Plains of North America. Little research has been done on the disappearing specie's ecology as the Shinnery Oak undesirably dominates the vegetation growing in its environment. Nonetheless, the species' restoration is vital to biodiversity, the well being of endangered species in the community, and livestock production. We used the DJI Phantom 4 drone to photograph the study site set in Western Texas. Photos of the area were taken over three different time periods: June, January, and March, depicting three clones of varying size and shape. Three clones were analyzed to compare differences in canopy size, color, and height resulting from seasonal changes. The dense cloud, 3D model, and orthomosaic were created after alignment and optimization of the photos. The orthomosaic was used to analyze distances between motts, sizes, and shapes of motts through R packages. Furthermore, error points and point density were compared to assess the accuracy of each data set.

**Project ID: CHEM 11**
**9:30a.m. - 9:45a.m.**

**Title: Synthesis of Fenarimol Derivatives as Potential Treatments for Mycetoma**
**Presenters:** Ethan Brazelton, Avdhan Kandikattu
**Mentor:** Dr. John Thurmond, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Antifungal therapy against eumycetoma, the fungal form of the infectious disease known as Mycetoma, has shown to be less than 27% effective, leading to the need for amputations and frequent surgeries. To find methods to control the predominant causative agent, Madurella mycetomatis, the crowdsourced MycetOS project was created with the intention of taking advantage of online communication between researchers. In particular, a fenarimol analog was found to be one of the most potent compounds active in vitro. Our goal was to synthesize derivatives of this lead compound so that partnering researchers through MycetOS would be able to test their potential and effectiveness in treating Mycetoma. This project has successfully synthesized compounds to be tested for their usability.

**Project ID: CHEM 03**
**9:30a.m. - 9:45a.m.**

**Title: Quantification of Polyreactive Antibodies in Cardiolipin Using Dinitrophenol**
**Presenters(s):** Keira Feliciano; Vanessa Rodriguez
**Mentor(s):** Golab Joseph, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Antibodies play a critical role in the immune system to recognize and defend the body from antigens. While most antibodies bind to one unique antigen due to the affinity maturation process, some antibodies bind with low affinity to multiple unrelated antigens, which is termed polyreactivity. In serum, there are many different polyreactive antibodies, of which have different affinities. Thus, using molecular modeling software, we quantified levels of polyreactive antibodies in serum, specifically Cardiolipin. We determined where DNP binds to Cardiolipin and how tightly bound by calculating energy levels, which could be used as an indicator of levels of polyreactive antibodies and can help with future drug discovery using polyreactive antibodies.

**Project ID: CMPS 08**
**9:30a.m. - 9:45a.m.**

**Title: Monitoring and Correcting HPV Vaccine Misinformation on Social Media**
**Presenter(s):** Ava Puchitkanont
**Mentor(s):** 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, mainly Instagram. 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, the captions and hashtags of vaccine related Instagram posts were examined and collected to study word frequency and sentiment analysis. The data was also used to do topic modeling to analyze what is being said in these Instagram posts.

**Project ID: BHVSO 10**
**9:30a.m. - 9:45a.m.**

**Title: Effects of Digital Tool Types on User Engagement and Basic Psychological Need Satisfaction in Online Learning**
**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. With COVID-19, the search for designing effective online learning tools has become more important than ever. Also, because students in higher education are more independent of their learning, researching how digital learning tools benefit or hinder them is important. One of the frameworks that attempts to integrate SDT into technology is the METUX model (Motivation, Engagement, and Thriving in the User eXperience). This field is relatively unexplored and there are many unanswered questions regarding autonomy design in technology. Specifically, Jeno et al. argued that there are inherent need-supportive elements in mobile learning tools. Taking the types of mobile tools into consideration might generate insight into what those inherent elements are. In addition, new relationships between the type of digital tools and user engagement can be discovered. In search of this, I performed several regression analysis of how the type of digital tools affected autonomy, competence, and user engagement.

**Project ID: BHVSO 04**
**9:30a.m. - 9:45a.m.**

**Title: An Analysis of The Exogenous Deaths of Directors During The 1960s and Their Implications**
**Presenter(s):** Christo Ekimov, Eunice Kim
**Mentor(s):** Carola Frydman, Kellogg School of Management,
Northwestern University
**Abstract/Project Intention:**
Deaths in a company's board of directors, particularly exogenous, have a significant impact on the company's success; their valuation is often strongly dependent on its leaders. Guided by Dr.Carola Frydman at Northwestern University's Kellogg School of Management, this paper addresses questions such as whether age of death, personal incentive, and expectations impact the extent to which businesses are affected by deaths of directors, what features characterize an ideal director, and who the most influential directors of the 1960s were. To conduct our experiments, we scanned historical records from the 1960s sourced from newspaper obituaries by utilizing a software called ABBYY14, and then performed analyses on the abnormal stock returns (AR) up to six days after the exogenous deaths of directors by utilizing Microsoft Excel. Generally, the deaths of "good" directors lower the company value as the company was highly dependent on them for their success, and deaths of "bad" directors maintain or increase the value because of either their lack of a role or detrimental role in the company. Assuming this, this paper strives to identify which traits are most desirable within the ideal director and create a model from which future leaders may be selected.

**Project ID: PHYS 10**
**9:30a.m. - 9:45a.m.**

**Title: Selection Cuts for Doubly Charged Higgs Bosons Decaying into Tau Particles.**
**Presenter(s):** Caroline Kowal, Kevin Zhang
**Mentor(s):** Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
We present new selection cuts for doubly charged Higgs bosons decaying into tau particles. The variables of the data include the leading lepton transverse momentum, same-sign invariant mass, opposite-sign invariant mass, and missing transverse energy values of each interaction. We also collect these values from data on each of the significant background events for the doubly charged Higgs decaying into tau particle interaction (QCD, DY, ttbar, and ZZ). For each variable, we superimpose background and signal data into a single histogram. We then run a script to compute the selection cut with the maximum significance, which we approximated using the number of signal events divided by the square root number of background events. After finding the optimal selection cuts for each variable, we apply all cuts and present the results below.

**Project ID: PHYS 17**
**9:30a.m. - 9:45a.m.**

**Title: Dark Photon Generation via Higgs Portal**
**Presenter(s):** Andy Tang
**Mentor(s):** Dr. Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
We present quantification of the potential to detect dark photons through Higgs portal decays to dark fermion pairs, as first analyzed in 2016 by ATLAS. The Higgs portal is one of two potential decay patterns under study: through further simulation we can compare it with a theorized supersymmetric (SUSY) portal and determine differences in lepton jets generated through the two portals. Using PYTHIA, analyses were performed to determine vertex displacement and lepton jet detection rates as a function of dark photon decay widths. Expected detection rates were then combined with decay simulations to determine dark photon signals from the production channel from dark fermion decay. The results of this study will help inform the direction of future dark matter searches.

**Project ID: MEDH 18**
**9:30a.m. - 9:45a.m.**

**Title: The Effect of Subcutaneous Electrical Stimulation on Hypertonia in Chronic Hemiparetic Stroke**

**Presenter(s):** Shreya Chakraborty, Yina Wang
**Mentor(s):** Dr. Julius Dewald, Dr. Hendrik Dewald, Dr. Hongchul Sohn,
Northwestern University

**Abstract/Project Intention:**
After brain injury, increased levels of monoamines in the central nervous system may result in hypertonia, or increased muscle tone on the affected side. The purpose of this project is to determine how low levels of cutaneous electrical stimulation affect hypertonia in patients with chronic hemiparetic stroke.

Electromyography (EMG) data was collected from the biceps, lateral triceps, and brachioradialis muscles before and after 20 minutes of electrical stimulation over the biceps. Electrical stimulation was conducted at a frequency of 20 Hz, pulse duration 0.1 ms, and an intensity slightly below the motor threshold. Furthermore, a sham stimulation was administered for 20 minutes, and flexor/extensor activation was intermittently performed to test whether hypertonia returned.

If stimulation of cutaneous afferents can reduce hyperexcitability of motor neurons in individuals with stroke, then by electrical stimulation of the skin, we expect to see statistically significant differences in hypertonia as measured by EMGs. The results from this experiment can be used to develop new treatments for hypertonia and associated stretch reflex hyperexcitability, common and debilitating motor symptoms of chronic hemiparetic stroke.

**Project ID: PHYS 18**
**9:30a.m. - 9:45a.m.**

**Title: File Input System Rework**
**Presenter(s):** Alexander Zhang
**Mentor(s):** Dr. Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Particle physics research involves processing up to millions of simulated particle collision events under a variety of conditions. These events are contained in Root files, and efficiently accessing these files is a crucial first step in the whole IMSA-CMS analysis. In our framework, the locations of the Root files corresponding to a condition are stored in text files, and the specific conditions chosen for analysis are determined in specially designed driver files. Our analysis' current input system relies on increasingly outdated and confusing hard-coded methods of processing Pick Files and accessing the proper text files; this project reworks our input system to bring it in line with current practice and allows for much more flexibility for future analyses.

**Project ID: BizIN 03**
**9:30a.m. - 9:45a.m.**

**Title: Status of Vitamin D in Children with Pediatric Acute-Onset Neuropsychiatric Syndrome (PANS)**

**Presentor:** Gabe Delgado
**Mentors:** Dr. Dareen Siri, Dr. Robert Kaufmann,
Midwest Allergy Sinus Asthma SC

**Abstract/Project Intention:**
Numerous studies have indicated an association between vitamin D deficienc and the immune dysregulation and pathogenesis of autoimmunity. This study was undertaken to determine the prevalence of vitamin D deficiency in children with PANS, an autoimmune disorder characterized by abrupt-onset neuropsychiatric symptoms. A retrospective chart review of 122 pediatric PANS patients at a single treatment center was performed. Data collected included 25-hydroxy vitamin D level, age, gender, and age of diagnosis. Vitamin D status was categorized as deficient (0-<20 ng/ml), insufficient
(20-<30 ng/ml) and sufficient (30-100 ng/ml). Patients were also stratified into two age groups; child (<12 years old) and adolescent (12-17 years old) and two gender groups; male and female. 8% of patients were categorized as deficient, 24% were insufficient, and 68% were sufficient. The odds ratio of vitamin D deficiency was 0.843505 [95% confidence interval (CI): -2.91 to 4.59] in PANS patients, when compared to deficiency, insufficiency, and sufficiency rates in the general US pediatric population. Vitamin D deficiency may be a risk factor for PANS in children. Supplementation

**Project ID: BizIN 09**
**9:30a.m. - 9:45a.m.**

**Title: Using 3D printing to develop a personalized and viable solution for COPD patients and CPAP users**
**Presentor(s):** Rushil Sambangi, Vidhi Shah
**Mentor(s):** Dima Elissa, VISMED 3D
**Abstract/Project Intention:**
Continuous Positive Airway Pressure (CPAP) machines offer relief to millions of people suffering from sleep apnea and chronic obstructive pulmonary disease (COPD). However, more than a third of CPAP users stop using their equipment due to compliance issues such as discomfort and air leakage. The goal of the business project was to devise a solution that would address these issues while producing a profitable product for VisMed3D. Since this is an ongoing project, the previous year was focused on creating a product workflow that would meet the necessary criteria for the solution. Throughout this academic cohort, the workflow was tested by conducting trials with the 3D scanner application, refining a patient's scan, and creating a 3D model that would be compatible with their CPAP machine. Along with this, a business model canvas was developed to demonstrate the viability of this solution both as profitable product for the company and an effective solution for patients.

## Session II - 10:05a.m. – 10:20a.m.

**Project ID: MEDH 32**
**10:05a.m. – 10:20a.m.**

**Title: Computer-Aided Drug Design and Synthesis of Atazanavir Derivatives for HIV**
**Presenter:** Samantha Gong
**Mentor:** Dr. John Thurmond, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
There is no drug on the market that successfully "cures" HIV, which leaves millions of people in an endless cycle of symptom suppressing drugs. The goal of this research project was to design and synthesize a better and more efficient medication starting from an already existing drug on the market: atazanavir. Using a program called SeeSAR to modify the structure of the drug molecule, I designed over 150 new compounds and analyzed them using SwissADME in regards to binding affinity, Lipinski's rules, CYP Inhibitors, GI Absorption, and LogP. Currently, I am in the process of synthesizing Atazanavir derivatives. I analyzed the theoretical and experimental NMR spectrography of the synthesized compounds.

**Project ID: MEDH 36**
**10:05a.m. – 10:20a.m.**

**Title: Using Protein Ligands for Design and Synthesis of a COVID-19 Treatment**

**Presenters:** Cameron Magana and Lucienne Petit
**Mentor:** John Thurmond, Illinois Mathematics and Science Academy

**Abstract/Project Intention:**
For several years, 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. The compounds are currently being synthesized.

**Project ID: CMPS 02**
**10:05a.m. – 10:20a.m.**

**Title: Efficient Dataset Creation Framework for Utilizing Complex Large-Scale Clinical Datasets in Machine Learning Applications**

**Presenter(s):** Braeden Cullen
**Mentor(s):** Dr. Yan, Illinois Institute of Technology

**Abstract/Project Intention:**
Artificial Intelligence-based analysis techniques have struggled to make headway in the field of neurological analysis. However, the systems that have been successfully implemented have shaped our modern understanding of neurological interactions. These analysis techniques are largely limited by a lack of robust frameworks for data generation and application, especially with relation to applications that require the usage of large datasets. This project seeks to resolve these issues plaguing modern neurological analysis techniques by outlining a detailed framework for the creation of an efficient registration framework for the formulation and registration of large-scale clinical datasets to significantly improve ease of usage in machine learning-based applications. Future steps include the application of this framework to modern clinical datasets to aid in the development of machine learning-based analysis tools which could significantly improve our understanding of neurological interactions.

