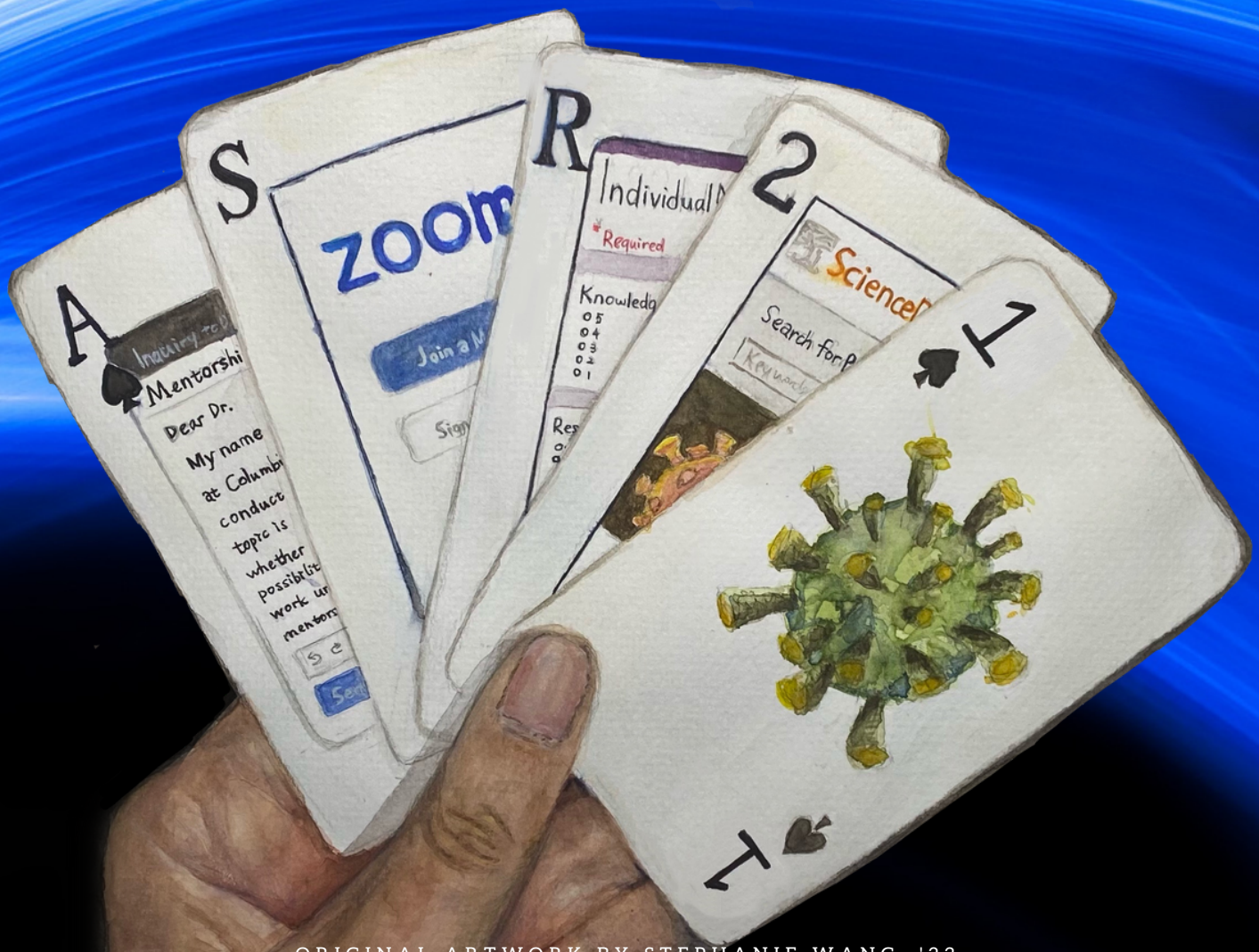
THE WAY YOU PLAY THE HAND

THE SECOND ANNUAL
CGPS ADVANCED SCIENCE RESEARCH SYMPOSIUM

MAY 18, 2021

CGPS



ORIGINAL ARTWORK BY STEPHANIE WANG, '23

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Mr. Yashin's closing remarks	7:10 p.m.
Annika Spaet's final words	7:12 p.m.

MESSAGE FROM DR. BILL DONOHUE, HEAD OF SCHOOL

This Advanced Science Research Symposium marks a great night for Columbia Prep. We are here to participate in the classic scientific discipline of gathering as an intellectual community to hear our student scientists present their original research. On this occasion we also offer our respect and admiration, as we are celebrating that we now have two cohorts of authentic scientists, including our first graduates of the program. These students have embraced the challenges of a unique and innovative curriculum that required them to be bold and intellectually adventurous. They have met the challenges admirably. Special appreciation is due to the students in the Class of 2021, who are not only our pioneers, but also have persevered through the challenges of this past year. We wish them well and ask that they stay in touch and remain participants by attending future symposia and other ASR events.

