

HARRISON SCIENCE RESEARCH PRESENTS:



The 18<sup>th</sup> Annual

# HARRISON HIGH SCHOOL SCIENCE AND TECHNOLOGY SYMPOSIUM

Monday, June 1, 2020 7:00 PM A Virtual Celebration!

Scientific presentations of original research, engineering, and design projects by Harrison High School Students



## Order of Events: Virtual Celebration

## Watch our entire Symposium on <u>this YouTube playlist</u> or follow the links below for each specific component.

### Welcoming Remarks, Program Highlights, & Introduction:

Kimberly Beukema, HHS Principal Joan O'Keeffe, Ed.D., Director of Science & Technology Allison Blunt, Science Research Teacher Randy Gunnell, Science Research Teacher

### Senior Reflection Videos

These are two-minute videos from each of our seniors as they talk about what science research has meant to them.

### **Montage**

A collection of photos of our students during the research process, at science fairs, and in the classroom.

## **Closing Remarks**

Final thoughts from our teachers and brief instructions on how to navigate the remainder of the symposium booklet.

## In the following pages of our Symposium Booklet you will find:

Senior Research Bio Pages, Abstracts, and Mini-Posters

Junior Abstracts

Sophomore Abstracts

\*\*The title of each student's project is a link to their research poster\*\* \*\*Seniors' names link to video recordings of their final presentations\*\*

## Overview of the Program

The Harrison Science Research program invites all students to participate in authentic and original scientific research. It is designed to provide participants with an understanding of research methodologies in the natural and social sciences, with an emphasis on both laboratory and bibliographic research. We encourage students to work with research scientists and professionals within their chosen area of interest so that they may develop a commitment to long-term focused research. Students may conduct independent research in mathematics, life science, physical science, psychology, or the social sciences and are required to use technology to organize research (presentation software and data management systems). Students maintain a portfolio of their work, which provides the basis for assessment. All students prepare to enter local, regional, national, and international scientific competitions. Students involved in the program demonstrate initiative, perseverance, and creativity, in an atmosphere where independent work habits are developed and fostered.

## Acknowledgements

Our program could not sustain itself without the overwhelming support received. We owe a special thanks to the following:

#### **Board of Education**

Kelly Mulvoy Mangan, *President* Lindy Wolverton, *Vice-President & Budget Liaison* Dennis DiLorenzo, *Trustee* Noreen Lucey, *Trustee* 

#### **Central Administration:**

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#### **Building Administration:**

Kimberly Beukema, *Principal* Laurie Griffo, *Assistant Principal*  Lawrence Mastrota, Assistant Principal

### Science Research Teachers

Allison Blunt

Randy Gunnell

#### Internal Review Board Members

Dr. Christopher Tyler, Ph.D. Dr. Lara Singer, Psy.D Dr. Brian Ladewig, Ed.D. Dr. Joan O'Keeffe, Ed.D. Dr. Amabell Abbott, Psy.D. Ms. Kim Beukema

## Abstracts of Tonight's Presentations

The following are abstracts of tonight's presentations. They are arranged by each student's class year, beginning with graduating seniors.

Kelly Kozak, *Trustee* Placido Dino Puccio, *Trustee* Robert C. Sullivan, Jr., *Trustee* Barbara Teevan, *District Clerk* 

## Felipe Adelmann Brants

#### Analysis of the Relationship between the Effect of different Stresses in *C. elegans* Animals and its <u>Progeny's Likelihood to Undergo Dauer Formation</u>



Location of Research: Life Science Complex at Syracuse University

> Mentor: Sarah Hall

Intended Major: Biological Engineering, Genetics

> Fairs & Awards: JSHS 2020 WESEF 2019 Westlake 2018

The goal of this research was to observe how the application of different stressors to C. elegans could result in different likelihoods of the progeny undergoing dauer formation, and postulate possible explanations for these behaviors. An experiment was devised where C. elegans were placed on small Petri dishes with different stress conditions and later removed from such conditions to reproduce, only to repeat the process for the following generation to count the number of individuals that underwent dauer formation. This procedure was repeated using pheromones and starvation as the stressors, on both N2 and HRDE-1 strains. The results indicated a significant difference in the number of dauer offspring between stress and control groups, and two different trends on the number of dauer offspring between the stressors. An ANOVA Oneway t-test was performed for comparing the various groups, with (p=0.005) between the pheromone trials applied to  $P_0$  and  $F_1$ , (p=0.0001) between the pheromone trials applied only to  $F_1$ , (p=0.02) between starvation trials applied to  $P_0$  and  $F_1$ , and (p= 0.05) between starvation trials applied to only  $F_1$ . When analyzing the pheromone trials, the progeny had a smaller likelihood to become dauer when the first generation was exposed to the stress, while when analyzing the starvation trials, the progeny had a higher likelihood to become dauer animals when the first generation was exposed to stress. This trend leads to the postulation that the different stressors trigger different mechanisms within the C. elegans.

### The Relationship between Different Stresses in C. elegans and its Progeny's Likelihood to Undergo Dauer Formation

#### Introduction

- Epigenetics studies how the environment impacts gene activity through transcriptional factors.
- Understanding gene activity is necessary for gaining better understanding of diseases such as cancer.
- It has been found that transcriptional factors can remain in gametes and be passed down to progeny.
- It has been concluded that epigenetics can impact mammals, possibly allowing for connections to human health.
- **Problem:** Few studies have attempted to explain the patterns for transgenerational epigenetics.
- **Goal:** Find relationship between stressing  $P_0$  and the appearance of the stress phenotype in  $F_1$  and suggest pathways responsible.
- **Hypothesis:** 1. A positive relationship between stressing P<sub>0</sub> and the chance of F<sub>1</sub> having the stress phenotype is found across multiple stresses 2.HRDE-1 pathway is involved in stress phenotype inheritance.