**Project ID: MEDH 03**
**10:05a.m. – 10:20a.m.**

**Title: NSD Histone Methyltransferases drive Cell Proliferation in HPV-negative Head and Neck Squamous Cell Carcinoma (HNSCC)**

**Presenter:** Ariela Asllani
**Mentors:** Yanis Boumber, Iuliia Topchu, Robert H. Lurie Comprehensive Cancer Center of Northwestern University

**Abstract/Project Intention:**
Histone modifications are essential in regulating chromatin function and structure. Abnormal histone methylation is often detected during tumor development and progression. NSD1, NSD2, and NSD3 are key histone methyltransferases (HMTs) that catalyze lysine 36 dimethylation (K36me2) at histone H3. Inactivating NSD1 mutations are frequent in head neck squamous cell carcinoma (HNSCC) commonly occur in HPV-negative oropharyngeal (OP) carcinoma and laryngeal carcinomas (LC) and define a novel prognostic subtype in LC, where they associate with dramatically improved overall and progression-free survival. Here, we explored the biological impact of the loss of function of NSD1 in head neck squamous carcinoma (HNSCC). We discovered that HNSCC cells with a damaging mutation in NSD1 have reduced
K36me2 methylation levels relative to NSD1 wild-type HNSCC cells. We als found slower cell proliferation in NSD1 mutant cell line (SCC4) in comparison with other NSD1 WT cell lines. To further investigate the biologic impact of NSDs, we knocked down NSD1 and NSD2 with shRNA in different histologic subtypes of HNSCC cell lines (JHU011, JHU022, Cal27, and FaDu cell lines). The depletion of NSD1 and NSD2 results in a reduction of K36me2 and a significant decrease in cell proliferation and clonogenic formation in HNSCC, but not in lung cancer cells. Next, we performed a flow cytometry-based assay and found that NSD1/NSD2 depletion in HNSCC cells causes a significant increase in apoptosis levels. Downstream signaling, gene expression effects, and possible cell cycle regulation by NSD enzymes remain to be investigated in more detail. Ultimately, NSDs serve as attractive candidates for drug development, and targeting NSD1/NSD2 enzymes may be a new strategy for improving outcomes in HNSCC patients.

**Project ID: PHYS 09**
**10:05a.m. – 10:20a.m.**

**Title: IMSA-CMS: Particle Physics at the LH**
**Presenter(s):** Sameer Komoravolu
**Mentor(s):** Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
This year, my research has focused on optimizing Dark Photon and QCD datasets by comparing characteristic variables to exclude virtual jets. The bulk of my work has been in deep learning, where I am using Root's TMVA library to create layered neural networks to distinguish between dark photons and other potential sources of particles. In the broader perspective, by selecting independent feature vectors, these data cuts allow us to improve the efficiency of lepton-jet selection, an optimization motivated by the reduction of the virtual background dataset.

**Project ID: CHEM 06**
**10:05a.m. – 10:20a.m.**

**Title: Minimizing Harmful Emissions from Common Explosives**
**Presenter(s):** Anthony Kholoshenko
**Mentor(s):** Joseph Golab, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
The intention of this molecular modeling chemistry project was to minimize harmful emissions from the common explosives trinitrotoluene (TNT) and composition-4 (C4). The explosives were modeled in Spartan, a molecular modeling software that allows for a variety of molecular calculations. Exothermic activation energy calculations were completed to understand initial energies required in the explosions and visualize how those energies fluctuate when certain groups of the molecule are modified. After decreasing activation energies to an amount that still allows for the reaction to occur, molecule structure was analyzed. The balance of harmful products was observed.

**Project ID: BHVSO 15**
**10:05a.m. – 10:20a.m.**

**Title: COVID-19 and Global Freedom**
**Presenter(s):** Bhargav Sampathkumaran
**Mentor(s):** Patrick M. Kearney, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
This project is a continuation of a project of the same name from the previous year. Last year's project failed to find correlations between the effects of the pandemic and trends in Freedom Scores, as measures by Freedom House's Freedom in the World (FIW) index. However, given that the pandemic continues to change in its nature, and given that more long-term effects of the pandemic can be seen now than during the time of the previous project, further analysis is warranted.

This year, new measures that have been affected by the pandemic, such as vaccination rates, have been included in analysis. The project also aims to conduct analysis on a regional scale in addition to country-by-country analysis, to avoid the possibility of large-scale, regional trends being negated in significance by the presence of measurements for every nation in analysis. All data has been updated to the beginning of 2022, and all analysis is conducted using the R programming language and R Studio text editor.

**Project ID: MEDH 29**
**10:05a.m. – 10:20a.m.**

**Title: Remedies for Glioblastoma Multiforme**
**Presenter(s):** Abhi Pasupula
**Mentor(s):** Dr. Sowmya Anjur, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Natural Remedies for Glioblastoma Multiforme (GBM) Glioblastoma multiforme, commonly known as GBM, is a form of the brain with uncontrollable cell growth. For the past few decades, there have been many attempts to find a working or reliable cure to reduce the effects of this tumor, but nothing has been successful. As a result, many of those affected turn to natural remedies for relief. We tested the cytotoxicity of U118 Glioblastoma multiforme cells when treated with tomato extract, garlic extract, and ginger extract. Solutions were prepared to induce the cell cultures and responses were monitored after a 2-week period, Cell cultures were recounted to identify the effect of these natural remedies, if any, on the Glioblastoma cells. Future plans include testing the cell cultures with natural compounds similar to tomato, ginger, and garlic. It is hoped to make a conclusion based on what compound would be best to use in response to GBM.

**Project ID: BIO 03**
**10:05a.m. – 10:20a.m.**

**Title: Arbuscular Mycorrhizal Communities in Grassland Restorations**
**Presenter:** Christian Cline
**Mentor:** Dr. Jennifer Bell, Northern Illinois University
**Abstract/Project Intention:**
Arbuscular Mycorrhizal Fungi (AMF) is a type of soil fungus that forms a symbiotic relationship with plant roots to assist the plant with gathering nutrients throughout the soil and managing water stress. We compared the AMF communities of an abandoned field inside the Morton Arboretum between 2016 and 2021 to determine if the addition of native tallgrass prairie plants, a different plant community prior to what was there before, has allowed for any sort of restoration to the area.

Soil samples taken from 2016 through 2021 were treated, and the DNA was isolated. Purified DNA was sent for sequencing and differences between the samples were noted. The AMF community present in 2021 is significantly different than the community present in 2016 ($p=.001$). This suggests that environments supporting AMF communities can recover from agricultural use and abandonment over time.

**Project ID: MEDH 07**
**10:05a.m. – 10:20a.m.**

**Title: Investigating the effectiveness of Metarrestin as a perinucleolar compartment inhibitor to suppress metastasis**
**Presenter(s):** Nandana Varma
**Mentor(s):** Sui Huang, Northwestern University Feinberg School of Medicine
**Abstract/Project Intention:**
Cancer is a leading cause of death worldwide and the second leading cause of death in the United States, and the primary cause of mortality is metastasis to other organs. The perinucleolar compartment (PNC) is a sub-nucleolar structure that has been associated with metastasis and the progression of cancer, resulting in poor patient outcomes. To combat metastatic cancer, look towards the drug metarrestin. Metarrestin disrupts the nucleolar structure by inhibiting these perinucleolar compartments, and could potentially be a therapeutic treatment of metastatic cancer. Continuing previous research on the effectiveness of metarrestin as a drug to suppress metastasis, we analyzed the effectiveness of derivatives of metarrestin in inhibiting PNCs by tagging PNCs with antibodies using immunofluorescence. Additionally, looking at soft agar compounds, we have been able to mimic tissue cells and how metarrestin treatment affects tumor cell growth.

**Project ID: ENGN 06**
**10:05a.m. – 10:20a.m.**

**Title: Impact of Solar Tracking on Solar Energy-Based Water Purification**
**Presenter(s):** Shawn Coutinho
**Mentor(s):** Brooke Schmidt, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Water purification remains one of the permeating questions for humanity throughout history as humans' need to consume clean water to satisfy their bodily needs hasn't matched up well with the type of water present on Earth in large quantities as roughly only 1.2 % is safe for human consumption. In recent years, with the continued development of technology, experiments have been conducted as far as efficient automation of the water purification process goes with varying results. 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 impact of adding solar tracking capability to a solar energy-based water purification system. This is accomplished through adding this capability to an already created design that uses readily available materials. The effectiveness of this new version is determined by comparing the amount of water purified by the end of a day by a stationary setup versus a mobile setup. A safety check is conducted by measuring the pH of both input and output water. Observed results concur with statistical significance of the impact of solar tracking during multiple trials.

**Project ID: CHEM 09**
**10:05a.m. – 10:20a.m.**

**Title: Chimeric Dynorphin-Morphine and their Resulting Interactions with Kappa and Mu Opioid Receptors**
**Presenter(s):** Matthew Torres
**Mentor(s):** Joe Golab, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Opioids are a drug that is often used as an analgesic. They work by binding to receptors in the brain, creatively known as “opioid receptors.” There are three main opioid receptors: the kappa receptor, the mu receptor, and the delta receptor. The delta and mu receptors are responsible for euphoria, addiction, and the most dangerous aspects of overdose, as well as the quintessential analgesic effect. The delta receptor is also responsible for analgesia, without the other dangerous side effects, although it must be noted that the delta receptor also triggers dysphoria. In this experiment, I tested an engineered form of morphine, as well as an engineered form of heroin, for how well they could bind with a preference towards the delta receptor, and compared my results against dynorphin, standard morphine and heroin, leu-enkephalin, and standard commercial delta receptor agonists to evaluate their efficiency.

**Project ID: CMPS 10**
**10:05a.m. – 10:20a.m.**

**Title: Sleepiness and Emotion Detection with CNN and MediaPipe**
**Presenter(s):** Andrew Zhang
**Mentor(s):** Victor Elarde, Tao Zhang; Northrop Grumman
**Abstract/Project Intention:**
According to research by Steinhauser et. al, inattention of the driver due to additional tasks, emotion changes, fatigue or eye movements played an important role in 78% of car accidents on the road. The National Highway Traffic Safety Administration estimates that at least 100,000 police-reported crashes are the direct result of driver fatigue each year. This equates to approximately 1,550 deaths, 71,000 injuries, and $12.5 billion in monetary losses. The goal of this SIR is to develop a system that detects and alerts unstable emotions and drowsiness during daily driving, in order to reduce that fatality on the road, saving dozens of lives. The SIR project monitors and analyzes driver's facial features using real time video and alert drive when drowsiness or unstable mood is detected. The project, based on open-source code, has integrated libraries of face-meshing (MediaPipe), emotion detection, TensorFlow (CNN), and the eye-aspect-ratio algorithm we developed. It classifies multiple emotions and identifies drowsiness effectively. Future explorations can be in the area of automatic driver's mode control. Emotion detection can serve as a regulator to adjust automotive informatics and climate systems to help stabilize drivers' emotions for a safe driving experience.

**Project ID: BHVSO 07**
**10:05a.m. – 10:20a.m.**

**Title: Bursting the First-Gen Bubble: A Holistic Analysis of the Effects of Intersectional Identities on the First-Generation College Student Experience**

**Presenter**(s): Shria Halkoda
**Mentor(s):** Patrick Kearney, Illinois Mathematics and Science Academy

**Abstract/Project Intention:**

First-generation college student status is yet another identity that contributes to postsecondary performance of an individual in the United States. Though enrollment of first-generation college students has substantially increased in the past years, the populace is still privy to vulnerabilities concerning successful performance within and post collegiate studies. Typically, American society tends to consider first-generation college students as part of a separate, marginalized minority alongside other minorities. However, this ideology fails to regard the heterogeneity within the first-generation college student minority. Extensive research has been conducted concerning the first-generation college student populace itself; however, few studies have considered the intersectionality of simultaneous identities and their effects on the postsecondary experiences of the average first-generation student. This study aims to address the effects of first-generation college student status in tandem with various identifying factors such as race, gender, and socioeconomic status on the performance of collegiate students, characterized by average grade point averages (GPAs) of current collegiate students and the average salaries of graduates in comparison to their peers. The conclusions of this study will aim to highlight the inequities within the first-generation college student populace and help to level the playing field for uture students to come.

**Project ID: BHVSO 05**
**10:05a.m. – 10:20a.m.**

**Title: Personality Correlates of Motor Activity in a Novel Environment and Relationship to Rewarding Effects of Methamphetamine**

**Presenter(s):** Megan Sia
**Mentor(s):** Dr. Emma Childs, The HAPPY Lab,
The University of Illinois at Chicago

**Abstract/Project Intention:**

In preclinical animal data, rodents that show a high locomotor activity response (HR) in a novel environment are more sensitive to rewarding drugs than those with a low locomotor response (LR). Thus, locomotor response to novelty is suggested to reflect trait sensation seeking in humans which is also positively related to drug reward. This study investigates whether the preclinical data translates to humans i.e., if high locomotor response in a novel environment is related to sensitivity to drug reward and if it is related to trait sensation seeking. Healthy men and women explored 2 novel rooms for 10-minute. Their movements were recorded by closed circuit cameras and activity was quantified by calculating the frame-to-frame change in pixels summed across the 10-min exploration test. They also completed personality questionnaires. At separate sessions, subjective responses to methamphetamine (MA 20mg) and placebo (PL) were measured. Participants were rank-ordered on motor activity and the top and bottom thirds (respectively HR and LR) were compared on responses to MA and PL. We found that, in comparison to LR, HR reported significantly greater positive rewarding experiences to MA. We also found a significant correlation between motor activity and personality traits reflecting impulsivity but not sensation seeking.