Finally, I must express my gratitude and respect to Mr. Yashin and Mr. Keith for exemplifying a unique combination of vision and support. They have created a community of scientists within the CGPS community that their students will forever remember as a foundational experience, regardless of their future college majors and pursuits.

Enjoy the evening,

Dr. Bill Donohue

MESSAGE FROM JOANIE DEAN, PREP SCHOOL DIRECTOR

Dear Columbia Prep Advanced Science Research Students and Graduates,

Congratulations! The entire Columbia Prep community is so proud of all that you have accomplished. Even in a global pandemic, your talent and hard work knew no bounds. When I visited your classrooms (and your Zoom rooms!), I was so impressed with the high caliber of your research, papers and presentations. You inspired fellow students, teachers, parents, and professors, and you have set a very high bar for those who will follow.

As we say goodbye to our inaugural class of ASR graduates, I know you join me in congratulating them for all they have accomplished!

With respect and admiration,

Joanie Dean

MESSAGE FROM PATRICE BUCKLEY, SCIENCE DEPARTMENT HEAD

Congratulations to all of the Advanced Science Research students and especially to the graduating seniors - Alex Lyons, Fabiha Rafrafin and Alex Sidorsky. Your persistence, your strength and determination during such a difficult time is to be commended. We acknowledge the countless hours you devoted to research and perfecting your presentations. You were supportive of one another and your instructors and demonstrated great resilience under stress.

A big thank you to Mr. Yashin and Mr. Keith for their guidance and mentorship. ASR at Columbia is growing and attracting many students thanks to their hard work. Now more than ever we need scientists in our world.

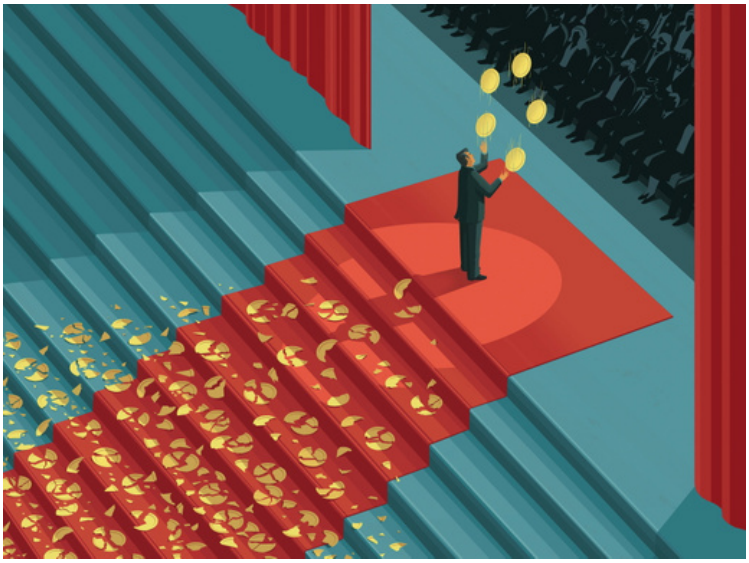
There is so much out there to explore and I hope that you will use this experience as a stepping stone to continue your journey in science research.

Best,

Patrice Buckley

MESSAGE FROM ILYA YASHIN, ASR INSTRUCTOR

When I hear my ASR students present to audiences who have never heard their presentation before, I often think of this illustration:



"Success" by Stephan Schmitz. Reprinted with author's permission.

I admire my students immensely not just for what you will read here or hear during the Symposium, but also for their difficult climb upward, littered with broken plates. It took them so much hard work, determination, and faith in themselves and in the ASR process to get where they are today—and most of them are not even halfway through their ASR journey. This is not easy even in a normal year, much less so in a year turned topsy-turvy by COVID-19. They've played their hand well.

In addition, the first three graduates of the CGPS ASR program—Alex Lyons, Fabiha Rafrafin, and Alex Sidorsky—deserve special recognition and a unique place in this program's history. They took a chance with going through this new program at an accelerated pace, and I am so glad that they were the ones to do it.

Much love,

Ilya Yashin

CONGRATULATIONS TO THE FIRST GRADUATES OF COLUMBIA PREP'S ASR PROGRAM!