### Methodology



### **Results & Analysis**



### Conclusion & Future Research

#### **Comparing stressors:**

**-Pheromone:** Stressing parental generation  $\rightarrow$  less Dauer formation in F<sub>1</sub>.

-Starvation: Stressing the parental generation  $\rightarrow$  more Dauer formation in F<sub>1</sub>

-Difference in trend between stresses suggests a difference in mechanism of activation.

#### **Comparing strains:**

-N2: Stressing both generations  $\rightarrow$  less Dauer formation in F<sub>1</sub>. -HRDE-1: Stressing both generations  $\rightarrow$  more Dauer formation in F<sub>1</sub>.

-Differences between the strain's reaction to stress suggests WAGO-9 involvement in the passing of stress phenotypes.

#### **Future Research:**

-Test other stresses such as temperature fluctuations, soil pH.

-Analyze methylation assay patterns

-Determine cause of excess Dauer in starvation assay to compare against N2 results.

- -Test starvation for HRDE-1.
- -Test for other Argonautes to develop the epigenetic pathway.

## Haley Amann

### Comparing the Effectiveness of Multiple Self Report Measures in Predicting Non-Suicidal Self Injury



Location of Research: Brown University

> Mentor: Dr. Richard Liu

Intended Major: Engineering

Fairs & Awards: JSHS 2020 WESEF 2019 - Mu Alpha Theta Award Tri County 2019 Westlake 2018 - 3rd Place in Behavioral Sciences

Suicide rates of adolescents have drastically increased throughout the past decade. It is crucial that risk factors are determined in order to prevent future suicides and decrease suicide rates. Non-suicidal self injury has been suggested to be one of the most prevalent risk factors and strongest predictors of suicide. The purpose of this experiment was to better understand risk factors which lead to non-suicidal self injury. The TAILS study used self-assessments and interviews to test the significance of multiple self-report measures in predicting suicide and other suicidal behaviors, including self-inflicted injury without the intent of suicide (non-suicidal self injury). Data from TAILS was used for a series of mediation analyses testing the significance of the Emotion Dysregulation (DERS), Suicidal Ideation (SIQ Jr), and Impulsivity (UPPS) Scales to predict non-suicidal self injury; a parallel mediation was then used to compare the significance of the scales to identify the strongest predictor for NSSI. Suicidal ideation is suicidal thoughts and behaviors and emotion dysregulation in one's lack of ability to control their feelings and reactions to stressful situations. It was hypothesized that the DERS would not be significant in predicting NSSI and the SIQ Jr and UPPS would, therefore, making suicidal ideation and impulsivity more effective in predicting NSSI. Secondly, it was hypothesized that impulsivity would be more significant than suicidal ideation. The results partially supported the hypothesis as they illustrated that the SIQ Jr was significant and was a stronger predictor than the DERS and UPPS. However, the results also demonstrated the DERS was significant, but not as strong as the SIQ Jr. These results acted as a potential model for predicting suicide; if doctors were to use the SIQ Jr, they would have a dependable source for predicting NSSI which could ultimately predict suicide.

### Comparing the Effectiveness of Multiple Self Report Measures to Predict Non-Suicidal Self Injury Haley Amann

#### Introduction

- Suicide is one of the leading causes of death in adolescents
- Non-suicidal self injury has been suggested to be one of the strongest risk factors for suicide
- Discovering the causes of inflicting self injury upon oneself is crucial in preventing future suicides
- There is a lack of research for identifying risk factors for NSSI
- Previous research does not test which measure (DERS or SIQ Jr) is a stronger predictor for NSSI



### Results & Analysis

- All scales significant in predicting NSSI (Figure 7,8,9)
- IQ Jr was the strongest predictor (Figure 11)
- The SIQ Jr and UPPS are full mediators for baseline depression and NSSI at 6 months (Figure 7,9)
- The DERS is a partial mediator for baseline depression and NSSI at 6 months (Figure 8)
- The SIQ Jr was suggested to be a stronger predictor of NSSI than the DERS (Figure 10)
- The SIQ Jr was suggested to be a stronger predictor of NSSI than the UPPS (Figure 11)

### Methodology

#### **Patients Studied**

190 patients were included in the analyses. All participants were part of the TAILS study. Patients ages 14 to 16.

#### A series of mediation analyses to determine significance:



#### Conclusion & Future Research

- The Emotion Dysregulation, Impulsivity, and Suicidal Ideation Scales were suggested to be significant in predicting NSSI
- When the scales were compared, the SIQ Jr was suggested to the most effective predictor
- Since all of the scales can suggest NSSI, they can also suggest a potential suicide attempt
- Since the SIQ Jr is a most significant predictor, it may be favorable to identify suicidal ideation over emotion dysregulation/impulsivity when attempting to predict potential acts of NSSI or suicide
- Discover alternative methods of predicting NSSI
- Use methodology to determine significance of other scales
- Identify triggers for depressed patients
- Identify the strongest mediator for depression to NSSI, if it is not suicidal ideation
- Determine the mediator(s) for self-injurers to attempt suicide

## Josh Cooper

Impact of the shock absorption properties of basketball shoe cushioning systems on the likelihood of lower extremity overuse injuries