**Project ID: BIO 11**
**10:05a.m. – 10:20a.m.**

**Title: Tiny Earth: Essential Microbes as Antibiotics for Model Pathogens**
**Presenter(s):** Rylie Bozarth; Divya Choudhary; Lily Powell;
Nachiket Rajinikanth
**Mentor(s):** Tanya Crum, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Antibiotic resistance is growing globally, making it necessary for new antibiotics to be discovered. Major pharmaceutical companies have stopped antibiotic discovery, claiming a lack of profitability, so academic institutions are crowd-sourcing this work. We started our research by collecting soil from environments stressful for bacterial survival. We performed a serial dilution of the soil in water to dislodge bacteria from other organic matter, plating the dilutions to obtain soil isolates. Unique bacterial colonies were identified and patched onto master patch plates. Using a modified Kirby-Bauer technique, bacteria were transferred from patch plates onto plates spread with each of the 10 ESKAPE pathogen relatives. If the patched bacteria produced antibiotics, we would see clear zones around each path, indicating that the bacteria can inhibit ESKAPE pathogen growth. The bacteria producing a large zone of inhibition were identified by 16S rRNA sequencing. A region of the 16S rRNA gene was amplified by PCR and sent for Sanger sequencing. We use BLAST to identify each bacteria to at least the Genus level. We also used the gram-staining technique to differentiate and identify the bacteria. Our next steps include possible Eukaryotic toxicity testing and organic extraction and testing of the antibiotic.

**Project ID: HIST 01**
**10:05a.m. – 10:20a.m.**

**Title: Coinage and Tyranny in Ancient Athens**
**Presenter:** Lauren Fakhoury
**Mentor:** Dr. Nicholas Cross, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Though it is generally believed that the first coins of ancient Athens, the *Wappenmünzen* ("heraldic coins"), were first minted in the mid-sixth century BCE, the historical context within which they emerged remains unclear. Most modern numismatists agree that they were minted under the authority of the tyrant Peisistratus. With what metal the coins were minted, by whom, and for what reason, however, are questions that pose greater difficulty. This paper aims to address them.

To begin, this paper assesses the *Wappenmünzen* as physical objects. The variety of images that appear on the coins, the coins' weight, and the source of the silver with which the coins were minted are taken into account. This paper then considers the *Wappenmünzen's* role in Athens. To determine the purpose for which they were minted, and by what moneyer, modern scholarship on the coins and their contemporary Athens is reviewed. Finally, this paper concludes by connecting the *Wappenmünzen's* physical and functional characteristics to the Peisistratid tyranny, suggesting that the inception of Athenian coinage and tyranny were inextricably intertwined.

**Project ID: BHVSO 20**
**10:05a.m. – 10:20a.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:**
The limited educational spectrum results in implicit biases that neglect or discriminate against Asian learners while perpetuating negative racial stereotypes. On the other hand, the lack of educational opportunities for Asian populations rooted in implicit biases can cause explicit biases to justify an intended and collective threat or violence due to their race or ethnicity.

The goal of my research is to explore how cultural competency can create an alteration of the linguistic educational system through culturally responsive curriculums. Ultimately, culturally competent pedagogy should obstruct both implicit and explicit biases. This research will focus on the following: examining the history of education in America, demographic data showing the racial and ethnic diversity among students in public high schools, perpetuated discriminatory practices in the assimilation of western culture and biases of the linguistic education, the importance of culturally competent pedagogy, and the methods in which educators can teach culturally competent pedagogy.

When educators practice cultural competency in the classroom, Korean immigrant students can develop their cultural identities, self-esteem, and multilingualism along with succeeding in their academic and social growth. Accordingly, culturally competent pedagogy can be beneficial for Korean immigrant students since they can preserve home-language learning, cultural experiences, cognitive values, and social integration.

**Project ID: MEDH 21**
**10:05a.m. – 10:20a.m.**

**Title: Characterization of the Wnt/β-Catenin Pathway in iPSC Induced Human Astrocytes**
**Presenter:** Amogh Shetty
**Mentors:** Srinivas D. Narasipura, PhD, Lena Al-Harthi, PhD, Tanner Shull,
Hemil Gonzalez, MD, Rush University Medical Center
**Abstract/Project Intention:**
Astrocytes are one of the most abundant cell types in the central nervous system (CNS), playing an important role in regulating the environment by participating in glutamate uptake, immunoinflammatory response of the CNS, and supporting the blood brain barrier (BBB). Sourcing a consistent supply of primary astrocytes for *in vitro* experiments is vital to understanding their role in CNS healt and biology. In the past, astrocytes were mainly sourced from adult deceased brains, gliomas (U87MG, U138MG), aborted fetal tissues and mice/rat brains. However, such sources can be difficult to access and can pose limitations due to lack of biological relevance, costliness, and legal implications. Recently, hiPSCs (human induced pluripotent stem cells) were successfully demonstrated to differentiate into induced astrocytes (iAs). iAs have become an important tool in studying astrocyte biology and function because, compared to other sources, iAs are a consistent and timely supply of proliferative astrocytes.

The canonical Wnt/β-catenin pathway is a pro-survival pathway robustly expressed in human astrocytes such as gliomas and fetal astrocytes. β-catenin is the central mediator of this pathway. The pathway regulates important astrocyte functions, such as glutamate uptake, immunoinflammatory response and HIV transcription. This pathway is not studied in iAs yet. Hence, in this study we seek to determine if Wnt/β-catenin pathway is expressed robustly in iAs. We demonstrated that Topflash, a specific reporter of this pathway, is robustly active when integrated via lentivaral approach. Further, inducing the pathway by using a molecular activator, CHIR99021 resulted in significantly higher induction of the TopFlash reporter activity. Furthermore, we detected robust expression of TCFs/LEFs (transcriptional activators of the pathway) mRNAs through RT-qPCR. Taken together,these results demonstrated that iAs do indeed robustly possess the Wnt/Beta-Catenin pathway.

**Project ID: PHYS 19**
**10:05a.m. – 10:20a.m.**

**Title: Lepton Jet Matching Efficiency at Different Cone Sizes**
**Presenter(s):** Robert Zhu
**Mentor(s):** Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
The existence of the dark photon is predicted by several theories beyond the standard model. In this study, we analyze particles in the dark photon's decay pattern, specifically lepton jets, to prove or disprove the existence of the dark photon. The number of lepton jets found and the number of recognized jets that are matched to an underlying neutralino depend on the cone size (Δr) used to search for jets. A large Δr includes more particles, resulting in more jets found, but could include unwanted particles as well. A small cone size includes fewer particles, making the jets found easy to match, but could omit wanted particles. The purpose of this study is to find the optimal Δr for identifying and matching lepton jets. A C++ program was used to simulate particle collisions and analyze the results. The Δr values tested were 0.01, 0.03, 0.05, 0.1, 0.3, 0.5, and 0.7. It was found that the Δr value with the most optimal matching efficiency was 0.05.

**Project ID: BizIN 04**
**10:05a.m. – 10:20a.m.**

**Title: Women and Infant Informational Healthcare Course**
**Presenter(s):** Temilope Akinmolayan & Kosisochi Onwuameze
**Mentor(s):** Dr. Karen Federici, Family First Physicians
**Abstract/Project Intention:**
A significant worry for a new mother is ensuring the baby is happy and healthy. Taking care of an infant can be quite challenging and knowing when and how to feed them is another obstacle. To make sure a baby is healthily growing, the baby needs to be fed. The main objective of our internship project was to create resources for women to educate them on the right foods to feed their infants. Finding the right foods to feed a child is quite challenging since there are over 160 allergenic foods and some are more allergenic than others, including cow's milk, eggs, peanuts, tree nuts, and fish. The American Academy of Pediatrics recommends introducing these allergy-inducing foods when the baby is ready to eat solids. New research has shown that for babies at high risk of developing a peanut allergy, giving them peanuts between four to six months of age can greatly reduce the risk of developing the allergy. With the guidance of Family First Physicians, a private practice that provides many services such as women's health, healthy lifestyle, aesthetics, and pediatrics, we were able to provide the resources by creating an online introduction course to infant feeding.

**Project ID: BizIN 10**
**10:05a.m. – 10:20a.m.**

**Title: Call to Action Campaign**
**Presenter(s):** Sooah Park
**Mentor(s):** Hailey Edwards, Office of State Representative
Barbara Hernandez
**Abstract/Project Intention:**
The Representative Barbara Hernandez works at the state level, listening to suggestions from her constituents in the 83rd District and enacting them through legislation. To do so, the Call to Action Campaign was launched to bring more awareness and urgency to the legislation she is proposing so that they will eventually get passed. The legislative Call to Action Campaign is a way for the Representative to push the bills she proposed for the January to May 2022 session. In order to do so, methods such as making call scripts, partnering with nonprofits and advocacy groups, social media and awareness campaigns, and conducting phone banking to reach out to more people were used. I helped by creating social media graphics, finding contacts for each bill to garner support, organizing phone banks, and conducting research on each bill to be able to promote the content.

## Session II - 10:25a.m. – 10:40a.m.

**Project ID: MEDH 33**
**10:25a.m. – 10:40a.m.**

**Title: The cost variations of tiopronin and the synthesis behind it**
**Presenter(s):** Maya Holland; Dorrie Peters
**Mentor(s):** Dr. John Thurmond, Illinois Math and Science Academy
**Abstract/Project Intention:**
Cystinuria is a medical condition in which stones that are composed of an amino acid called Cysteine are found strictly in the bladder, kidney, and ureter. Said condition is controlled through a medication documented as tiopronin; however after Thiola, the most common anaccessible brand, raised prices by 2900%, it became virtually impossible to afford. This study works through the synthesis of tiopronin and the costs associated with the synthesis in our lab. The process includes the combination of 2-chloropropionic acid and thionyl chloride forming α-chlorpromazine which is then involved in a coupling reaction with glycine and sodium carbonate to form α-chloropropionylglycine. This product was then combined with sodium sulfide nonahydrate, sulfur,
and sodium hydroxide to form tiopronin. Results and cost analysis will be described.

**Project ID: CHEM 15**
**10:25a.m. – 10:40a.m.**

**Title: Design and Synthesis of Emtricitabine Analogs as Potential Treatments for HIV**
**Presenter(s):** Dean Oquendo
**Mentor(s):** Dr. 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. Previously, a compound with a better binding affinity that was designed using computer aided drug design was found. The goal of this study is to synthesize the compound in the lab and test the product produced. The chemical synthesis is currently in progress. The newly designed drugs showed better binding affinity than emtricitabine and could lead to development of new HIV drugs.

**Project ID: CMPS 06**
**10:25a.m. – 10:40a.m.**

**Title: The Effects of Variability in C-V2X Networks**
**Presenters:** Hernandez Aguirre Luis, Doshi Shaan, Karra Vikram
**Mentor:** Dr. Randall Berry, Northwestern University, Evanston
**Abstract/Project Intention:**
Our research investigates C-V2X networking, an LTE-based technology that enables communication from vehicles to infrastructure (stoplights, crosswalks, etc), pedestrians, and other vehicles without the use of network towers. Using the network, vehicles are able to communicate Basic Safety Messages (BSMs). BSMs communicate a car's speed, velocity, position, and other information detailing a vehicle's state and path. By efficiently communicating BSMs, traffic safety can be improved. We created a simulation that allowed us to evaluate the efficacy of CV2X networks in various scenarios. To account for multiple factors, variables within the simulation were changed manually, such as the number of resource blocks, frequency channels, minimum and maximum time spent in a resource block, number of vehicles in the network, and the presence of oblivious and sophisticated attackers. Our study focused on gathering the optimal arrangement of variables to maximize the success rate (the ratio of vehicles that could successfully transmit their BSM) of the network. Research began with the investigation of the success rate when more vehicles and more resource blocks were added to the system. The tradeoff between the addition and reduction of multiple variables within the system were also analyzed through the success rate.

**Project ID: MEDH 04**
**10:25a.m. – 10:40a.m.**

**Title: Key Elemental Differences causing Cisplatin Induced Hearing Loss**
**Presenters:** Rujuta Durwas, Pranit Guntupalli, Faisal Patel
**Mentor:** Claus-Peter Richter, Department of Otolaryngology,
Feinberg School of Medicine, Northwestern University
**Abstract/Project Information:**
Cisplatin is a platinum-based chemotherapy drug used to treat various types of **c**ancers, including sarcomas, some carcinomas (i.e. small cell lung cancer, and ovarian cancer), lymphomas and germ cell tumors (DrugBank, 2021). Cisplatin can cause hearing loss in the cochlea, which is a result of some of the cancer therapies that happen in hospitals. In this study three experimental groups were looked at, Cisplatin alone, Cisplatin in conjunction with Honokiol, and Honokiol by itself. Honokiol is used due to the possibility that the drug can provide effects to limit cisplatin induced hearing loss by inhibiting the production of ROS. Samples of the three test groups were taken and scanned at Argonne National Laboratory using an 8-BM photon beam. A comparison using the Image J program reveals the concentration of elements located within the inner ear. A closer look at Cisplatin with Honokiol revealed significant differences in Platinum levels when compared to Cisplatin alone and reports of significantly less hearing loss is recorded with these patients. Cisplatin levels of Platinum reveal ototoxicity and with a complement of Honokiol can bind to platinum and significantly reduce the ototoxicity present.

**Project ID: PHYS 11**
**10:25a.m. – 10:40a.m.**

**Title: Higgs Combine Tool: Setting Limits on the Mass of the Doubly Charged Higgs Boson**
**Presenter(s):** Karrick McGinty
**Mentor(s):** Dr. Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
The doubly charged Higgs boson is a theoretical particle that coulexist but has never been found. The Higgs Combine Tool (HCT) is a tool that uses Bayesian statistics to calculate limits based on particle accelerator data. I used 3000 inverse femtobarns of data which is the expected amount for the HL-LHC upgrade. I created text files that I fed into this tool that contained information about background, which are particles that look the same as the doubly charged Higgs boson, and how often I would expect the doubly charged Higgs boson to appear if it were to exist. Since these numbers vary depending on how much mass this Higgs has, I calculated different expected limits for different masses. This allowed me to calculate an expected lower limit on the mass of the doubly charged Higgs boson.