ALEX LYONS

FABIHA RAFRAFIN

ALEX SIDORSKY

Seniors

ALEX LYONS

TITLE:
INTRA-PROCEDURAL PROSTATE MRI REGISTRATION:
A DATA-EFFICIENT SIAMESE NEURAL NETWORK (SNN) DESIGN

MENTOR:
DR. ALBERTO ROSSI
UNIVERSITY OF FLORENCE

COLLEGE:
CARNEGIE MELLON SCHOOL OF COMPUTER SCIENCE

INTENDED MAJOR:
ARTIFICIAL INTELLIGENCE

The process of registering (aligning) intra-procedural prostate magnetic resonance images (MRI) with corresponding pre-procedural images improves the accuracy of certain surgeries, such as a prostate biopsy, by making it appear as if both images were taken under the same conditions. Registration models use machine learning, often in the form of convolutional neural networks (CNN), to efficiently automate the alignment process. However, gathering the necessary data for training a registration model is a problematic step. Many smaller hospitals may not have the resources needed to obtain an annotated training dataset, making the training of standard deep CNN difficult. To address this issue, I created a siamese neural network that registers prostate MRI images taken during a prostate biopsy to pre-procedural prostate MRI images. It works by randomly warping the moving image (intra-procedural), producing 18 different copies, and then choosing the best aligned copy with respect to the reference image (pre-procedural). The result is a model that can not only accurately register MRI images using a small dataset, but one that can outperform existing models as well, making it more accessible to smaller hospitals.

- Tech support, ASR Symposium 2020
- Presenter, International Symposium on Visual Computing, 2020
- First author of a published, peer-reviewed paper
- 3rd place, Computer Science category at the NYC Metro Area section of the Junior Science and Humanities Symposium
- Regeneron Talent Search 2021 Entrant
- First Award in category and one of top 13 projects overall, Terra NYC STEM Fair
- Finalist, International Science and Engineering Fair 2021
- Finalist, GENIUS Olympiad 2021
- Invited to present to members of the Medical Imaging team at General Electric

"Without a doubt, many of my favorite memories when looking back at high school will have come from ASR. Not only did I learn and accomplish so much more than I thought I ever could, but I will be happy going to college knowing that I have the courage to chase my dreams and follow through."

Seniors

FABIHA RAFRAFIN

TITLE:
THE EFFECT OF COVID-19 ON THE DRIVING BEHAVIOR OF INDIVIDUALS WITH PRECLINICAL ALZHEIMER'S DISEASE

MENTOR:
DR. CATHERINE ROE
WASHINGTON UNIVERSITY SCHOOL OF MEDICINE IN ST. LOUIS

COLLEGE:
YALE UNIVERSITY

INTENDED MAJOR:
COGNITIVE SCIENCE

Driving behaviors in individuals with Alzheimer's Disease (AD) are potentially hazardous to the drivers themselves and to public safety at large. Changes in driving behavior have also been shown to occur in individuals with preclinical AD, but it is not clear whether these behaviors may prove hazardous as well, especially during times of stress. The presence of COVID-19 provides us with a unique opportunity to study driving behaviors under the stress of the pandemic, more specifically the potential stress caused by personal risk factors for COVID-19. Using data from the Knight Alzheimer's Disease Research Center, I analyzed the impact of the stress of COVID-19 on the driving behavior of 111 older adults with medical risk factors, individuals with preclinical AD, and individuals with both medical risk factors and preclinical AD. I hypothesized that, compared to healthy older adults, older adults with preclinical AD would show a greater decrease in both the frequency and length of their driving trips during the COVID-19 pandemic, and that those with risk factors would exhibit a greater degree of change. I found that drivers with preclinical AD exhibited a significant decrease in the length of trips during the coronavirus pandemic, while older adults with risk factors, regardless of preclinical AD status, did not make any significant changes to their driving. This indicates that older individuals with preclinical AD appeared to make cautionary changes to their driving in response to the pandemic, but not based upon individual medical risk factors. This lack of change due to risk factors supports the idea that individuals with preclinical AD may be self-regulating their behavior and may not pose an increased risk to either themselves or to the public.

- Master of Ceremonies, ASR Symposium 2020
- Regeneron Talent Search 2021 Entrant
- Terra NYC STEM Fair 2021 Entrant

"ASR pushed me out of my comfort zone so often that I am no longer afraid of being challenged."