Location of Research: Home

Mentor: Dr. Howard Hillstrom

Intended Major: Undecided

Fairs: NYSSEF 2020 Tri-County 2019 WESEF 2019 Westlake 2018

Performance basketball shoe cushioning systems are designed to balance two key characteristics: shock absorption and energy return. A greater amount of shock absorption is intended for injury prevention while increased energy return allows for better performance. The purpose of this study was to determine the relationship between shock absorption properties of basketball shoe cushions and the likelihood of lower extremity overuse injuries. The methodology included two phases. In Phase One, the shock absorption capabilities of four basketball shoe cushioning systems were tested in a "Drop Test." A metal weight was dropped onto an apparatus which put force onto the heel of deconstructed cushions, which rested on a force plate. The force plate measured the intensity of the force that passed through the cushion, which established the relative shock absorption capabilities of the cushioning systems. The results of the test demonstrated, with statistical significance, that the shock absorption capability of the Nike Zoom Shift cushioning system is inferior to that of the AND1 Tai Chi, AND1 Attack and Nike Lebron 16. The second phase of the study determined the force applied to the foot using advanced insole technology during jump landings for participants wearing each of the four basketball shoes. It was demonstrated, with statistical significance, that there was more force on the foot in the Zoom Shift and the AND1 Attack cushioning systems compared to the Lebron, which implies better protection for the athlete wearing the Lebrons. Since increased force on the foot over time is a key driver of overuse injuries, the results from the two phases in the study were compared to demonstrate that the greater shock absorption capabilities of the Lebron cushioning system leads to less force on the foot, and therefore, a lower likelihood of overuse injuries.

## Impact of the Shock Absorption Properties of Basketball Shoe Cushioning Systems on the Likelihood of Lower Extremity Overuse



## Nellie Fisher

Creating a Wearable Device to Help Parkinson's Patients Maintain an Upright Seated Position



The purpose of this study was to create a device to be able to measure the acceleration of a person as they fall over in their chair to be able to find a threshold for the speed at which people fall over in their chair. This was all done to ultimately create a device to help people with Parkinson's Disease be able to maintain an upright seated position in a chair to reduce harm. In order to be able to create the device, an arduino board and an IMU sensor were interfaced and mounted to a vest to be worn by participants. Participants were shown a demonstration of a "model fall" and were then asked to fall five times to the left and five times to the right. The main variable tested was the persons acceleration when they began to fall in their chair. From this data, through analyzing graphs and finding the averages of the trial for each individual participant it was found that for the left side the threshold was -0.2709ms-2 to -0.0777ms-2 and for the right side was -0.2152ms-2 to -0.1110ms-2. This threshold means that in building a device for people to wear, the device would need to be able to recognize this threshold.

## Creating a Wearable Device to Help Parkinson's Patients Maintain an Upright Seated Position

## Introduction

- 10 million people affected by Parkinson's worldwide (Parkinson's News Today, 2020)
- No cure for Parkinson's Disease
  - Need for creating devices to make everyday life easier
- · Many side effects from Parkinson's
  - Tremor
  - Stiffness
  - Impaired balance/ falling
  - Inability to maintain an upright seated position
- Inability to sit up properly causes trouble communicating, eating, and danger when left without supervision

### **Engineering Goal**

Create a device that can help Parkinson's patients maintain an upright seated position.

#### Purpose

Determine acceleration threshold using an IMU sensor and Arduino during a fall from a seated position.

#### Overview

#### Sensor

MakerFocus MPU-6050 GY-521 Module IMU sensor

#### Measures orientation, velocity, and gravitational forces through use of accelerometers and gyroscopes

- Belt
  Used to hold the IMU sensor steady
- Help eliminate non-fall movement

Figure 3

#### Arduino

Arduino UNO
 Transfers information from IMU
 sensor to the computer

Inflatable Bag

- SolidWorks generated model
   Curved side to provide support to the waist and mold to wearers body
- Finger like structure with multiple fingers going around the waist
- Hollow with no sides for visual purposes

#### Air Compressor

- Refillable small air compressors
   Lightweight
- Will be attached to inflatable bag to fill and push person back upright

## **Results & Analysis**



- All the averages for each person to both side
  - All the falls were over different time frames
    - Falls are not all starting at the same time
    - Some people's falls are longer or shorter
- Circles represent first jerk (change in acceleration)

#### Next Steps

- Code a program to be detect when the person is falling over (using the determined threshold) and then be able to open the air compressor nozzle to allow air to fill up the bags
- Program the Arduino to communicate with the air compressor and test the threshold



## Conclusion

- Device satisfies goals
  - Found the threshold at which people accelerate as they fall over in a chair
- Promote safety and allow for normal life functions
- Need for a device like this to be created since falling over in a chair can be a real threat to safety
- Can be implemented into the lives of those with other disorders that have similar side effects

#### Discussion

- The threshold can be used to program the eventual suit to be able to inflate upon sensing an acceleration within the threshold
- Healthy participants = 80% accuracy rate for people with Parkinson's (Harari and Mummidisetty, 2019)

## Julian Glover

### Optimization of Pole Selection Based on an Energy Analysis in the Pole Vault



Location of Research: Harrison High School

> Mentor: Kate Zanot

Intended Major: Electrical Engineering

> Fairs & Awards: WESEF 2018 JSHS 2020

To assess the energy of a pole vault system, the spring constant of a required pole must first be determined. Before analyzing the experiment, it must first be understood that poles act as springs during a vault, due to compression, and therefore contain elastic energy. An experiment was conducted to determine to determine the spring constant of three different poles to be tested in a system. In the pole vault event, the weight rating, flex rating, and length of a pole can be varied to affect the system, and among the three poles tested, these three values were not the same for all three. This assured that the spring constant would vary. Each pole was compressed to a different displacement, and the force required to complete this act was recorded to correspond with the given displacement. Since poles act as a spring in a system, they hold elastic energy. After determining the spring constant of each pole, the value was used to assess the energy released by a pole given a displacement. This value will serve to further analyze the effect of velocity on the system.