**Project ID: CHEM 07**
**10:25a.m. – 10:40a.m.**

**Title: Methane Removal Using Zeolites: A Computational Analysis**
**Presenter(s):** Aditi Kumar
**Mentor(s):** Dr. Joseph Golab, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Global warming is a pressing problem in the world today and it is exacerbated by the release of greenhouse gases, such as methane, into the atmosphere. Zeolites are being examined as a potential solution to the methane problem because they have a unique structure that can trap molecules. In particular, zeolites containing transitional metals show promise in oxidization reactions. Methane oxidation is an important reaction because it turns methane that contributes to global warming into methanol, a useable fuel source. In my project, I model zeolites containing different transitional metals using a software called SPARTAN and calculate their energies as a methane molecule passes through it. By looking at the energies of each zeolite, I can examine their stability and effectiveness relative to each other, helping determine which zeolites are better for atmospheric methane removal.

**Project ID: BHVSO 16**
**10:25a.m. – 10:40a.m.**

**Title: The Impact of Marriage and Gender on Annual Household Income**
**Presenter:** Cordelia Sirais
**Mentor:** Patrick Kearney, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
This project builds off of the results of "The Impact of Women on Annual Household Income per County" (Sirais & Venkatraman 2021), which explored the ways that gender roles affected financial wellbeing. The study will explore possible correlations between marital status and average annual household income on a county-level. By compiling datasets from the United States census, the project will analyze how gender roles in combination with two-person marriages play a part in the economic growth of counties in the Midwest. Various statistical tests and graphical methods will be used in order to examine the data for statistically significant patterns, and the results of the previously referenced project from 2021 will be compared to the results of this project. The results will show whether there is a correlation between the higher annual household income in counties with a 1:1 gender ratio and a higher number of married couples. Other extenuating factors will also be accounted for, such as race and education level. The project will examine possible reasons behind the relationship that is found.

**Project ID: BIO 01**
**10:25a.m. – 10:40a.m.**

**Title: Conceptual Life History Model for the Western Burrowing Owl**
**Presentor:** Elizabeth Carlson
**Mentor:** Yuki Hamada, Argonne National Laboratory
**Abstract/Project Intention:**
The Burrowing Owl of California has been noted as a species of concern regarding the development of solar energy facilities in their habitat. Successful conservation planning requires a deep understanding of the species' population dynamics. This knowledge is scattered throughout studies and a singular model regarding the owl's life history does not exist. Thus, we developed a conceptual life history model of the Western Burrowing Owl shaped by the species's life decisions based on age and sex. The population dynamics are decided by seasonal instincts concerning mating season as well as nest succession. The adult male and female model is mirrored and they both follow a general cycle of a mating/nesting season followed by a non-migration period. Our model closely matched with observed patterns of the western burrowing owl, including reproduction, mate fidelity, dispersion factors, life expectancy, and population size. The consequent purpose of this model is to explore decisions made by the various life stages of the western burrowing owl and to predict responses to solar energy development. The model can be used to inform solar energy industry makers and regulatory agencies on how to build future solar power facilities while conserving the western burrowing owl population.

**Project ID: BIO 04**
**10:25a.m. – 10:40a.m.**

**Title: The Role of the Nucleolus and the Effects of its Protein Knockdown on the Differentiation of Keratinocyte Cells**

**Presenter(s):** Rohit Katakam, Margaret Wei
**Mentor(s):** Dr. Sui Huang, Feinberg School of Medicine,
Northwestern University

**Abstract/Project Intention:**
Use immunofluorescence microscopy and knockdown nucleolar proteins that inhibit certain nucleolar structures to determine whether the nucleolus influences differentiation in keratinocyte cells.

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 observedin a single keratinocyte sample. Throughout cellular differentiation, DNA moves to different places throughout the nucleus; this experiment serves to determine whether the nucleolar structure dictates that movement. To test this hypothesis, treatments that distrupted and retained nucleolar structure were analyzed.

Using immunofluorescence microscopy, images of keratinocyte cells were taken using different channels to isolate the structures of interest. Each nucleus (DAPI), was categorized into four layers of differentiation, from the basal layer (layer 1) to the surface layer (layer 4). Quantitative data was collected on nucleoli (TxRed) and centromeres (FITC) throughout the stages of differentiation. The data was analyzed to determine the effect of treatments on differentiation as well as the role of centromeres and nucleoli in the process.

Through examining the nucleolar-nuclear ratio, average nucleolar number, average centromere number, and percent of centromeres associated with nuclei and lamin, the treatments effects are apparent in differentiation. siPol1 increased the rate of differentiation, while siUTP4 halted differentiation. To study treatments further, we collected data on siNPM1 and siPol1.

**Project ID: MEDH 14**
**10:25a.m. – 10:40a.m.**

**Title: A Genome Wide Association Study (GWAS) to Detect Single-nucleotide Polymorphisms (SNPs) and Identify Risk Loci for Parkinson Disease**

**Presenters:** Dhruv Patel, Pranav Patel
**Mentor:** Dr. Steven Lubbe, Feinberg School of Medicine
Northwestern University

**Abstract/Project Intention:**

Parkinson's disease (PD) is a severe neurodegenerative disease, resulting from complex interactions between genetic and environmental factors. To analyze the genetic foundations of the disease, a genome-wide association study (GWAS) can be employed to filter genetic markers, identify single-nucleotide polymorphisms (SNPs), and associate genetic variants. Identification of SNPs significantly contributes to the accuracy of polygenic risk scores (PRS; risk score dependent on SNPs in independent cases).

Through a hypothesis-free whole-exome sequencing (WES) analysis of 10,035 control samples and 5,333 case samples, predominantly from individuals of European descent, we identified multiple risk locus and markers of early-onset PD (less than 40 years). Methodology was three-fold: quality control (QC), population stratification, and association. QC enabled the removal of 2,000+ data-skewing samples through comparison to the Human Genome Database, testing for sex, inbreeding, heterozygosity, SNP missingness, and minor allele frequency. Population stratification enabled the identification of a sample demographic (EU). Genome association allowed for the generation of Manhattan plots (with baseline significance of $p = 5.0 \times 10\text{-}8$), which compared statistificance significance (as -log10p) against chromosomes. Results indicated SNPs of this sample existed most significantly on
locis 4, 13, 15, and 17.

**Project ID: ENGN 01**
**10:25a.m. – 10:40a.m.**

**Title: Locating Receivers in Three-Dimensional Cartesian Space using SAGA GPS Scintillation and Navsol Data**

**Presenter:** Aarya Khapre
**Mentor:** Dr. Seebany Dutta-Barua, Illinois Institute of Technology

**Abstract/ Project Intention:**

Global Positioning System (GPS) satellites orbit earth and store positional information that is relayed to receivers on earth. Disruptions in the signal can result in changes in the amplitude and phase of the radio waves. These disruptions can be a result of an atmospheric phenomena known as scintillation, which is caused by plasma particles in the atmosphere interacting with the waves. An accurate position of the receivers is required to analyze the scintillation data and how plasma affects radio signals.

This project calculates and plots definitive location solutions of six ASTRA Connected Autonomous Space Environment Sensor (CASES) receivers in Alaska in the Geographic Coordinate System (latitude- longitude) format. The positions were determined by computing the mean of navigation solution data stored by the receivers. IIT's Apollo server was used to extract the data files, which stored the navigation solution data in three-dimensional cartesian space, and run the MATLAB computation codes. Latitude- Longitude positions were obtained after converting the position solutions computed in three-dimensional space.

**Project ID: ENGN 05**
**10:25a.m. – 10:40a.m.**

**Title: Investigating the Structural Integrity of Different Bond Angles in Simple Bridges**
**Presenters:** Shiraz Baxamusa, Nickolas Carter, Neil Dighe
**Mentor:** Dr. Dave Devol, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
In the past couple of decades, the stances on the perfect truss structure have been widely varied, with new studies popping up every couple of years using new modeling techniques to prove one hypothesis or another. Sometimes, the need for simplicity is a dire one, and research focused on the best structure for a simple bridge is very limited. We started our research by creating ten sets of easily replicable bridges using balsa wood and a different connection angle for each bridge. We tested the load each bridge could hold and ran a regression analysis in relation to the length each bridge spanned to find which angle provided the best support per degree and, by relation, meter spanned. We found that when the bridge angle was less than 130 degrees, its structural integrity significantly increased, making its support per meter spanned double from 70 degrees to 50 degrees alone. Our findings imply that smaller angles of conjunction in bridges support greater weights, but the benefits only apply to angles less than

**Project ID: PHYS 05**
**10:25a.m. – 10:40a.m.**

**Title: Dark Photons with Z' Portal**
**Presenter(s):** Kevin Huang, Jack Morby
**Mentor(s):** Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
We are working on the simulated generation of the dark photon with a Z' portal. We currently have the generation of dark photons through a SUSY model, so to explore the behavior of other production channels in our search for dark photons, we are using the Z' portal. With the Pythia 8.3 application, we are generating these particles using a Monte Carlo method. The production of dark photons starts with the collision of a quark and an antiquark coming from two different protons. The collision of the quarks produces a Z', which then branches into two dark particles radiating dark photons. To search for the existence of this production we cannot detect the dark photon directly, so instead, we are searching for the signal that the dark photons decay to, which is more than two leptons.

**Project ID: BHVSO 01**
**10:25a.m. – 10:40a.m.**

**Title: Data Science to Identify Inequalities in CPS**
**Presenter(s):** Aaliyah Ali, Balaji Balachandran, Oliver Ni, Christin Ann Sanchez
**Mentor(s):** Dr. Angel Alvarez, Feinberg School of Medicine, Northwestern University
**Abstract/Project Intention:**
The project identifies how the Chicago Public School System (CPS) unequally distributes resources among schools and neighborhoods within Chicago. This analysis is done using traditional data science programs such as Microsoft Excel functions, Python, and R. In the various analyses that have been conducted, we have compiled data from publicly accessible datasets FOIA'ed from CPS; including the distribution of library materials, NWEA test scores of students grouped by school, transfers of students from schools, etc. The analyses display patterns of inequality between the schools. The trends outlined by the data can serve to inform future changes to the status quo through proposals at board meetings.

**Project ID: PHYS 14**
**10:25a.m. – 10:40a.m.**

**Title: Estimating Acceptance for Multilepton Events as a Function of Invariant Mass**
**Presenter(s):** Eric Shackelford
**Mentor(s):** Dr. Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
This talk will discuss a major overhaul of our data analysis architecture which permits the use of multiple file types. The code we use to work with particle physics datasets previously only worked when those datasets were written in MiniAOD format. After the overhaul, the code can be easily made to run on any file format, including DELPHES which was used in our most recent analysis. This new framework permits the automated generation of stack histograms which show the total expected background in comparison to the expected signal for a given channel. These plots are crucial for every analysis, and the current effort to automate their generation grew out of the code written to produce these plots for our doubly charged Higgs and lepton jet studies.

**Project ID: CMPS 11**
**10:25a.m. – 10:40a.m.**

**Title: A Machine Learning and Deep Neural Networks Approach to Diagnosing Idiopathic Pulmonary Fibrosis**

**Presenter(s):** Rashmi Alawani
**Mentor(s):** Samuel Hamilton, Deborah Rachelle Winter Ph.D.,
Feinberg School of Medicine, Northwestern University

**Abstract/Project Intention:**
Idiopathic Pulmonary Fibrosis (IPF) is a lung disease with a mean survival of 2-5 years from the time of diagnosis in which alveolar tissue progressively becomes stiff fibrotic scar tissue, reducing breathing capacity and eventually leading to respiratory failure. The use of Machine Learning could predict IPF cases more precisely than the current surgical lung biopsy treatment years before the onset of the disease, allowing doctors to better plan treatments and reduce unnecessary surgeries. This project aimed to design an accurate Machine Learning (ML) and Deep Neural Network (DNN) model to create an assistive tool for IPF diagnosis. A series of common ML models, including Random Forest, Support Vector Machine, Naive-Bayes, and J48, were tested for highest prediction accuracy. The dataset, provided by Peking Union Medical College, was split into a training and testing set, and was also scaled into a range of 0 to 1 for a higher accuracy rate. A Keras DNN binary classification model was created using 2 hidden layers with 7 and 5 nodes, respectively and performed higher than the highest-scoring ML model, J48, with a final accuracy rate of 89%. Currently, a predictive web application utilizing Django is being designed to test the DNN.

**Project ID: MEDH 23**
**10:25a.m. – 10:40a.m.**

**Title: Analyzing the Differential Expression of OPTN during Herpes Simplex Virus-2 Infection**

**Presenter(s):** Mathew Illimoottil
**Mentor(s):** Dr. Deepak Shukla, Dr. Tejabhiram Yadavalli,
University of Illinois at Chicago

**Abstract/Project Intention:**
Herpes Simplex Virus Type 2 (HSV-2) is one of the most widespread sexually transmitted infections in the world today, infecting more than 500 million people worldwide. In a recent article, we showed that OPTN, a gene that codes for the Optineurin protein, selectively marks essential HSV proteins for degradation in an autophagy-dependent manner and that an essential chemokine, CCL5, positively correlated with OPTN expression during human genital HSV-2 infection when screened through the Gene Expression Omnibus (GEO) functional genomics data repository.GEO2R is a software that allows users to compare multiple groups of samples in a GEO Series across different experimental conditions and identify differentially expressed (upregulated or downregulated) genes across those conditions based on author-normalized expression values (log2 scale). In this study, we analyzed the aforementioned HSV-2 dataset using GEO2R for other potential correlation partners of OPTN. We took the 46 genes with the highest Pearson correlation coefficients with OPTN during the “lesion” (active) state and calculated their correlation coefficients in the “control” condition. We then subjected those 46 genes to STRING analysis and discovered that 7 of the 46 genes -- TMEM186, PCMTD1, LAMP3, RNF149, APOL3, FLVCR2, and SMAP2 -- did not have any known experimental correlations with OPTN prior.