Seniors

ALEX SIDORSKY

TITLE:
IMPROVING OUR UNDERSTANDING OF NEW YORK CITY'S MICROCLIMATES USING A NOVEL OBSERVATIONAL NETWORK

MENTOR:
DR. PRATHAP RAMAMURTHY
CITY COLLEGE OF NEW YORK

COLLEGE:
WASHINGTON UNIVERSITY IN ST. LOUIS

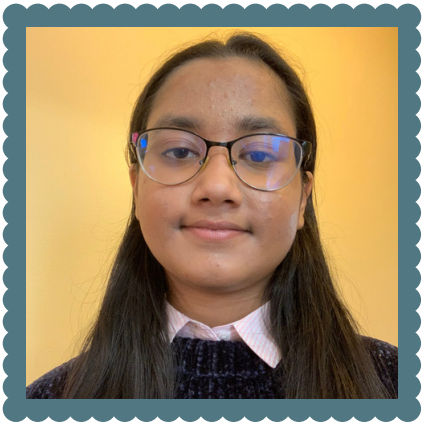
INTENDED MAJOR:
ARCHITECTURE & ECONOMICS

Climate change has become the world's most paramount challenge and cities are expected to become even more densely populated. Cities such as New York City are considered global metropolises and are expected to be directly affected by the adverse effects of climate change. New York City's microclimates and intra-urban variability is still largely unknown and not commonly investigated on the ground. To better understand NYC's microclimates, the Urban Hydro-Meteorological Testbed project was formed at City College to improve climate mapping and modelling, direct resource allocation, and improve flood warnings. I utilized 19 weather stations from the Testbed to define and differentiate NYC's microclimates based on four fundamental climate variables: air temperature, precipitation, relative humidity, and soil moisture. Using 1.08 million data points, I successfully quantified a number of distinct associations among local weather variables at stations throughout the city and demonstrated that New York City's microclimates vary not only anecdotally, but in a statistically significant manner.

- Program editor, ASR Symposium 2020
- Honorable mention, American Statistical Association's 2020 Virtual Science Fair
- Regeneron Talent Search 2021 Entrant
- Terra NYC STEM Fair 2021 Entrant
- Finalist, GENIUS Olympiad 2021

"ASR has been a transformative learning experience for me. I learned that discovering what you are passionate about and pursuing it to the highest level is one of the most rewarding tasks you can do as a student. I am truly walking out a different person than two years ago."

Nearly 500 million people use language systems such as Grammarly or Google Translate on a daily basis. These systems can identify the meaning of a word using machine learning models (MLMs) in a task called word sense disambiguation (WSD). MLMs identify patterns in data, construct some rules about disambiguating words, and then test what they have learned by finding the definitions of a new dataset of words. Another task in natural language processing is part-of-speech tagging, which identifies the part of speech of a given word using models called Part-of-Speech Taggers (POSTs). Current research on the intersection of WSD and POSTs indicates that using POSTs in the training data of MLMs makes these models more accurate, but the specific changes in accuracy different POSTs make in WSD models is still unclear. Identifying these effects can help improve the accuracy of language systems used daily. I am currently working to explore the effect of three different POSTs on the accuracy of five different WSD models. First, I will pass a text through a POST, and then provide this data to the WSD MLM. This model will be tested by giving it ambiguous words in a sentence and asking the model to provide the definition. By assessing these various models and their accuracy, I hope to expand research on how POSTs can improve the accuracy of natural language processing tasks, including WSD.



RAIHANA RAHMAN

ASSESSING THE IMPACT OF PART-OF-SPEECH TAGGERS ON WORD SENSE DISAMBIGUATION

MENTOR:

DR. TERRY RUAS
UNIVERSITY OF WUPPERTAL

JUNIORS

AKSHAY SHIVDASANI

A CHEMICAL PROBE OF THE ROLE OF CARM1 GENE IN SUPPRESSING CANCEROUS ACTIVITY

MENTOR:

DR. MINKUI LUO
MEMORIAL SLOAN KETTERING CANCER CENTER

Over 600,000 people lose their lives to cancer annually in the United States, and nearly 10 million more throughout the world. Cancer as a whole is very difficult to research, partly because more than 200 diseases fall into the category of cancer, each with different mutations and variations of the disease, along with other complications. Even when studying only one form of cancer, it can be difficult to find patterns within different cancerous samples, because of the role that cellular plasticity plays in the growth of cancer. Cellular plasticity describes the ability of cancerous cells to change cell types, mutate, and divide rapidly. Because these mutations and changes in the phenotype of cancerous tumors are random and vary from person to person, it is challenging to develop an effective treatment that works for everyone. My mentor and I are bypassing this by instead targeting the biological mechanisms that allow for cancerous cells to divide rapidly. We have identified a gene, CARM1, which has been shown to contribute towards cancerous growth, and we seek to investigate whether the suppression of CARM1 leads to the reduction of cancerous cell division. We will be using gene knockout and gene silencing, both of which target CARM1 gene expression and will ultimately render CARM1 inoperative. Gene silencing works to reduce the expression of a gene, whereas gene knockout completely erases the gene from the genome. I will be performing statistical analysis on single-cell sequencing data, which is the genomic information of every cell that we experiment with, to see whether there is a significant difference in cancerous growth after the suppression of CARM1, and whether there are any differences between the gene knockout and gene inhibition methods. I hope to determine whether CARM1 suppressors could serve as candidates for future clinical trials that seek to identify potential cancer treatments.