### **Optimization of Pole Selection Based on an Energy Analysis in the Pole Vault Event**

#### Introduction

Pole vault is a Track and Field event where a vaulter attempts to convert the horizontal momentum of a sprinting approach into vertical momentum, in an attempt to reach a height that is greater than that of a placed bar (see image below). Many factors influence a vault:

- 1. Pole length
- 2. Pole weight rating
- 3. Pole flex rating
- 4. Vaulter speed
- 5. Vaulter height
- 6. Vaulter Weight

I wish to see how the factors of a pole itself influence a pole vault system



#### Step 1 Step 2 Step 3 Step 4 Poles choser Poles bend to Graphed, used Spring constant based on different the graph data to used to find the specific displacements find spring trend in energy differences and Force taken at constant release for each similarities each pole, compared displacement to force applied Greater weight rating $\rightarrow$ Greater release of energy pushing vaulter upward Greater length $\rightarrow$ Greater release of energy pushing vaulter upward $F = -k \cdot x$ Figure 11

Methodology

## Conclusion & Future Research

Image of

experiment

Using this spring constant value, energy can be calculated. The equation for both potential and kinetic energy for a spring is:  $U = \frac{1}{2}kx$ This equation can be rewritten to correlate force and energy, by simply setting x-(F/k): E-(1/2)k(F/k)/2 Pole 1 Figure 2 - Of an all Force (Newtons) Pole 2 Figure S Force (Newtond) Pole 1 Figure 10 Pole 2 Force (Newtons) Pole 3

**Results & Analysis** 

- Greater Weight rating correlated with an increase in energy release per unit displacement

   a. Likely due to an increase in the pole's rigid features.
- Longer pole had an inverse relationship in energy release

   a. Likely due to the increase surface area of the pole which allows for greater release of other forms of energy, as well as a reduce in the rigidness of the pole
- 3. Displacement increased, it reached a point of exponential increase per unit force applied

a. Implying there is a gradual increase in energy release onto vaulter initially, put past a certain point there is a sudden decrease, causing a possible pole shatter

Future research will include:

- 1. Finding the correlation between a runner's velocity and applied force
- 2. Relation between velocity and energy.
- Analyzing the change in angular momentum in a pole vault system could also prove vital to maximize pole bend

   The height of a vaulter can affect the initial angular momentum that is changed during the system.

## Cameron Hackett

### Using a Vacuum Chamber to Determine the Efficiency of Propellers at High Altitudes



Location of Research: Harrison High School

> Mentor: Randy Gunnell

Intended Major: Economics

Fairs & Awards: Westlake 2018 WESEF 2019 Tri-County 2019

One of the most pressing issues in today's world is manmade pollution clogging up environments and ecosystems across the planet. Many of this waste comes in the form of plastic, toxic chemical leakage, and, most often, gas output from the countless reaction-reliant machines we use today. These gases, known as greenhouse gases, sit in the upper atmosphere and create a greenhouse effect, trapping heat and contributing to climate change. One such greenhouse gas is Carbon Dioxide, created when carbon from combustible fuel mixes with the atmosphere and bonds with oxygen. Millions of tons of Carbon Dioxide are created every day by factories and vehicles, specifically aircraft. Jet fuel is highly reactive and burns at an extremely high rate, causing significantly more gas output than other vehicles. Although we have not yet achieved the technology and infrastructure necessary to switch the aviation industry to all electric power plants, there are ways to improve the efficiency of aircraft engines and decrease gas output. One such way to do this is by improving the efficiency of aircraft propellers and turbines, forcing more air through them using the least fuel possible. One factor which is often not taken into account when developing such technologies is altitude. As an aircraft flies higher, the air around it behaves differently, and I aim to find out at which altitudes do certain propellers operate more efficiently. Since most aircraft spend much of their flight time at high altitudes, determining this may help decrease Carbon Dioxide Emissions from this form of transport we rely on so much.

## The Effect of Air Pressure on Aircraft Turbine Efficiency

#### Introduction

- One of the most pressing issues in today's world is manmade pollution clogging up environments and ecosystems across the planet.
- Greenhouse gases sit in the upper atmosphere and create a greenhouse effect, trapping heat and contributing to climate change.
- We need to find a way to combat this through the use of more efficient technologies
- Specifically in air travel
- Many planes are inefficient at high altitudes due to low air pressure
- We need to find a way to test and design turbines and propellers which would operate more efficiently than standard ones at these pressures



### **Results & Analysis**

- Results show a clear linear decrease in thrust as air pressure decreases
- One anomaly at 20kPa-5kPa
- Thrust actually increased as the pressure decreased
- Highly uncharacteristic and strange



Force Created By a Propeller With Constant Power Input at Varying Air Pressures

### Methodology

- Propeller driven by DC Motor running at 8V
- Placed on a force sensor
- Inside a vacuum chamber
- Air pressures varied from 100kPa to 5kPa
- Force measurements taken at each pressure



### Conclusion & Future Research

- My hypothesis was partially supported by this study
  - The graph was most linear, until 20kPa of pressure
  - At this point, the propeller was producing about 0.01N less thrust than it was at 5kPa
  - These two datapoints contradict my hypothesis
- Although I did not achieve full support of my hypothesis, this leaves an area for much future research
- I hope to continue this project in the future, as it is important for the aerospace industry to burn as little fuel as possible
  - Not only to sustain the Earth, but to sustain the industry itself