**Project ID: BIO 13**
**10:25a.m. – 10:40a.m.**

**Title: Exploring ancestral sequences**
**Presenter(s):** Nathaniel Gao
**Mentor(s):** Keith Gagnon, Southern Illinois University, Carbondale
**Abstract/Project Intention:**
Ancestral sequence reconstruction, commonly abbreviated as ASR, is a method used to estimate the sequence and properties of an extinct organism's genes. Exploring ancestral sequences has shown the possibility of resurrecting ancient genes for use in current research. Clustered Regularly Interspaced Short Palindromic Repeats, or CRISPR, is used in prokaryotes as their antiviral system. Cas9, an enzyme associated with CRISPR, can be used to cut DNA at specific locations. This has made CRISPR Cas9 a topic of interest as a tool for genetic editing, and by extension its evolutionary history is important to study. Therefore, ancestral sequence reconstruction can be used in order to understand CRISPR Cas9 and its history. The sequences discovered can provide information on its evolution and development as a biotech tool, which will be valuable insight in the genetic engineering field. In this project, I investigate various strains of CRISPR Cas9 and other relating sequences using the maximum likelihood method of ancestral sequence reconstruction to find their closest relative ancestors. This can provide insight into the evolution history of different Cas9 strains, and eventually their use at a larger scale.

**Project ID: IN2 IS 01**
**10:25a.m. – 10:40a.m.**

**Title: Searching for a New STEM Curriculum**
**Presenter(s):** Mineso Jung, Kaylee Zhou
**Mentor:** Steve Goldblatt
**Abstract/Project Intention:**
This study strives to create an online STEM curriculum for the children in developing countries, specifically Uganda by evaluating and making a personalized curriculum for the child to train their skills to pursue their career in STEM at a young age. The curriculum consists of different modules, which include videos and quizzes for each lesson, and a few content related games. This curriculum is a unique innovative approach as students from a STEM school help children in Uganda as it is created based on STEM high school students' own experience and perspective with various fields of STEM topics. The following is the list of topics and activities for each subject. It also explores ways to help children interested in STEM to pursue their interests and develop their knowledge in STEM. While our tangible goal is to create a curriculum for children that incorporates Algebra, Geometry, Climate Change, and Water and Sanitation. In the end, our goal is to create a community with STEM interests in local areas in Africa through innovative ways (Uganda). We hope to gain feedback from children in Uganda about the effectiveness of our curriculum and learn areas we can improve upon.

## Session II - 10:45.m. – 11:00a.m.

**Project ID: MEDH 34**
**10:45.m. – 11:00a.m.**

**Title: Fragment-based drug discovery and synthesis of SARS-CoV-2 therapeutics**
**Presenter(s):** Hannah Johnson
**Mentor(s):** Dr. John Thurmond, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
During the COVID-19 pandemic, the usual drug development timeline has been substantially condensed. This shortened timeline aims to facilitate the discovery of a safe and effective therapy as soon as possible, as the number of global COVID cases rise. Moreover, the COVID Moonshot open-sourced initiative facilitates the accelerated development of a COVID antiviral. After the published fragment screening on the main protease (MPro) of SARS-CoV2 yielded 66 fragment hits, fragment x0434 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 fragment interaction. SeeSAR analysis features allowed for the visualization of the ligand-protein structure and identification of key interactions driving binding affinity. Nearly four hundred compounds were produced from the chosen fragment to further investigate by looking at ADME properties. After evaluating predicted drug safety, molecules with the best projected effectiveness were selected for synthesis. The synthesized compounds were then evaluated with nuclear magnetic resonance (NMR) and compared against starting compounds and predicted data to ensure that the proper compound was produced. Thin-layer chromatography (TLC) was also used to verify purity of the compounds. Confirmed compounds will likely proceed to collaboration with the COVID Moonshot consortium.

**Project ID: CHEM 16**
**10:45.m. – 11:00a.m.**

**Title: Uncovering an Improved Version of Donepezil, an Alzheimer's Treatment**

**Presenter:** Amrut Pennaka
**Mentor:** John Thurmond, Illinois Mathematics and Science Academy

**Abstract/Project Intention:**
Alzheimer's disease, a form of dementia that declines cognitive function, is one of the world's most prevalent diseases, currently with no cure discovered. Many drug therapies for the treatment of Alzheimer's are centered around the cholinergic hypothesis, which states that the decrease of acetylcholine (ACh), a crucial neurotransmitter, is the start of the development of Alzheimer's. To counter this, most Alzheimer's drugs, including the very popular Donepezil (approved in 1996), are acetylcholinesterase inhibitors. These medications consist of small molecules that prevent ACh being broken down by the acetylcholinesterase enzyme, preserving ACh in the brain. To discover more efficient acetylcholinesterase inhibitors using modern methods of drug discovery, a computer model of Donepezil binded to an acetylcholinesterase protein was taken as a source of inspiration and put into SeeSAR to computationally create small molecules that could bind better to the enzyme. The resulting small molecules and their properties as a drug were analyzed utilizing SwissADME to determine which could be used in a medical treatment setting.

**Project ID: CMPS 04**
**10:45.m. – 11:00a.m.**

**Title: The Construction and Evaluation of a Neural Network-Based Deep Learning Model using Transcriptomic Data to Predict Alzheimer's Disease-Related Neuropathological Indexes**

**Presenter:** Elaina Xiao
**Mentors:** Jubao Duan, Siwei Zhang, NorthShore University HealthSystem

**Abstract/Product Intention:**
The elderly population is disproportionately affected by Alzheimer's disease, which is observed cognitively. Using a set of next-generation RNA sequencing project (ROSMAP) from NorthShore University HealthSystem combined with clinical diagnostic profiles, we constructed a neural network-based deep learning model to predict the occurrence and severity of three geriatric-related pathological features. The final consensus cognitive diagnosis (cogdx) was taken post-mortem. Braak stage is the severity of neuritic tangles (braaksc), and CERAD score measures the number of neuritic plaques (ceradsc). This machine learning module utilized neural networks by using the Python Scikit-Learn package to establish a categorial learning model using the severity evaluation scores as category levels. The model used one-hot encoding at the computational level and two layers of 256 and 64 neurons. Finally, on the evaluation of predication efficiencies, cogdx, which had two categorial levels of 1 and 2, had an accuracy of 99%. The CERAD score also had categorial levels of 1 and 2 and had an accuracy of 96%. Lastly, the Braak set had severity levels from 0 to 3. However, during the subsequent analysis, there was no category 0 presented in the training data, resulting in three categorial levels. The model had an accuracy of 45% .

**Project ID: MEDH 06**
**10:45.m. – 11:00a.m.**

**Title: Analyses of Expression Patterns of Genes Associated with Inherited Retinal Degeneration in Different Cell Types of the Human Retina**

**Presenter(s):** Himani Kamineni
**Mentor(s):** Jane Y. Wu, Department of Neurology, Center for Genetic Medicine, Lurie Cancer Center, Feinberg School of Medicine, Northwestern University

**Abstract/Project Intention:**
Inherited retinal dystrophies (IRDs) are familial or inherited forms of retinal degeneration that are characterized by the progressive loss of photoreceptor cells, leading to the eventual loss of vision. Genetic studies have identified more than 300 genes that are altered in different forms of IRDs. Analyses of human retinal single-cell RNA-sequencing (scRNAseq) data from published studies were performed to examine differential gene expression in different retinal cell types and understand how correlations in gene expression in various retinal cell types may play a role in the pathogenesis of IRDs. Our analyses have shown remarkably different patterns of expression of genes associated with different subtypes of IRDs in different retinal cell types. Interestingly, different genes associated with the same pathological subtypes of IRDs may show distinct patterns of expression in different retinal cell types. Gene pathways were analyzed to examine the relationship between IRD genes and molecular function in the human retina. Using different tools, gene networks were also constructed by clustering genes into networks based on correlations in their expression levels. Identifying gene pathways annetworks will provide information that will lead to a better understanding of the pathogenesis of IRDs.

**Project ID: PHYS 13**
**10:45.m. – 11:00a.m.**

**Title: Sample Generation and Background Plot Generation for Dark Photon Events**
**Presenter(s):** Reese Ramos
**Mentor(s):** Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
This analysis focuses on automating the generation of dark photon samples and generating background plots for dark photons. The current CRAB sample generation takes in a dataset name, generator fragment, the number of events, and the number of jobs to split the events up into. To generate the samples to be used in our analyses, the GEN, SIM, DIGIPremix, HLT, RECO, and MiniAOD steps need to be manually run over each job. To automate the progression of jobs through these steps Bash and Python scripts were created for starting jobs, checking their progress, and passing them onto the next step when ready. As one application of this framework, plots of the invariant mass, transverse momentum, and leading lepton transverse momentum were generated in an attempt to separate the signal from the background.

**Project ID: CHEM 08**
**10:45.m. – 11:00a.m.**

**Title: On the Favorability of the Initiation Reaction of Polymerization of Various Polymers**
**Presenter(s):** Will McClain
**Mentor(s):** Dr. Joseph Golab, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Polymers such as polystyrene, polyvinyl chloride (PVC), and nylon are very useful materials; they're used in everything from packaging to piping to other everyday plastics. Every polymer is made up of many, many monomers stitched together to make a new substance. Their syntheses are very elaborate processes and are made up of multiple steps. The step to focus on is the initiation step: the step in which a free radical bonds to a monomer in an addition reaction to create a modified monomer that now also has a free radical. This will lead into the next step, but that is beyond the scope of this project.

The initiation step of any polymerization reaction requires energy to start, and some polymers have more "energy expensive" initiation steps than others. The purpose of this project is to compare the initiation reactions of various polymers (polystyrene, PVC, nylon) and find the temperature at which their initiation is the most favored. The change in Gibbs free energy of each reaction will be studied and compared using SPARTAN computation to find the temperature at which it is the lowest. The results from this computation will be used to find the most "energy cheap" reaction.

**Project ID: BHVSO 17**
**10:45.m. – 11:00a.m.**

**Title: State-based Sexual Health Education and its Effect on Youth STD Rates**
**Presenter:** Sarah Wheeler
**Mentor:** Patrick Kearney; Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
Though Sexually Transmitted Diseases (STDs) are not uncommon, they remain a taboo topic in many American families. Unfortunately, the stigma surrounding STDs often leads to deficient knowledge about them. The incorporation of STDs, their causes, and their treatment into education is a crucial component for teenagers to make healthy decisions regarding their lives and health. However, not all states require comprehensive sexual health education to be taught, greatly varying the STD education American students receive. This research aims to examine the relationship between different states' education standards and youth STD rates, if any, hypothesizing that comprehensive, more-inclusive standards ultimately decrease the rates of STDs in youth.

Moreover, this research focuses on two STDs -- chlamydia and gonorrhea -- and how their rates in youth change based on the quality of eight components: comprehensiveness, structure, data, relevance, diversity, age-appropriateness, medical accuracy, and need-based specificity. The data included the number of respective STD cases per state in the chosen age group (16-24), state population of age group, race, sex, unemployment rate, median household income, and state standard of sexual health education.

**Project ID: BIO 05**
**10:45.m. – 11:00a.m.**

**Title: The Use of fNIRS in Developmental Psychology**
**Presenter(s):** Shreeya Avadhanula
**Mentor(s):** Dr. Amanda Seccia, University of Chicago
**Abstract/Project Intention:**
During the course of this research project, we study how children of young ages solve simple math problems, along with identifying their exact thought process and ideas. One of the prominent things researchers observe are gestures. What is it about gesturing that makes it such an effective tactic for mankind? Why is gesturing so prominent in human nature? In order to tackle questions like this, we focus our research on looking into what exactly is going on in a child's brain when they are gesturing. We provide children with math equivalent problems to see how their brain reacts and what exactly is going on when solving these problems. It was found that using an fNIRS device was very beneficial. fNIRS is a relatively new neuroimaging tool that is easy to use for children and relatively non-invasive compared to other neuroimaging techniques. On a rather scientific level, the fNIRS device measures hemodynamic responses (oxygen levels in the brain). It was discovered that the more cognitive energy required for a task, the more oxygen is required to be metabolized by brain tissue. In other words, the harder a task is, the more oxygen is needed.

**Project ID: MEDH 17**
**10:45.m. – 11:00a.m.**

**Title: Promoting Diversity in Pharmacogenetics by Analyzing Genetic Variation Data with Respect to Metabolite Formation from African American-donor-derived Hepatocytes**
**Presenter:** Sabrina Zhang
**Mentor:** Dr. Minoli Perera, Carolina Clark, Northwestern University
**Abstract/Project Intention:**
Pharmacogenomics is being increasingly used to guide certain clinical prescription decisions and will feed into future precision medicine applications. However, current pharmacogenetics (PGx) studies (and thus, the clinical guidelines coming out of PGx studies) are done predominantly using subjects of European descent and thus not representative of the human population. CYP function can be very different between ethnicities, and thus basing clinical studies/guidelines on one ethnicity undermines the application to all populations. Our project began by isolating hepatocytes from African-American liver donors; each donor was genotyped. The hepatocytes were used in a cell culture experiment where 6 clinically relevant probe-drugs were dosed in vitro and over the course of four hours, we took several time points and measured the accumulation of metabolite for each drug using LC-MS. We calculated a rate of metabolite formation to determine if these rates were associated with genetic variation through GWAS (Genome-Wide Association Studies). Through the work we are currently conducting, we are able to contribute valuable data for minority populations. The inclusion of these populations is vital because it helps us improve the accuracy of the representation of diverse populations in precision medicine.