SIYANG WEI

THE ROLE OF KIDNEY IMMUNE CELLS IN DIABETIC KIDNEY DISEASE

MENTOR:

DR. FU JIA
ICAHN SCHOOL OF MEDICINE AT MOUNT SINAI

Diabetic kidney disease (DKD) is a kidney disease caused by type 1 or type 2 diabetes, and it can affect the kidneys' ability to remove waste products and extra fluid from the body, which can lead to damaged kidney, damaged nerves, heart disease, and blood vessel disease. There is no clear symptom for DKD, and the pathology of DKD is not fully understood. Kidney tissue extracted from DKD patients exhibits increased levels of inflammatory cytokines, inflammatory chemokines, and adhesion molecules. These three types of molecules all relate to immune cells and inflammation. Inflammatory cytokines is a type of signaling molecule that is secreted from immune cells that promotes inflammation. Inflammatory chemokines are molecules that attract immune cells to the site of inflammation. Adhesion molecules are proteins that attach on the surface of cells which direct leukocytes from the blood-stream towards inflammatory foci. For this reason, we think it is important to study the role of kidney immune cells among DKD patients, even though it is not an autoimmune disease. My study will focus on the pathological changes occuring in kidney immune cells due to DKD in a mouse model. I will use single-cell RNA sequencing (scRNA-seq), a technology that is used to study the RNA expression in a large population of cells, to identify immune cells that are present or active in kidneys of DKD patients. I will also use single-cell transcriptomics, a technology that examines the expression level of individual cells in a given population by measuring the messenger RNA (mRNA) concentration, to study how different cell types respond to early-stage diabetes differently and the changes in their expression of genes. Immunofluorescence staining, a way to detect antigens by their antibodies, will also be used to study changes in kidney cells at the protein level. This study will help with understanding the pathology, or the causes and effects, of DKD more, which will assist treating DKD in more efficient ways.

JUNIORS

YUQIAO ZOU

USING PHOTO CROSSLINKING ARGININE MIMIC TO CHARACTERIZE THE EFFECTS OF HISTONE LYSINE METHYLATION

MENTOR:

DR. MINKUI LUO
MEMORIAL SLOAN KETTERING CANCER CENTER

Proteins consist of a chain of different amino acids. After a protein is synthesized during translation, its structure and function can be further modified through post-translational modifications (PTMs), in which chemical groups are added or removed from amino acid side chains. PTMs are especially important in histone proteins, proteins that DNA wraps around, as histone PTMs can regulate gene expression. An important type of PTM is histone lysine methylation, which is the addition of methyl groups to the amino group of a lysine sidechain. Abnormalities in histone H3 lysine methylation can lead to the emergence of cancer. Although they are important, interactions caused by histone PTMs are often weak and transient, making it difficult to identify their binding partners and fully characterize the effect of these modifications. One way to overcome said difficulties is through the use of photo crosslinking unnatural amino acids (UAAs), which are engineered amino acids that can form covalent bonds with nearby molecules upon exposure to ultraviolet light. Photo crosslinking UAAs can be incorporated to a peptide probe, a shortened mimic of the full length protein, at a location near the modified residue (specific amino acid site) of interest so it can capture and thereby help us identify the binding partner through covalent bonding. By identifying previously unknown binding partners of post-translationally modified histone proteins, future studies can focus on characterizing their functions and mechanisms to further our understanding of epigenetic gene expression. In my project, I will synthesize histone H3 peptide probes (shortened mimic of histone H3 protein) containing a crosslinking mimic of arginine amino acids to study the effects of histone lysine methylation. I plan on using these probes to characterize the binding partners of methylated lysine residues at H3K4, H3K9, H3K14, and H3K18 residues on histone 3 proteins.