## Julia Kindler

The Effect of Smartphone Usage on Concentration Levels and Academic Performance



Location of Research: Harrison High School

> Mentor: N/A

Intended Major: Undecided

Fairs & Awards: JSHS 2020 Upstate NY- 3rd Place in Behavioral Science JSHS 2020- 3rd Place in Behavioral Science WESEF 2019 - American Psychological Association Award

The use of smartphones worldwide is increasing exponentially. In 2011, just 35% of Americans owned a smartphone, compared to 96% in 2019 (Pew Research, 2019). In France, a law was recently passed banning the use of cellphones in schools and it was found that test scores have already climbed by 6%, specifically 14% among low performing students (LSE, 2018). In the U.S., studies have reported negative effects of smartphones on college students but little research pertains to high school students. The question asked was, "How does the presence of and usage of a smartphone impact concentration levels and academic performance in high school students?" Participants answered survey questions to assess perceived smartphone effects, concentration tests were administered with and without their smartphone, and teachers assessed student's smartphone use in class compared to academic performance. The results showed that students universally perceived negative effects from their smartphone (p<.05), concentration levels decreased with the mere presence of a smartphone (approached significance, p=.06), and a higher smartphone usage rating assigned by a teacher correlated with decreased test scores (these results were not significant). These results indicate that concerns about smartphone usage are valid for high school students and further study is appropriate.

## The Effect of Smartphones on Concentration Levels and Academic Performance





### **Hypothesis: Partially Supported**

- Students were aware of possible dangers of smartphone use
- The presence of a smartphone led to a decrease in concentration levels
- Increased smartphone usage was shown to negatively correlate with academic performance
- · The lack of significance can be attributed to the lack of diversity in the population
- Concerns about smartphone usage are valid for high school students and further study is appropriate
- . Comparison of the impact of smartphone use on the distraction/academic performance of various demographic groups
- Study the effect of smartphone usage on academic performance over an extended period of time
- Study the behavioral patterns of children who regularly interact with a smartphone
  - Potential to reveal more about the effects of smartphone on the brain

## Lydia LaBelle

### The Impacts of a Primarily Female Practice on Lessening Gender Discrepancies in Cataract Surgery



Location of Research: Tanzania

Mentor: Dr. Susan MacDonald

> Fairs & Awards: JSHS 2020

Cataracts are a condition that causes more of global blindness and visual impairment than does any other eye condition. Cataracts are primarily caused by age and so are not preventable, however they are treatable through a range of surgeries. The availability of such surgeries varies greatly around the world; developing nations often have fewer surgeries or trained surgeons, resulting in an increase in overall blindness as the cataracts continue to develop in the population. MacDonald (2019) suggested that women receive cataract surgery significantly less often than men, resulting in more female blindness. When they do receive surgery, women are often older than the average male receiving cataract surgery, and their blindness is more severe. While there is much research to demonstrate this discrepancy, there is a lack of information regarding its cause. A survey was distributed in Tanzania to cataract surgical patients asking questions about their at-home support, as well as their time spent with cataracts in hopes of determining possible causes of gender discrepancies. The results found that the difference between men and women in access to surgery was not significant, thus not supporting the hypothesis. However, it is significant that the surgical team who approached these patients was largely female and knowledgeable of gender discrepancies. This indicates that an increased understanding of gender discrepancies, and possible an increased presence of women performing surgery, can lessen the inequalities between men and women in access to surgery.

## Impact of a Primarily Female Practice on Gender Discrepancies in Cataract Surgery

### Introduction



Figure 1: LaBelle, 2018

cataracts cause 51% of global blindness, and 90% of these people are in the developing world

surgery than did men (p>.05).



Cataracts are a

clouding of the

lens in the eye If untreated,

cataracts lead to

- Vision loss can increase gender inequalities
- Male cataract surgical coverage rate is 1.2-1.7 times higher than that for females



**Results & Analysis** Although not significant, more males were operated on than were females (p>.05). rage Age Prior to Surgery of Females Versus Ma when Surgery Performed by Primarily Female Tean Although not significant, females were older than men at the time of surgery were on average (p>.05). Average Visual Acquity Prior to Surgery of Females Versu verage Time with Cataracts Prior to Surgery for Females Ver Males when Surgery Performed by Primarily Female Team Males when Surgery Performed by Primarily Female Tean Although not significant, females had a The male average time spent with lower average visual acuity at the time of cataracts was significantly higher than

that for females (p<.05).

### **Conclusion & Future Research**

- Collect data on the amount of women involved in global ophthalmology practices
- Compare data to other female led programs to determine the impact of a higher prevalence of women on surgical gender discrepancies in other nations
- Implement outreach strategies into other regions to confirm whether it equalizes access to cataract treatment

### Conclusion

- Globally, there are significant gender discrepancies in access to cataract surgery
- A study was performed to determine the effect of female medical personnel in lessening cataract surgical discrepancies
- Increased awareness of such inequalities greatly decreased the presence of discrepancies
- Knowledge of gender discrepancies and a higher presence of female surgeons with a desire to lessen such discrepancies can greatly and effectively decrease inequalities in access to cataract surgery.