**Project ID: ENGN 03**
**10:45.m. – 11:00a.m.**

**Title: Designing a Variable Compliance Leg for Soft-Ground Locomotion**
**Presenter(s):** Jai Sutaria
**Mentor(s):** Paul Umbanhower, Northwestern University
**Abstract/Project Intention:**
Legged locomotion on soft-ground is essential to designing robots for tasks such as disaster relief and extraterrestrial exploration where the ground may be yielding instead of rigid. In order to have successful legged locomotion on soft-ground, as much energy as possible needs to be conserved. This project aims to conserve this energy by minimizing the penetration depth of a robot foot hitting the ground. In order to do this, a mechanism is tested that utilizes force control by means of springs with data being collected for further analysis. Through utilizing an integrator simulation as a basis of comparing data, this project sets the groundwork for designing a robot leg. Eventually, this project aims to be explored further through the creation of said robot leg that is able to self-sufficiently function on multiple different ground stiffnesses.

**Project ID: CHEM 19**
**10:45.m. – 11:00a.m.**

**Title: Designing Potential Inhibitors of SARS-CoV-2's Main Protease from (2S)-N-(4-carbamoylphenyl) oxolane-2-carboxamide**
**Presenters:** Kelly Cruz, Kenith Taukolo
**Mentor:** Dr. John Thurmond, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
With the rise in cases of SARS-CoV-2, it is imperative to discover a drug—in this case, an oral drug—to combat the virus's ability to swiftly replicate. Fragment-based drug discovery provides a useful starting point in regards to the design of inhibitors rather than utilizing larger molecules. Due to the small size of these fragments, they can bind themselves to the main protease of SARS-CoV-2 and serve as starting points in designing larger, more potent inhibitors of the viral replication cycle. Through altering the structure of the fragment (2S)-N-(4-carbamoylphenyl) oxolane-2-carboxamide, a known inhibitor of the main protease of SARS-CoV-2, on SeeSAR, 1389 compounds were designed and four potential new inhibitors were selected for further evaluation. After running an analysis on ADMETlab 2.0, it was clear that inhibitors (3) and (4) were the most likely candidates for potential research in the future as the results of inhibitors (1) and (2) were marked with multiple high risks. When comparing inhibitors (3) and (4), both inhibitors predict some form of toxicity towards the human body and difficulties with the real-world implementation of the drug. However, inhibitor (3) lacks the ability to be effectively absorbed by the human body, making inhibitor (4) the more favorable choice. Further research and laboratory work is needed to fully understand each inhibitor's efficacy in-vivo.

**Project ID: PHYS 07**
**10:45.m. – 11:00a.m.**

**Title: Lepton Selection for Dark Photons**
**Presenter(s):** Rohan Jain, Zhengyu Pan
**Mentor(s):** Dr. Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
We study lepton selection for dark photon events using simulated Monte Carlo events, for application in the Compact Muon Solenoid experiment. We find the optimal filters and cuts to limit background events while maintaining the amount of signal events. The types of background were QCD, Drell-Yan, $t\bar{t}$, diboson, and triboson. The types of filters implemented were based on invariant mass, transverse momentum, and relative isolation. We optimize the cuts with respect to sensitivity. Our process was initially to superimpose the graphs of each of these qualities to estimate the most beneficial cuts. Then, we used C++ to test the sensitivity of each possible set of cuts. We considered improvements in sensitivity of less than 10% insignificant.

**Project ID: PHYS 15**
**10:45.m. – 11:00a.m.**

**Title: Attempted Recovery of Invariant Mass Through Final State Radiation**
**Presenter(s):** Zoie Sloneker
**Mentor(s):** Peter Dong, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
The same sign invariant mass histograms, produced from running simulated proton-proton collisions that produce doubly charged Higgs bosons samples, are unexpectedly skewed. While it was expected that the graphs would have a clean spike at 800 GeV, they had long tails on the right and left sides. The goal of the analysis was to use different methods to include final state radiation photons in order to recover the invariant mass, which would lessen the tails on the produced graphs. Many methods were tried, each using different physical principles such as delta r, phi, eta, and pt. Each attempted method produced a new same sign invariant mass histogram. After superimposing the new graphs over the old ones, and comparing them all, it was concluded that none of the methods had a significant impact on the invariant mass and
the graphs.

**Project ID: MEDH 08**
**10:45.m. – 11:00a.m.**

**Title: Effectiveness of Biofeedback and Postural Training on Spinal Positions**
**Presenter(s):** Jasmine Liu
**Mentor(s):** Aruna Ganju, Feinberg School of Medicine,
Northwestern University
**Abstract/Project Intention:**
Body posture involves multiple aspects of the body with standing, sitting, and walking being major factors contributing to an individual's posture. Bent or slouched posture often leads to various negative health issues such as back pain, joint degeneration, and spinal dysfunction. Within the medical field, surgeons often spend hours in awkward positions while operating which leads to long-term poor spinal alignment. The posture training device called The Upright™ utilizes biofeedback to correct and improve individual body posture. This study is the preliminary stage of a two-part study which involves the Northwestern Feinberg surgeons utilizing The Upright™ device to improve posture outside of the operating room. In this preliminary study, the effectiveness of the training device will be analyzed and tested; however, this stage will not include testing the device on surgeons. This study provides evidence to support that wearable posture feedback is an effective tool in correcting and improving daily posture.

**Project ID: PHYS 21**
**10:45.m. – 11:00a.m.**

**Title: Creating and Using Sb-124 to Calibrate a Bubble Chamber Dark Matter Detector**
**Presenter(s):** Atharva Gawde
**Mentor(s):** Eric Dahl, PhD, Dept. of Physics and Astronomy
Northwestern University
**Abstract/Project Intention:**
One of the longest-standing fundamental questions in physics is the nature of dark matter. Galactic rotation curves, gravitational lensing, cosmic microwave background, and galaxy cluster collisions have all supported the existence of a large invisible matter component to the universe since 1933 and Zwicky's early observations of objects at the edge of the Coma cluster.

To address this problem, the Dahl Group's goal, in collaboration with the Scintillating Bubble Chamber (SBC) Collaboration, is to introduce and develop new nuclear recoil detection technology that combines two existing technologies: bubble chamber electron recoil rejection and liquid scintillator event-by-event energy resolution. This technique searches for WIMPs (Weakly Interacting Massive Particles), a leading dark matter candidate that would interact with normal matter by scattering elastically off atomic nuclei. The SBC Collaboration has suggested that a scintillating liquid argon bubble chamber be operated and analyzed at Fermilab for dark matter and neutrino studies.

This contribution to the development of a scintillating liquid argon bubble chamber focuses on nuclear recoil sensitivity calibration to identify the lowest energy nuclear recoils while simultaneously excluding electron recoil events and background events. The Neutron Therapy Facility at Fermilab will be aid in developing reliable antimony-beryllium neutron sources, which are explored and modeled both experimentally and initially via simulations to ideal sources for optimal calibration.

**Project ID: MEDH 24**
**10:45.m. – 11:00a.m.**

**Title: The Role of the Blood-Brain Barrier in Stopping the Spread of SARS-CoV-2 to the Brain and Brain Tumors**

**Presenter(s):** Sajal Shukla
**Mentor(s):** Dr. Tibor Valyi-Nagy, University of Illinois at Chicago

**Abstract/Project Intention:**
The initial site for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection is the upper respiratory system. In many patients, however, the virus finds a way to reach the lungs, which can result in serious infection. Coronavirus can also spread to various parts of the body causing multiorgan failure. Although over 80% of patients with severe COVID-19 demonstrate neurological symptoms, very little direct evidence exists to support the claim that the virus can cross the blood-brain barrier and actively infect the brain. Interestingly, we discovered lung cancer tissue spread to the brain of a COVID-19 patient to be positive for SARS-CoV-2 along with brain tissue adjacent to the metastatic tumor. These findings raise the possibility that metastatic tumors may bring the virus from alternative parts of the body to the brain or may break down the blood-brain barrier to allow for the virus to spread to the brain. In this project, based on extensive literature review, we discuss the role of the blood-brain barrier in limiting the spread of SARS-CoV-2 to the brain and possible mechanisms, which may allow SARS-CoV-2 to reach and infect the brain and brain tumors. We also provide detailed information about the pattern of SARS-CoV-2 detection in metastatic brain tumor and adjacent brain tissue. These findings are important for the understanding of mechanisms by which SARS-CoV-2 can cause brain disease.

**Project ID: BizIN 06**
**10:45.m. – 11:00a.m.**

**Title: Data Science for Nonprofits with Asgard Data**
**Presenter(s):** Nadia Ludwig, Tyler Smith
**Mentor(s):** Chris Giessler, Asgard Data LLC.
**Abstract/Project Intention:**
Asgard Data is a data analysis-focused company that helps specifically non-profits derive meaning from their data. The focus of the business project surrounded the most effective ways to analyze data, aid in website design, and explore the structure of small businesses and their needs.

Over the past six months, the company benefited through the implementation of various updates to the style and message of their home website. This was coupled with valuable insights into the backend of their website alongside potential hurdles they would have to address to further edit the content and deliverance of the page. Additionally, in the realm of data analysis, the company gained more hands as it dipped into Azure DevOps, exploring the various data sets from non-profits they were supplied in order to gain insights.

Through regular meetings and independent research, the Asgard Data team provided guidance towards valuable insight in novel Data Science concepts, product marketing, and client relations. There was significant time spent working hands-on with the platform landing page to become proficient with version control and developer operations. Working with the team allowed for a glimpse into the data science world, and an eagerness for future opportunities to apply this new knowledge.

## Session III - 11:25.m. – 11:50a.m.

**Project ID: CMPS 03**
**11:25a.m. – 11:50a.m.**

**Title: Water Quality Data Collection through mWater Software**
**Presenter(s):** Erin Yoo
**Mentor(s):** Dr. Melissa Lenczewski, Northern Illinois University
**Abstract/Project Intention:**
Easily accessible water quality data is crucial in showing how local water supplies may be impacting public health and the environment for communities around the world. This project takes 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 using mWater, a robust online platform for collecting and managing water quality data. The data management system includes transferring historical data records into the mWater database, creating data collection surveys, and producing data visualizations that are available to the public. The mWater data management and publication system have also been adapted to cenote water quality studies conducted in Mexico through the NIU REU summer research program. Data 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. Further, the project involved collecting and running Kishwaukee River water samples through Exact Micro 20 water quality tests. This field and lab work provided valuable insight into how the mWater data management system could be improved, demonstrating the importance of interdisciplinary collaboration between computer science and biology.

**Project ID: ERSP 01**
**11:25a.m. – 11:50a.m.**

**Title: Estimating the Number of Earth-Sized Habitable Planets in our Galaxy**
**Presenters:** Liam Archer, Edgar Carlos, James Johnston, Alice Li, Diego Montes, Cesar Osornio, Advait Patel, Theo Schreiber, Manaal Shamsi, Pietro Stabile, Kyler Yu
**Mentor:** Eric Hawker, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
First launched in 2009, NASA's Kepler Space Telescope was sent to discover Earth-sized planets orbiting other stars. Since then, several methods for searching for these planets have developed, one of which is the transit method. Using host star light curves, transits can be defined as dips in the light curve that indicate when the planet's orbit has crossed in front of a relative position of the star. Here, we utilize this method to search for earth-sized habitable exoplanets. Following real transit data, we created simulated data that closely modeled actual exoplanet transits. Then, we created a neural network algorithm that is trained to detect transits using this fake data. Using these processes, we were able to calculate a general efficiency of our model and the telescope, and this probability can then be used to estimate just how many earth-sized habitable exoplanets are in our galaxy.

**Project ID: MATH 01**
**11:25.m. – 11:50a.m.**

**Title: Classifying the Isomorphy Classes of the Special Orthogonal Group for Characteristic 2**
**Presenter(s):** Shiqi Cheng
**Mentor(s):** Dr. Ellen Ziliak, Dept. of Mathematical and Computational Sciences, Benedictine University
**Abstract/Project Intention:**
In this presentation we will be studying the Special Orthogonal group which consists of matrices that are orthogonal with determinant 1. The values in our matrices are in a finite field of characteristic 2, this means we are working modulo 2. The goal of this research is to characterize the involutions for this group. Applications of our research can be found in many fields including molecular systems biology, rotational physics, and computer graphics.

**Project ID: BIO 07**
**11:25a.m. – 11:50a.m.**

**Title: Exploring RCA Heat Stress Acclimation Strategies in C4 Grasses**
**Presenter(s):** Amanda Chen; Emily Johnson; Laila Walton
**Mentor(s):** Dr. Sarah Stainbrook, Washington University in St. Louis
**Abstract/Project Intention:**
As global temperatures continue to rise, food security has become an increasingly relevant problem growing out of maintaining crop yield under adverse environments, and one approach is to improve photosynthesis activity in plants. Photosynthesis in many plant species is limited when ambient temperatures increase past their optimal range. As a result, our research aims to explore and improve the performance of Rubisco activase (RCA), a key enzymein photosynthesis. We investigate the effectiveness of different heat stress acclimation strategies across three C4 grasses, namely Zea mays, Sorghum bicolor, and Setaria viridis, where regulation could potentially mitigate some of the decrease in RCA's ATPase activity due to denaturation. Each purified plant sample has a multitude of incubation periods: 0hr, 1hr, 6hr, and 48hr. Using a molybdate arsenite assay, we measure both the effect of different Mg2+ ion concentrations on RCA performance and the correlation between ADP-to-ATP ratios and RCA activity. Lastly, we measure the effect of different preincubation temperatures on RCA activity using an NADH-linked assay. Our progress with all three protocols currently indicate strong correlation to expected results and regulatory effects.