Cystic fibrosis (CF) is one of the most prevalent autosomal recessive diseases among Caucasians. The most common mutation that leads to CF is known as the ΔF508 mutation, and it impacts the cystic fibrosis transmembrane conductance regulator (CFTR) protein's shape and thus its ability to transport chloride ions to the outside of the cell. Chloride ions are responsible for drawing in water molecules to the body's mucus to ensure that it serves as a thin and mobile lubricant. The dysfunctional CFTR protein channels result in thick, sticky mucus which often causes problems in organs such as the pancreas, lungs, and intestines. One way CF can be treated is through the use of CFTR modulators: correctors and potentiators. Correctors help the CFTR protein form the correct shape, so it can traffic to the cell membrane. Once at the cell membrane, potentiators help hold the gate of the CFTR protein open to maximize the flow of chloride ions through the channel. While the use of CFTR modulators has been an effective treatment in older children and adults, it has not yet been approved for children under the age of two. I am hoping to study the effects of using a CFTR modulator with CF-positive fetuses in an animal model. If a fetus has been prenatally diagnosed, this could be a more effective treatment than beginning a CFTR modulator as a toddler. This is because, instead of attempting to manage an already present build-up of mucus, we would be attempting to avoid the build-up before it is at hand. This would likely avoid a bowel obstruction known as meconium ileus, which is often seen at birth in CF patients, and if the patient continues taking the CFTR modulator after birth, this could potentially avoid or delay issues that are seen at later ages in organs such as the lungs. If successful, this type of research, although not a cure, could help to resolve typical CF outcomes before they arise.

MORGAN AMOILS

Investigating the physiological outcomes of the ΔF508 mutation of CF after the implementation of a CFTR modulator *in utero*

Sophomores

SARA BERZINJI

Oyster restoration and the ecosystem services provided by oysters

Mentor:
Dr. Gulnihal Ozbay
Delaware State University

Oysters have a profound impact on their ecosystems. Oyster reefs provide many benefits to their environment and can provide habitats for other species, protect shorelines, filter water, and more. Unfortunately, due to climate change and overharvesting, the oyster population has suffered greatly. With the dwindling population of oysters come poorer water quality, poorer diversity of fishes and crustaceans (sea creatures like crabs, shrimps, ect.), and eutrophication. Eutrophication is a process which occurs when too many nutrients and heavy metals enter a body of water; it can lead to dead zones and severe algae growth, which limits other species from accessing sunlight and dissolved oxygen. Scientists have attempted to restore oyster populations by creating artificial reefs. However, one thing that is frequently not taken into consideration when creating artificial oyster reefs is oyster recruitment. This is the natural process in which oyster spat attach to hard substrate, which helps create long-term success in artificial reefs. I am currently studying the ecosystem services provided by oysters and oyster restoration alongside my mentor. I hope to eventually be able to set up Taylor Floats (floats used commonly to collect data on oyster restoration) and conduct a restoration attempt of my own, using the data to better understand oyster restoration, recruitment rates of oysters in different environments, and the ecosystem services they provide.

ANDREW CHEN

Disparities in student achievement and the impact of the COVID-19 pandemic on students in online learning

Mentor:
Dr. Erik Ruzek
University of Virginia and NWEA

Educational equity is the measure of achievement, fairness, and opportunity in education. The transition from in-person to online learning caused by the COVID-19 pandemic largely increased the number of student absences in school and decreased face-to-face interactions between students and teachers, thus negatively impacting student academic performance. The impact of the pandemic on student achievement depends on many factors including inequality in access to technology, the nature of courses students are enrolled in, and, most importantly, racial and socioeconomic disparities in the education system. Studies have predicted that disadvantaged students and students of color are more vulnerable than others to experience disruptions in education brought on by the pandemic. Overall, student learning gains (improvement in a student's learning from the beginning to end of a course) in reading and math are predicted to have been much lower in the 2019-2020 school year compared to past school years. Future research in this field should focus on ways in which the pandemic affected student education, the factors influencing the Hispanic-white and Black-white academic achievement gaps (referring to disparities in academic performance among subgroups of students), and how student characteristics such as race, socioeconomic status, school district, grade level, etc. impact educational equity. I hope to conduct a research project on how school-level factors (e.g., school district characteristics and demographics) can help explain disparities in student achievement and how the pandemic has affected such disparities.