## Victoria Lendino

### The Effect of Gender on Anxiety and Competitive Drive



Location of Research: Harrison High School

> Mentor: Mr. Gunnell

Intended Major: Mathematics

Fairs & Awards: STS 2020 - Competitor JSHS 2020 - Selected Speaker NYSSEF 2020 - Competitor WESEF 2019 - Critica Behavioral Science Achievement Award Westlake 2018 - 3rd Place in Behavioral Sciences

In academic competition, specifically mathematics, there are clear differences in the anxiety levels as well as the competitive drive or performance levels of males and females. Understanding the connection between gender, anxiety, and competitive drive can aid the development of a deeper understanding of the competitive dynamic of males and females within academics. This experiment tested differences in anxiety and competitive drive between the sexes by asking high school juniors enrolled in AP calculus BC to take the State-Trait Anxiety Inventory (STAI) to evaluate their level of anxiety before and after completing three problem sets in three different types of competitive scenarios: by themselves, in same sex competition, and in coed competition. Additionally, the experiment aimed to determine if there was a link between gender, anxiety level, and performance level, which indicated competitive drive, by comparing the individual results of each participant throughout the rounds, and cross comparing these performance levels to their self reported anxiety levels throughout the rounds. It was determined that females experienced a significantly higher level of anxiety than males in individual competition, homogeneous competition, and coed competition. Additionally, females performed significantly worse in coed rounds of competition compared to same sex competition. In academic competition for males, males' performance was significantly better in the same sex round compared to the individual round. Furthermore, males performed significantly better in the coed competition round compared to individual competition. Understanding the differences in the anxiety and performance levels between the sexes in various types of competitive academic environments could help explain differences in the male to female ratio in many STEM professions or classes.

## The Effect of Gender on Anxiety and Competitive Drive

Introduction	Gap in Knowledge	Hypothesis
As competitive event becomes closer, somatic and cognitive anxiety increase (Martens et al, 1990) Females= significantly more anxious than males before & during athletic competition (Hussain, F., Zaman, A., & Idris, M., 2014) Females' performance Genezy, U., & Rustichini, 2004) Significantly more males in A level math courses compared to females (Mendick, H., 2006)	No known research into relationship between gender, anxiety, performance level, and competitive drive	Girls will experience higher levels of anxiety and decreased performance levels compared to boys while performing in individual, coed, and same sex academic competition
Recruitment of Participants	Methodology	





### Conclusion

- Hypothesis supported
- Reveals differing effects of competition on anxiety levels of males and females
- Create discussion about existing social stigma of girls in competition
- Explain differences in competitive positions

### Future Research

- Investigate the causes of competitive anxiety
- Create math model for competitive anxiety
- Relationship btw







## Sara McSweeney

Increasing the Desiccation Tolerance of *Eragrostis tef* Through Exogenous Application of Abscisic Acid to Ensure Food Security for the Future



Location of Research: Harrison High School University of Cape Town, South Africa

> Mentor: Dr. Cassandra Naidoo Prof. Jill Farrant

Intended Major: Environmental Biology

#### Fairs & Awards:

Science Talent Search Scholar 2020 NYSSEF 2020 - High Honors in Plant Science NY JSHS 2020 - 3rd Place in Biochemistry WES/ROC JSHS 2020 - 2nd Place in Biological Sciences Tri-County 2019 - 3rd Place in Environmental WESEF 2019 - 3rd Place in Plant Sciences Westlake 2018 - 1st Place in Plant Science

With the world population expected to reach ten billion by 2050 and the large loss of agricultural land due to climate change, food security is one of the largest issues for governments and farmers today. Eragrostis tef is a gluten-free, highly nutritious staple crop for Ethiopia that has the potential to ensure food security. It is drought tolerant, but only partially desiccation tolerant, meaning that it will still die if it loses much of its water. Abscisic acid (ABA), a plant hormone, has been known to confer desiccation tolerance when applied exogenously to seeds. The purpose of this study was to increase the desiccation tolerance of *E. tef* through exogenous application of ABA so that more countries can use it as a food source. This experiment was conducted in two stages: an optimization and proof of concept, and an experimental procedure. Due to the fact that E. tef is a precious resource, the model organism Arabidopsis thaliana was used in the optimization stage. It was determined that seeds were not the ideal tissue for ABA application because of low germination rates, possibly due to a barrier created by the seed coat. Therefore, in the experimental stage, calli, or masses of undifferentiated cells, of *E. tef* were used to ensure that ABA was taken up. The hypothesis that ABA would increase the desiccation tolerance of *E. tef* calli was supported, as ABA-treated calli had a significantly higher relative water content, significantly lower electrolyte leakage, and higher overall chlorophyll and carotenoid content.

# Increasing the Desiccation Tolerance of *Eragrostis tef* through Exogenous Application of Abscisic Acid to Ensure Food Security for the Future

### Introduction

#### • Eragrostis tef

- Ethiopia & South Africa
- gluten-free & nutritious
- staple crop
- drought tolerant
- Resurrection plants
  - drought & desiccation tolerant
- Ntuli (2012)
  - Drought Tolerance: *internal* water content
  - Desiccation Tolerance: ↓ internal water content
- Abscisic acid (ABA): key regulator in response to stress (drought)
- Loss of agricultural land due to drought; 70 % increase in food production needed
- Need crops that can maintain yield with less water

### **Results & Analysis**

#### Phase 1:

- Significantly lower germination than expected (p<0.01)</li>
- Few alive after 14 days
- Seeds <u>not</u> most effective vector for ABA uptake
  - Barrier created by seed coat
- <u>Callus</u>: mass of undifferentiated cells
  - No barrier, easier uptake

#### Phase 2:



Chla 🔳 Chlb 🔳 Car

**Figure 5:** Relative Water Content of *E. tef* calli in the three different treatments: Control, Water, and ABA treatment. Significance was found between ABA and Control treated-calli and the ABA and Water-treated calli (p<0.05).

**Figure 6:** Electrolyte leakage of entire *E. tef* calli in the three different treatments: control, water, and ABA treatment. Significance was found between ABA treatment and control (p<0.05). No significant difference existed between the ABA and water treated calli.