**Project ID: CMPS 09**
**11:25a.m. – 11:50a.m.**

**Title: Options Pricing with Neural Networks**
**Presenter(s):** Marco Bravo, Daniel Ma, Michael Yudovich,
Edward Zhang, Philip Yi
**Mentor(s):** Phadmakar Patankar, Illinois Mathematics and Science Academy
**Abstract/Project Intention:**
In the modern day, Artificial Neural Networks (ANNs) have been recently used and tested to calculate and predict options pricing [Ke 2019], but currently, the most tested and reliable methods are the Binomial and Trinomial methods. Binomial and trinomial pricing models are valuation methods for financial derivatives, namely, options. The methods create a binomial or trinomial tree through an iterative process that allows for specification of nodes, or points of time, throughout the time span between the valuation date and an option's expiration date ["How the Binomial," 2020]. In both binomial and trinomial trees there is a starting option price, but the difference between the methods are the steps that the price can take. In a binomial tree, the price can either go up or down by a multiplier, but a trinomial tree also has a probability to stay constant [University of Leicester 2019].

However, these mathematical methods hold several flaws. The Binomial and Trinomial methods require an enormous amount of calculations when measuring a single optIn the modern day, Artificial Neural Networks (ANNs) have been recently used and tested to calculate and predict options pricing [Ke 2019], but currently, the most tested and reliable methods are the Binomial and Trinomial methods. Binomial and trinomial pricing models are valuation methods for financial derivatives, namely, options. The methods create a binomial or trinomial tree through an iterative process that allows for specification of nodes, or points of time, throughout the time span between the valuation date and an option's expiration date ["How the Binomial," 2020]. In both binomial and trinomial trees there is a starting option price, but the difference between the methods are the steps that the price can take. In a binomial tree, the price can either go up or down by a multiplier, but a trinomial tree also has a probability to stay constant [University of Leicester 2019].

However, these mathematical methods hold several flaws. The Binomial and Trinomial methods require an enormous amount of calculations when measuring a single option over a long period of time. Additionally, the Binomial method is far too simple. The underlying asset is forced to be worth two prices, which is inaccurate. ANNs have been shown to decrease times in calculations after their initial training period [Liu 2019].

In this study, we will be exploring how the calculations completed through trained ANNs compare against Binomial and Trinomial methods in predicting European and American Option prices. To do this, we will be using a dataset of American and European options from the time period of January to December 2019, specifically the put options of Alphabet, Inc. in the American Markets and Royal Dutch Shell in European Markets. And then they will be compared using real-time data for both ion over a long period of time. Additionally, the Binomial method is far too simple. The underlying asset is forced to be worth two prices, which is inaccurate. ANNs have been shown to

decrease times in calculations after their initial training period [Liu 2019]. In this study, we will be exploring how the calculations completed through trained ANNs compare against Binomial and Trinomial methods in predicting European and American Option prices. To do this, we will be using a dataset of American and European options from the time period of January to December 2019, specifically the put options of Alphabet, Inc. in the American Markets and Royal Dutch Shell in European Markets. And then they will be compared using real-time data for both.

## Session III - 11:55a.m. – 12:20p.m.

**Project ID: MEDH 16**
**11:55a.m. – 12:20p.m.**

**Title: A Bayesian hierarchical model of longitudinal dynamics**
**Presenter(s):** Siddharth Tiwari
**Mentor(s):** Andrew Vigotsky, A. V. Apkarian, Center of Translational Pain, Feinberg School of Medicine, Northwestern University
**Abstract/Project Intention:**
Pain is the most ubiquitous and economically burdensome condition in the world. For this reason, pain relief—a decrease in pain over time—is the primary outcome for clinical trials across many fields, ranging from pharmaceuticals to physiotherapy. Often measured at few, discrete time points (e.g., pre- and post-intervention), measures and statistical models of pain relief are poor. The low temporal resolution increases vulnerability to regression-to-the-mean, decreases the precision of treatment effect estimates, and patient-specific trends in pain relief can neither be captured, forecasted, nor explained. Here, we propose a Bayesian hierarchical model of longitudinal pain relief that contains two Markovian states: a pain trajectory state and a pain flare state. Our model makes use of daily pain rating data to model time points within states within individuals. Group assignments can be used to investigate the effects of interventions while demographic and patient-specific parameters—such as psychometric assessments and brain properties—can be used for predictive modeling. By fully exploiting time-series data, we can obtain better estimates of treatment effects, in addition to identifying parameters that explain both between- and within-patient heterogeneity. Our model represents a step towards high-resolution patient symptom monitoring, disease progression, and individualized clinical forecasting.

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

**Title - An Evaluation of Variant Annotation Tools – Alamut Batch, ENSEMBL Variant Effect Predictor (VEP), and ANNOVAR - for Clinical Next Generation Sequencing (NGS) based Genetic Testing**

**Presenter:** Sachleen Tuteja
**Mentor:** Dr. Kai Lee Yap, PhD, FACMG, Director of Molecular Diagnostics,
Ann and Robert H. Lurie Children's Hospital of Chicago,
Assistant Professor of Pathology, Feinberg School of Medicine,
Northwestern University

**Abstract/Project Intention:**
Dramatically expanding our ability for clinical genetic testing for inherited conditions and complex diseases such as cancer, next generation sequencing (NGS) technologies are allowing for rapid interrogation of thousands of genes and identification of millions of variants. Variant annotation, the process of assigning functional information to DNA variants based on the standardized Human Genome Variation Society (HGVS) nomenclature, is a fundamental challenge in the analysis of NGS data that has led to the development of many empirically based tools. In this study, we evaluated the performance of three variant annotation tools: Alamut Batch, ENSEMBL Variant Effect Predictor (VEP) and ANNOVAR, benchmarked by a manually curated ground truth set of 298 variants from the medical exome database at the Molecular Diagnostics Laboratory at Lurie Children's Hospital. Of the three tools, VEP produces most accurate variant annotations (HGVS nomenclature for 297 of the 298 variants) due to usage of updated gene transcript versions within the algorithm. Alamut Batch called 296 of the 298 variants correctly; strikingly, ANNOVAR exhibited the greatest number of discrepancies (20 of the 298 variants, 93.3% concordance with ground truth set). Adoption of validated methods of variant annotation is critical in post analytical phases of clinical testing.

**Project ID: MEDH 05**
**11:55a.m. – 12:20p.m.**

**Title: Exploring Retinal Projection to the Medial Amygdala: Laterality, Sex, and Cell Types**

**Presenter(s):** Shikhar Gupta, Kavin Suhirtharen
**Mentor(s):** Ms. Devon Greer, Dr. Gregory Schwartz,
Feinberg School of Medicine, Northwestern University

**Abstract/Project Intention:**
In the mouse brain, there are 59 retinorecipient regions, including the medial amygdala (MeA). The MeA is a sensory integrating region where social information is processed, especially those related to sexual selection, aggression, and pup retrieval. The neurons that link visual input to the brain are known as retinal ganglion cells (RGCs). There are ~47 mouse RGC subtypes, each with their own light stimulus sensitivities and activity patterns. As the MeA is notorious as the sexually dimorphic social behavioral hub, it is worthwhile beginning to explore sex differences or laterality differences in this retinorecipient area. Using anterograde, intravitreal injections in the retinal terminal densities at the MeA from cable length, fill volume, tortuosity, and branch points, differences between the left MeA and the right MeA in male and female mice were explored. To identify which RGC subtypes are expressed in the MeA, we used functional and morphological analysis after retroviral tracing. These findings determined a broad overrepresentation of direction-selective and orientation-selective subtypes. Determining the functional specificity of RGCs projecting to the MeA may provide insight on the role of visual input in these medial amygdala-related behaviors.

**Project ID: MEDH 09**
**11:55a.m. – 12:20p.m.**

**Title: Effect of PMN Presence on Cancer Vascularization in Colorectal Tumors of Mice**

**Presenter:** Edward Ning
**Mentors:** Ronen Sumagin, Triet Bui, Feinberg School of Medicine, Northwestern University

**Abstract/Project Intention:**
Ulcerative colitis (UC) is a type of chronic inflammatory bowel disease (IBD), where deregulated immune responses promote exacerbated inflammation and formation of ulcers in the large intestine. IBD is also one of the high-risk factors for the development of colorectal cancer (CRC). Robust neutrophil infiltration is an important feature of both UC and CRC and in both cases, disease severity is clinically correlated with elevated neutrophil numbers in the tissue. Using a preclinical mouse model of CRC (AOM/DSS) and cell sequencing analyses, the Sumagin Lab found that tumor infiltrating neutrophils promote tumor vascularization by providing metalloproteinase-14 and Osteopontin. To confirm these findings at a protein level, tumor sections from early and advanced murine colon tumors induced by AOM/DSS treatment with and without prior elimination of tumor neutrophils were stained using immunohistochemistry for MMP-14, Spp1 and VEGFa, a known angiogenic factor. While VEGFa upregulation was neutrophil-independent, detailed image analyses revealed neutrophil-dependent induction of OPN expression in the tumor stroma and MMP14 in the tumor center specifically in advance tumors, consistent with the role of these factors in tumor vascularization and the rtole of neutrophils in CRC progression.

# Presentation Schedule Reference List | IMSAloquium 2022

| Student First | Student Last | Session | Time | Project ID |
|---|---|---|---|---|
| Temilope | Akinmolayan | II | 10:05a.m. | BizIN 04 |
| Rashmi | Alawani | II | 10:25a.m. | CMPS 11 |
| Elizabeth | Alcala | I | 8:50a.m. | CHEM 02 |
| Edwin | Alcantara | I | 8:50a.m. | BIO 12 |
| Aaliyah | Ali | II | 10:25a.m. | BHVSO 01 |
| Gautham | Anne | I | 8:50a.m. | PHYS 01 |
| James | Anterola | I | 8:50a.m. | CHEM 10 |
| Liam | Archer | III | 11:25a.m. | ERSP 01 |
| Ariela | Asllani | II | 10:05a.m. | MEDH 03 |
| Shreeya | Avadhanula | II | 10:45a.m. | BIO 05 |
| Balaji | Balachandran | II | 10:25a.m. | BHVSO 01 |
| Siddarth | Bangaru | I | 9:10a.m. | BIO 06 |
| Dean | Barrow | I | 8:50a.m. | PHYS 01 |
| Akash | Basavaraju | I | 8:50a.m. | MEDH 27 |
| Taylor | Baugh | I | 8:50a.m. | CHEM 01 |
| Shiraz | Baxamusa | II | 10:25a.m. | ENGN 05 |
| George | Bayliss | I | 9:10a.m. | PHYS 02 |
| Surya | Bhamidi | I | 9:30a.m. | PHYS 03 |
| Rylie | Bozarth | II | 10:05a.m. | BIO 11 |
| Marco | Bravo | III | 11:25a.m. | CMPS 09 |

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|---|---|---|---|---|
| Kennedy | Bray | I | 8:50a.m. | BHVSO 06 |
| Ethan | Brazelton | I | 9:30a.m. | CHEM 11 |
| Nathan | Brodsky | I | 8:50a.m. | BHVSO 19 |
| Edgar | Carlos | III | 11:25a.m. | ERSP 01 |
| Elizabeth | Carlson | II | 10:25a.m. | BIO 01 |
| Nickolas | Carter | II | 10:25a.m. | ENGN 05 |
| Shreya | Chakraborty | I | 9:30a.m. | MEDH 18 |
| Saanvi | Chelikani | I | 9:10a.m. | ENGN 02 |
| Amanda | Chen | III | 11:25a.m. | BIO 07 |
| Isabella | Chen | I | 9:10a.m. | MEDH 30 |
| Shiqi | Cheng | III | 11:25a.m. | MATH 01 |
| Divya | Choudhary | II | 10:05a.m. | BIO 11 |
| Natali | Chung | I | 8:50a.m. | MEDH 37 |
| Dean | Cianciolo | I | 9:30a.m. | PHYS 03 |
| Christian | Cline | II | 10:05a.m. | BIO 03 |
| Shawn | Coutinho | II | 10:05a.m. | ENGN 06 |
| Kelly | Cruz | II | 10:45a.m. | CHEM 19 |
| Braeden | Cullen | II | 10:05a.m. | CMPS 02 |
| Adam | Daki | I | 9:30a.m. | BIO 08 |
| Ramzi | Daki | I | 8:50a.m. | CHEM 02 |
| Gabriel | Delgado | I | 9:30a.m. | BizIN 03 |
| Neil | Dighe | II | 10:25a.m. | ENGN 05 |

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|---|---|---|---|---|
| Nooriyah | Doriwala | I | 8:50a.m. | BizIN 07 |
| Shaan | Doshi | II | 10:25a.m. | CMPS 06 |
| Jeff | Duan | I | 8:50a.m. | CHEM 10 |
| Reyna | Duffy | I | 9:30a.m. | ENVR 01 |
| Rujuta | Durwas | II | 10:25a.m. | MEDH 04 |
| Christo | Ekimov | I | 9:30a.m. | BHVSO 04 |
| Lauren | Fakhoury | II | 10:05a.m. | HIST 01 |
| Keira | Feliciano | I | 9:30a.m. | CHEM 03 |
| Jesus | Fileto | I | 9:10a.m. | PHYS 02 |
| Jonah | Fisher | I | 8:50a.m. | BHVSO 19 |
| Serena | Gacek | I | 9:10a.m. | BIO 10 |
| Ela | Gadi | I | 8:50a.m. | BizIN 01 |
| Nathaniel | Gao | II | 10:25a.m. | BIO 13 |
| Atharva | Gawde | II | 10:45a.m. | PHYS 21 |
| Gabriela (Gabi) | Georgieva | I | 9:10a.m. | ENVR 02 |
| Sammuel | Go | I | 9:30a.m. | MEDH 31 |
| Samantha | Gong | II | 10:05a.m. | MEDH 32 |
| Nathaniel | Graf | I | 8:50a.m. | PHYS 04 |
| Pranit | Guntupalli | II | 10:25a.m. | MEDH 04 |
| Akshat | Gupta | I | 8:50a.m. | MATH 02 |
| Shikhar | Gupta | III | 11:55a.m. | MEDH 05 |
| Lethzeylee | Gutierrez | I | 9:10a.m. | MEDH 30 |