Sophomores

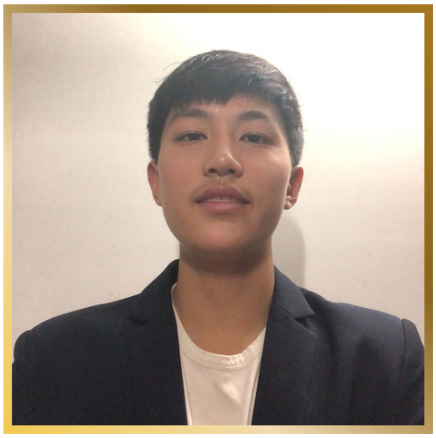
LUCAS LIBSHUTZ

Exploring the surface chemical composition of Titan

Mentor:
Dr. Paul Corlies
Massachusetts Institute of Technology

Titan, a moon of Saturn, is often considered to be one of few potentially habitable locations within the solar system due to its unique chemical makeup, and the fact that it is the only other body besides Earth that contains liquid on its surface. Although Titan's surface has been comprehensively mapped and photographed, the majority of its chemical composition is still unknown. By further understanding the compositions of certain key regions on the surface such as craters and lakeshores, researchers can then possibly discover more about what lies below the surface. For instance, past research has studied regions of argon-40 scattered around the surface and found a conversion mechanism that transforms potassium to argon subterraneously. Identifying and mapping out the presence of other compounds can help us learn more about Titan's geology and geological processes. I plan to focus my research in this area, possibly looking for novel compounds and their relation to the surface, such as why certain compounds are distributed in certain ways. My mentor and I plan to look for compositional similarities across the surface to deepen our understanding of Titan's geology.

Methylation is the addition of a methyl group (a stable hydrocarbon molecule) to a DNA base or protein, which results in the regulation or expression of a particular gene. Methylation sites are often occupied by methyl-binding proteins such as MeCP2, and often aid in methylation processes for gene silencing. Mutations in methylation and methyl-binding proteins are known to cause genetic diseases such as cancer and Rett Syndrome. However, the ambiguous relationships of methylation and methyl-binding proteins and long-term gene repression leave many questions to be answered. Studying the relationships between methylation processes and chromatin structure (either “closed” or “open” structure, turning the genes on or off) can help us better understand gene expression. Insights about gene repression, gene stability, and transcriptional activity can bolster our understanding of the important epigenetic processes. With the help of my mentor, I will use different analytical methods, mainly optical tweezers, to study relationships between methylation and methyl-binding proteins. Optical tweezers rely on the momentum of light to act as a force trap, by using a highly focused laser to move or levitate microscopic objects. In this way, optical tweezers can be used to analyze DNA by isolating or combining objects of interest to be analyzed. The relationships between chromatin structure and DNA could be observed with these microscopes.



JOSHUA LUO

Effects of methylation and methyl-binding proteins on chromatin structure and long-term gene repression

Mentor:
Gabriella Chua
The Rockefeller University

Sophomores

ARJUN SHARMA

Using machine learning to analyze social determinants of health in order to improve population health outcomes

Mentor:
Dr. Sanjay Basu
Harvard Medical School

Healthcare is one of the most important sectors of the US economy. Any increase in efficiency will not only be beneficial to people’s well-being but could also free up resources that could potentially be allocated towards other uses. It was found that the overwhelming majority of factors affecting population health are accounted for by social determinants of health (SDoH). Examples of SDoH include crime rates, infrastructure quality, high school graduation rates, and even levels of civic participation. Given the abundance of data, researchers are increasingly utilizing machine learning algorithms to analyze SDoH factors. I am currently working under the guidance of my mentor on a project applying machine learning techniques on an open source dataset. The primary goals of the project are to figure out and describe how much primary care provider (PCP) density has changed over time among urban and rural counties across the US, determine whether rural counties are more sensitive to changes in PCP density, and use machine learning to predict whether the infusion of PCPs will improve life expectancy in rural counties. The insights gained from the study could be used to inform public policy under the Biden administration, showing how to strategically deploy PCPs in a way that optimizes overall population health.

MAYA SMITH

Cytokines represented in Tay-Sachs disease patients post AXO-AAV-GM2 injection

Mentor:
Dr. Terence R. Flotte
University of
Massachusetts Medical School

Tay-Sachs disease (TSD) is a rare, neurodegenerative genetic disease. The symptoms of TSD are caused by the Hexosaminidase-A (Hex-A) enzyme's inability to break down a fat in the brain called GM2-Ganglioside. This fat builds up and interrupts the body's normal biological processes, such as being able to control voluntary muscle movements and automatic processes like digestion and respiration. My mentor has begun phase one of a two-stage clinical trial for a potential TSD treatment. He is using an investigational gene therapy called AXO-AAV-GM2 in hopes to be able to restore the function of the Hex-A enzyme. To be able to accomplish this, the therapy introduces a working copy of the gene encoding for the Hex-A enzyme. An adeno-associated virus (AAV) was used in the treatment to deliver the vector to the cells in the body. AAVs are small, single stranded DNA-viruses that integrate themselves into cells of mammals at a low level. In my project, I will be analyzing the data from the clinical trial, specifically looking at cytokines, which are cell-signaling molecules that help with cell to cell communication in immune responses. They also help to stimulate the movement of cells towards sites of inflammation, infection, and trauma. For example, by allowing cells to communicate with each other, when inflammation is evoked, white blood cells can move to the targeted area as fast as possible to fight off the infection. Since cytokines send immune responses to other organs and cells in the body, by analyzing this data, it can be determined how the body reacts to the AXO-AAV-GM2 therapy and whether it will recognize the AAV as a foreign substance.