**Figure 7:** Total chlorophyll and carotenoid estimation of *E. tef* calli in the three different treatments: Control, Water, and ABA treatment. Significance was found in chlorophyll b content between the Water and ABA-treated calli.

### Methodology



## Phase 1: Proof of Concept & Optimization of Experiment Done in US

- Model organism: Arabidopsis thaliana
- Seeds: most ideal vector  $\rightarrow$  genetic variation
- 4 Groups:
  - Regular control: WT (wildtype)
  - •(-) control: ABAr (resistant)
  - •(+) control: ABAd (deficient)
  - •Experimental: DR (drought resistant)

•Germination rates & viability after 14 days

#### Phase 2: Experimental Procedure- Pilot Study Done in South Africa



- 1. Callus induction of *Eragrostis tef* seeds
- Apply treatments (none, dH₂O, 20µM ABA)
- 3. Transfer calli to regeneration medium
- 4. Drying under LAF
- 5. Conduct stressor assays

### **Conclusion & Future Research**

Hypothesis supported: Eragrostis tef calli exogenously applied with ABA exhibited traits associated with

## Mr. And designation to large the state of th



Figure 1: Eragrostis tef plant.

Adapted from Kamies, 2015.

## Nasia Meimeteas

<u>Predicting the Relationship between Marriage and Discussion of Women's Issues in Congressional</u> <u>Representatives: A Multiplicative Interaction Model Approach</u>



Location of Research: Harrison High School

Mentor: Professor Christopher Stout

> Intended Major: Global Health

Fairs & Awards: STS Scholar 2019 - Behavioral Sciences Tri-County 2020 - 2nd place in Math and Computers WESEF 2019 JSHS 2020 NYSSEF 2020

This study uses a multiplicative interaction model to predict the relationship between marital status and Congressional representatives' likelihood to discuss women's issues. Based on Stout, Kretschmer, and Ruppaner's (2017) findings that heterosexual marriage in women alters the perception of self-interest by institutionalizing partnerships with men and decreasing the feeling of connection to other women, it was hypothesized that married women would discuss women's issues less often than unmarried women. Alternately, heterosexual married men would support women's issues more than unmarried men because of their connection to their partner. Twitter was chosen as the data source for this study as it provides frequent, unfiltered representative communication. 167,784 tweets from 408 representatives in the 115th Congress were coded for discussing women's issues — defined as the discussion of sexual harassment, sexual assault, pay inequality, the recognition of women, human trafficking, women's health issues, gender disparities in profession, and international women's issues with the exclusion of anti-choice tweets. A multiplicative interaction was used to model the frequency of discussion of women's issues based on gender and marriage. The hypothesis was supported. The results showed that an unmarried Congresswoman was significantly more likely to discuss women's issues than a married Congresswoman (p<.01). Additionally, a married Congressman was significantly more likely than an unmarried Congressman to discuss women's issues (p<.1). The implications were that unmarried Congresswomen and married Congressmen advocated for women's issues more than their counterparts did. Being able to predict the behavior of future candidates may alter the political choices of voting citizens by allowing them to make more informed decisions.

Predicting the Relationship between Marriage and Discussion of Women's Issues in Congressional Representatives: A Multiplicative Interaction Model Approach





Female	PERCENT FEMALE API	PEAL ERROR
	0.06***	(0.01)
Married	0.01*	(0.00)
Female#Marr	ed -0.02***	(0.01)
White	-0.00	(0.00)
Age	0.00	(0.00)
Democrat	0.01**	(0.00)
PVI	0.00***	(0.00)
Percent Fema	e 0.00	(0.00)
Total Tweet	-0.00	(0.00)
Constant	-0.10	(0.07)
Observations	408	
R-squared	0.47	
0		

communication

### **Conclusion & Future Research**

• Married congresswomen 2% less likely than unmarried women to discuss women's issues Married congressmen 1% more likely than unmarried congressmen to discuss women's issues Hypothesis supported: Married congresswomen  $\square$  likely to discuss 0 women's issues than unmarried 0 Married congressmen likely to discuss women's issues than unmarried Model able to predict likelihood to discuss women's issues accurately in future candidates and representatives Future Research Test marital statuses other than "married" and "not • married" 0 Divorced and widowed Can results predict actual behavior?

## Matthew Murno

### Optimizing Strength and Impermeability of Martian Sulfur Concrete for Building Structures



Location of Research: Harrison High School and Manhattan College

> Mentor: Dr. Hochstien

Intended Major: Computer Science

Fairs & Awards: NYSSEF 2020 Westlake 2018

In this paper, I will discuss the effects of changing the ratio of sulfur and regolith in a mixture to make Martian Sulfur Concrete on its permeability and percent voids. This is important because NASA is planning on sending astronauts to Mars, and of a structure were to be built on the planet, it would need to be able to hold air but release some moisture. The samples were each measured out with respect to the percentage by weight based on the volume of the container that would be put into the oven. Then the complete samples were put through a series of tests to find the masses and densities in order to solve for the percent voids. The results demonstrated that the fifty fifty mixture made with sulfur chunks had the least percent voids, but was not statistically different than the fifty fifty mixture made with sulfur dust. However the sixty-forty mixture of regolith and sulfur respectively was significantly less than the mixture with sulfur chunks and approaching significantly less than the mixture with sulfur dust. Overall, the study demonstrates that when humans go to Mars, they must create a mixture that is either primarily sulfur or equally sulfur and regolith to make a structure that will hold air.