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|---|---|---|---|---|
| Matias | Habib | III | 11:25a.m. | ERSP 01 |
| Shria | Halkoda | II | 10:05a.m. | BHVSO 07 |
| Aubrey | Hall | I | 9:10a.m. | CHEM 04 |
| Luis | Hernandez | II | 10:25a.m. | CMPS 06 |
| Maya | Holland | II | 10:25a.m. | MEDH 33 |
| Kevin | Huang | II | 10:25a.m. | PHYS 05 |
| Hector | Ibarra | I | 9:10a.m. | PHYS 06 |
| Temilolu | Ijisesan | I | 9:10a.m. | BHVSO 09 |
| Matthew | Illimoottil | II | 10:25a.m. | MEDH 23 |
| Esther | Im | I | 9:10a.m. | BizIN 02 |
| Katelyn | Ingles | I | 9:30a.m. | MEDH 28 |
| Lily | Isibue | I | 8:50a.m. | BHVSO 19 |
| Rohan | Jain | II | 10:45a.m. | PHYS 07 |
| Emily | Johnson | III | 11:25a.m. | BIO 07 |
| Hannah | Johnson | II | 10:45a.m. | MEDH 34 |
| James | Johnston | III | 11:25a.m. | ERSP 01 |
| Himani | Kamineni | II | 10:45a.m. | MEDH 06 |
| Gabriella | Kanallakan | I | 9:30a.m. | CHEM 05 |
| Avdhan | Kandikattu | I | 9:30a.m. | CHEM 11 |
| Vikram | Karra | II | 10:25a.m. | CMPS 06 |
| Rohit | Katukam | II | 10:25a.m. | BIO 04 |
| Zhou | Kaylee | II | 10:25a.m. | IN2 IS 01 |

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|---|---|---|---|---|
| Aarya | Khapre | II | 10:25a.m. | ENGN 01 |
| Anthony | Kholoshenko | II | 10:05a.m. | CHEM 06 |
| Nathan | Kilmer | I | 9:30a.m. | PHYS 08 |
| Eunice | Kim | I | 9:30a.m. | BHVSO 04 |
| Sameer | Komoravalu | II | 10:05a.m. | PHYS 09 |
| Rachael | Koterba | I | 8:50a.m. | BHVSO 19 |
| Caroline | Kowal | I | 9:30a.m. | PHYS 10 |
| Aditi | Kumar | II | 10:25a.m. | CHEM 07 |
| Jayant | Kumar | I | 9:10a.m. | PHYS 20 |
| Ayati | Lala | I | 9:10a.m. | MEDH 35 |
| Samuel | Lee | I | 9:30a.m. | BHVSO 10 |
| Kevin | Lemus | I | 8:50a.m. | ENGN 04 |
| Alice | Li | III | 11:25a.m. | ERSP 01 |
| Joyce | Li | I | 9:30a.m. | MEDH 02 |
| Irene | Liu | I | 8:50a.m. | CMPS 05 |
| Jasmine | Liu | II | 10:45a.m. | MEDH 08 |
| Annabelle | Lu | I | 8:50a.m. | BHVSO 03 |
| Nadia | Ludwig | II | 10:45a.m. | BizIN 06 |
| Ilan | Lunken | I | 8:50a.m. | ENGN 04 |
| Jessica | Lyseng | I | 9:10a.m. | BHVSO 21 |
| Daniel | Ma | III | 11:25a.m. | CMPS 09 |
| Aidan | Maddox | I | 9:30a.m. | MEDH 02 |

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|---|---|---|---|---|
| Cameron | Magana | II | 10:05a.m. | MEDH 36 |
| Shreya | Mahesh | I | 8:50a.m. | MEDH 26 |
| Miles | Massey | I | 9:10a.m. | MEDH 35 |
| William | McClain | II | 10:45a.m. | CHEM 08 |
| Karrick | McGinty | II | 10:25a.m. | PHYS 11 |
| Jung | Minseo | II | 10:25a.m. | IN2 IS 01 |
| Diego | Montes | III | 11:25a.m. | ERSP 01 |
| Jack | Morby | II | 10:25a.m. | PHYS 05 |
| Naveena | Mutharasan | I | 8:50a.m. | CHEM 01 |
| Liam | Nelson | I | 9:10a.m. | PHYS 12 |
| Oliver | Ni | II | 10:25a.m. | BHVSO 01 |
| Edward | Ning | III | 11:55a.m. | MEDH 09 |
| Elizabeth | Nyamwange | I | 8:50a.m. | CMPS 12 |
| Venus | Obazuaye | I | 9:10a.m. | MEDH 12 |
| Minju | Oh | II | 10:05a.m. | BHVSO 20 |
| Kosisochi | Onwuameze | II | 10:05a.m. | BizIN 04 |
| Dean | Oquendo | II | 10:25a.m. | CHEM 15 |
| Cesar | Osomio | III | 11:25a.m. | ERSP 01 |
| Carson Sage | Owen | I | 8:50a.m. | BIO 12 |
| Rebecca | Pae | I | 9:10a.m. | BHVSO 13 |
| Zhengyu | Pan | II | 10:45a.m. | PHYS 07 |
| Gerardo | Paramo | I | 8:50a.m. | BIO 12 |

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|---|---|---|---|---|
| Jesse | Park | I | 8:50a.m. | CHEM 13 |
| Sooah | Park | II | 10:05a.m. | BizIN 10 |
| Abhiram | Pasupula | II | 10:05a.m. | MEDH 29 |
| Advait | Patel | III | 11:25a.m. | ERSP 01 |
| Dhruv | Patel | II | 10:25a.m. | MEDH 14 |
| Faisal | Patel | II | 10:25a.m. | MEDH 04 |
| Pranav | Patel | II | 10:25a.m. | MEDH 14 |
| Amrut | Pennaka | II | 10:45a.m. | CHEM 16 |
| Dorothy | Peters | II | 10:25a.m. | MEDH 33 |
| Lucienne | Petit | II | 10:05a.m. | MEDH 36 |
| Cole | Plepel | I | 9:10a.m. | MATH 03 |
| Revanth | Poondru | I | 9:10a.m. | BizIN 08 |
| Lily | Powell | II | 10:05a.m. | BIO 11 |
| Ava | Puchitkanont | I | 9:30a.m. | CMPS 08 |
| Kevin | Qu | I | 9:30a.m. | BIO 08 |
| Nachiket | Rajinkanth | II | 10:05a.m. | BIO 11 |
| Reese | Ramos | II | 10:45a.m. | PHYS 13 |
| Apurva | Reddy | I | 8:50a.m. | MEDH 26 |
| Adriana | Rodriguez | I | 8:50a.m. | BHVSO 19 |
| Vanessa | Rodriguez | I | 9:30a.m. | CHEM 03 |
| Catelyn | Rounds | I | 8:50a.m. | BIO 09 |
| Nikita | Rudrapati | I | 9:30a.m. | BHVSO 14 |

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|---|---|---|---|---|
| Rushil | Sambangi | I | 9:30a.m. | BizIN 09 |
| Bhargav | Sampathkumaran | II | 10:05a.m. | BHVSO 15 |
| Christin | Sanchez | II | 10:25a.m. | BHVSO 01 |
| Theo | Schreiber | III | 11:25a.m. | ERSP 01 |
| Rachel | Selvaraj | I | 9:30a.m. | MEDH 02 |
| Eric | Shackelford | II | 10:25a.m. | PHYS 14 |
| Vidhi | Shah | I | 9:30a.m. | BizIN 09 |
| Manaal | Shamsi | III | 11:25a.m. | ERSP 01 |
| Amogh | Shetty | II | 10:05a.m. | MEDH 21 |
| Sajal | Shukla | II | 10:45a.m. | MEDH 24 |
| Megan | Sia | II | 10:05a.m. | BHVSO 05 |
| Dev | Singh | I | 9:10a.m. | CMPS 07 |
| Cordelia | Sirais | II | 10:25a.m. | BHVSO 16 |
| Zoie | Sloneker | II | 10:45a.m. | PHYS 15 |
| Tyler | Smith | II | 10:45a.m. | BizIN 06 |
| Lily | Song | I | 9:30a.m. | ENVR 01 |
| Pietro | Stabile | III | 11:25a.m. | ERSP 01 |
| Kavin | Suhirtharen | III | 11:55a.m. | MEDH 05 |
| Mojadesola | Suleiman | I | 9:10a.m. | CHEM 18 |
| Michelle | Sun | I | 9:10a.m. | CHEM 04 |
| Sumedha | Surubhotla | I | 9:30a.m. | MEDH 31 |
| Jai | Sutaria | II | 10:45a.m. | ENGN 03 |

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|---|---|---|---|---|
| James | Tan | I | 9:10a.m. | PHYS 16 |
| Andy | Tang | I | 9:30a.m. | PHYS 17 |
| Kenith | Taukolo | I | 8:50a.m. | MEDH 15 |
| Kenith | Taukolo | II | 10:45a.m. | CHEM 19 |
| Patrick | Tenedor | I | 8:50a.m. | BHVSO 19 |
| Siddharth | Tiwari | III | 11:55a.m. | MEDH 16 |
| Mathew | Torres | II | 10:05a.m. | CHEM 09 |
| Sachleen | Tuteja | III | 11:55a.m. | MEDH 01 |
| Rishik Reddy | Ummareddy | I | 9:30a.m. | BIO 08 |
| Nandana | Varma | II | 10:05a.m. | MEDH 07 |
| Bhavya | Vegesna | I | 9:10a.m. | BIO 14 |
| Gabriella | Velzaques | I | 9:10a.m. | BHVSO 21 |
| Renaldo | Venegas | I | 8:50a.m. | CHEM 10 |
| Laila | Walton | III | 11:25a.m. | BIO 07 |
| Gloria | Wang | I | 9:30a.m. | CMPS 01 |
| Yina | Wang | I | 9:30a.m. | MEDH 18 |
| Margaret | Wei | II | 10:25a.m. | BIO 04 |
| Sarah | Wheeler | II | 10:45a.m. | BHVSO 17 |
| Dheeran | Wiggins | I | 9:10a.m. | PHYS 02 |
| Elaina | Xiao | II | 10:45a.m. | CMPS 04 |
| Philip | Yi | III | 11:25a.m. | CMPS 09 |
| Michael | Yodovich | III | 11:25a.m. | CMPS 09 |

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|---|---|---|---|---|
| Erin | Yoo | III | 11:25a.m. | CMPS 03 |
| Kyler | Yu | III | 11:25a.m. | ERSP 01 |
| Alexander | Zhang | I | 9:30a.m. | PHYS 18 |
| Andrew | Zhang | II | 10:05a.m. | CMPS 10 |
| Edward | Zhang | III | 11:25a.m. | CMPS 09 |
| Kevin | Zhang | I | 9:30a.m. | PHYS 10 |
| Sabrina | Zhang | II | 10:45a.m. | MEDH 17 |
| Makayla | Zheng | I | 8:50a.m. | BIO 12 |
| Kaylee | Zhou | I | 8:50a.m. | BHVSO 18 |
| Robert | Zhu | II | 10:05a.m. | PHYS 19 |

# Mentor List | Student Inquiry and Research

**Argonne National Lab**
Yuki Hamadan

**Benedictine Univ**
Ellen Ziliak

**Carnegie Mellon University**
Ashique KhudaBukhsh

**Illinois Institute of Technology**
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Yan Yan

**Ann and Robert H. Lurie Children's Outpatient Ctr**
Kai Lee Yap

**Morton Arboretum**
Chuck Cannon

**North Grumman Corp.**
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**Northern Illinois University**
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Wesley Swingley

**NorthShore Univeristy HealthSystem**
Jubao Duan
Subhajit Sengupta

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Randall Berry
Eric Dahl
Julius Dewald
Carola Frydman
Yoram Lithwick
Dimitris Papanikolaou
Paul Umbanhowar

**Northwestern, Feinberg**
Angel Alvarez
Apkar Vania Apkarian
Yanis Boumber
Rodrigo Braga
Will Dune
Aruna Ganju
Andrea Graham
Sui Huang
Judd Hultquist
Kiarri Kershaw
Steven Lubbe
Minoli Perera
Claus-Peter Richter
Greg Schwartz
Chisu Song
Ronen Sumagin
Deborah Rachella Winter
Jane Wu

**Rush University**
Lena Al-Harthi
Meghan Moran
Srinivasa Narasipura

**Southern Illinois University**
Keith Gagnon

**The University of Chicago**
Tong-Chuan He
Valluvan Jeevanandam
Ryan Robinett
Amanda Seccia

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Ming Wang

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Jessica Amacher
Sowmya Anjur
Kevin Broy
Mark Carlson
Nick Cross
Tanya Crum
Dave DeVol
Peter Dong
Evan Glazer
Joe Golab
Eric Hawker
Patrick Kearney
David Lundgren
Devon Madon
Bill McGrail
Phadmakar Patankar
Crystal Randall
Brooke Schmidt
John Thurmond

# Mentor List | Business Internship Program

**Alpha Valuations**
Lori Hall

**Asgard Data, LLC**
Stephen Geissler

**Blockbins**
Dane Christianson

**Family First Physicians**
Karen Federici

**Illinois State Treasurer's Office**
Joseph Daniels

**Midwest Allergy Sinus Asthma SC**
Dareen Siri

**Office of State Representative Barbara Hernandez**
Hailey Edwards

**Tuglus LLC**
Angeline Tuglus

**TurnUp Activism**
Paul Cano

**VISMED 3D**
Dima Elissa

**IMSA IN2 Independent Study**
Steve Goldblatt

Cover designed by Alex Zhang, IMSA student, April 20, 2022.