Sophomores

ANNIKA SPAET

Water retention of green roofs with edible vegetation

Mentor:
Dr. Tyler Carson
Arcadis Engineering

Urbanization has increased at a rapid rate which has caused weather and climate systems to deteriorate. The effects of climate change can be mitigated by implementing green infrastructure methods such as green roofs (GRs). GRs are roofs that are partly or fully covered with vegetation that can help reduce stormwater runoff, energy use, and air pollution. GRs are increasingly implemented into commercial and residential structures to reduce stormwater runoff. Although GR water retention is well-studied, more work needs to be done to test the effectiveness of edible plants in GRs at retaining water. More specifically, there has been little research on the ability of edible plants to retain water in the humid continental climate, which is the climate that makes up much of upstate New York. It is still unclear whether certain species of crops are suitable for the severe conditions on GRs. The conditions of GRs are harsh due to stronger winds, higher solar radiation, and shallow growing substrate. Furthermore, it is critical to choose the right crops for GRs to maximize the stormwater retention and agricultural possibilities for edible vegetation. I plan to build a GR in upstate New York using plants that are edible, shallow-rooted, and acclimated to the humid continental climate. I want to observe the amount of water retained by the GR with edible vegetation compared to a roof with no vegetation. Hopefully, this research will be beneficial to close the research gap for edible vegetation in the humid continental climate.

Loneliness is a universal phenomenon that affects one-third of the population among industrialized countries, with a high prevalence in adolescents and older adults. Loneliness is defined as the subjective discrepancy between an individual's existing and desired social relationships. Loneliness has been found to be associated with multiple adverse mental health outcomes such as depression, anxiety disorders, suicide ideation and behavior, and cognitive decline. Thus, it is crucial to prevent and mitigate loneliness. To do so, we first need to better understand the protective factors for loneliness, which are characteristics that reduce the impact of loneliness—that is, they are associated with a lower likelihood of negative outcomes. Finding protective factors for loneliness can help us understand which kind of intervention would be the most effective, as we would know the characteristics that the intervention would need to focus on. I am currently working with my mentor to explore the possible protective factors for loneliness. Optimism, happiness, belongingness, hope, social network size, and online social network size are several protective factors that I plan to investigate in my study. Participants will be given an online survey to test their loneliness level and standardized scales for each protective factor. I will then look for possible correlations between levels of loneliness and different protective factors.

STEPHANIE WANG

Examining potential protective factors for loneliness

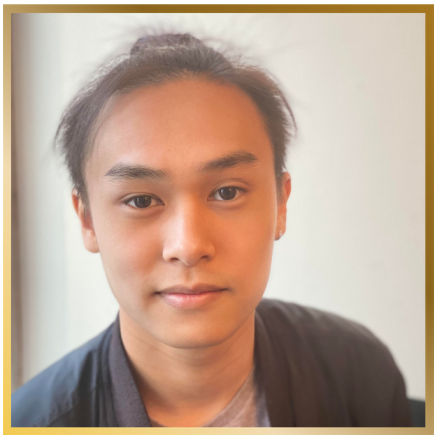
Mentor:
Dr. Antonia Ypsilanti
Sheffield Hallam University

Sophomores

KALEB WONG

Using forensic entomology to improve the estimation of the postmortem interval

Mentor:
Dr. Baneshwar Singh
Virginia Commonwealth University of Richmond



I am currently studying forensic entomology, the study of arthropods (or insects) and forensic microbiology, the study of microorganisms, as they apply to forensic science. Both microbiology and entomology can help determine the postmortem interval, the amount of time that a corpse has been dead for. The use of fly larvae and their life stages in forensics is not new but it could be better understood, and microbiology is just starting to be considered as court case evidence. These studies can tell us the time when a victim was killed. In certain cases it can even help us narrow down the suspect based on the time of the murder. In the future I hope to study the relationships between entomology and microbiology, like the interkingdom species communications, which is the symbiotic relationship between microorganisms and the blow flies. By starting with studying the life stages of the larvae, I can begin to associate different species of microorganisms with the life stages of the larvae, furthering our understanding about the postmortem interval. With the information that I gather through my research, I hope to create better and more cost effective methods of gathering evidence and data, for labs that have a harder time gaining access to more expensive equipment.

A NOTE OF THANKS

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