### Optimizing Strength and Impermeability of Martian Sulfur Concrete for Building Structures

#### Introduction

- Humans have been building structures on Earth • for generations
- However, with recent talks about space • launches and sending people into space, do Humans know how to build structures on Mars?
- To send materials to the planet Mars would be too expensive, costing about \$2,920 per kilogram of Earth material
- It will require about 100-200 kilograms of materials to build a structure on Mars

## Demold the cylinder for further testing ued until 80% Percent voids test Compression test Mass taken for each sample A compression test was conducted in a compression test machine

The concrete was compressed to

determine the threshold of force

Submerged in water for two weeks Buoyant mass and saturated masses were taken (Dry Mass / Saturated Mass - Buoyant Mass) = Bulk Density (Dry Mass / Dry Mass - Buoyant Mass) = Apparent (Apparent Density - Bulk Density) / Apparent Density = Percent Voids

#### **Results & Analysis**



Percent voids are heavily impacted by the amount of sulfur in the mixture

As the amount of sulfur increased. the percent voids of the mixture increased significantly

For the 50%/50% mixture with chunks and the 60%/40% mixture P<0.05 For the 50%/50% mixture with dust and the 60%/40% mixture P=0.07

#### **Conclusion & Future Research**

- Sulfur concrete is the most viable option for building on Mars
- It is possible to manipulate the amount of materials in the sulfur concrete to effect percent voids
- Compression strength does not change significantly when low amounts of sulfur are used.
- Sulfur concrete needs to be made with higher amounts of sulfur
- Sulfur salts may yield different results if sulfur concrete was created with it

### Methodology

## Josephine Robb

### The AVP Sub-populations Involved in Infant-directed Aggression



Location of Research: Albert Einstein College of Medicine

**Mentor:** Dr. Anita Autry and Ilaria Carta

> Intended Major: Neuroscience

Fairs & Awards: WESEF 2019 JSHS 2019 - 2nd Place in Behavioral Sciences Westlake 2018 - 2nd Place in Behavioral Sciences

There are many factors that are involved in or could be the cause of infant-directed aggression. This study examined the different PVN AVP subpopulations that are involved in infant-directed aggression, focusing on pDyn and CRH, as they are both heavily involved in the brain's processing of stress. Three groups of age-matched mice were tested: virgin males, virgin females, and fathers. They would undergo a behavior test where they are exposed to a pup to determine if they are infanticidal or parental. The tissue was then collected and processed using an RNAscope HiPlex treatment that marks expressed mRNA strands, causing them to fluoresce under a microscope. Once the RNAscope treatment was finalized, the sections of the PVN were viewed under a microscope and images were captured for analysis. The analysis included using multiple computer software programs to count the number of cells that expressed the desired markers as well as determine which cells were activated during behavior. The results showed a trend for increased concentrations of AVP/CRH cells in infanticidal VM, possibly indicating that VM mice will view a pup as a threat or stressor, perhaps causing their adverse reaction.

## The AVP Sub-populations Involved in Infant Directed Aggression

### Introduction

- Parenting evolved to increase an offspring's chances of survival
  - **Thompson (2014)**: under stress, parent may turn neglectful or infanticidal



- Autry et al. (2019): PVN projects to Perifornical Area (PeFA) which is active during infant-directed aggression
- Schwarzer (2010): PVN involved in Hypothalamic Pituitary Axis (HPA) which mediates stress response
- **Brunnlieb et al. (2016)**: AVP plays role in social behaviors (aggressive and parental)
  - Subpopulations: pDyn and CRH
  - Both involved in stress response
  - (Pedersen 1991): CRH linked to infant directed neglect and aggression
- Maybe aggressive individuals interpret offspring as a stressor

### Purpose

Examine the AVP-subpopulations found within the PVN, specifically pDyn and CRH

### Hypotheses

- 1. The AVP neurons of aggressive individuals will express more pDyn and CRH
- 2. These neurons will be more active

### Methodology





Figure 10. Coronal cross section of the PVN of a VF. Here we can also see each individual sub-population that is being examined. CRH is in magenta, pDyn in red, AVP in orange, and cfos is in cyan. C-fos allows us to determine when a neuron has been active. (Carta and Robb 2019)



### Results & Analysis



Figure 11. Coronal cross section of the PVN of a VM. We can already see a big difference between VF and VM: there seem to be a higher concentration of AVP neurons. (Carta and Robb 2019)



Figure 12. Coronal cross section of the PVN of a father. When contrasted with both VM and VF there seems to be a low concentration of AVP and AVP sub-populations in this mouse. (Carta and Robb 2019)

### Discussion

**OVERALL**: VM had higher number of AVP-subpopulations and a higher number of those cells were activated

### Evaluation

-Small # of organisms -# of cells may vary depending on cut

### Application & Future Direction

- No direct link  $\rightarrow$  speculation: human infant-directed behaviors may be modulated by the same chemicals
  - Similar chemical distribution
  - Maladaptive human behaviors: postpartum depression

#### FUTURE:

- Examine other AVP-subpopulations
- Examine AVP mRNA (more specific)

## Pablo Rolon and Mason Rigor

The Effect of Body Fat Percentage on The Knee Landing Angle and Subsequent Impacts on The Rate of ACL Injuries



Location of Research: Harrison High School

> Mentor: Mr. Gunnell

Intended Major: Pablo: Undecided Mason: Biomedical Engineering

> Fairs & Awards: Westlake 2018 WESEF 2019

Anterior cruciate ligament (ACL) injuries are a significant injury that many high school athletes go through each year. There are many factors that may contribute to the risk of suffering a debilitating ACL injury. One way to determine a factor of injury is looking at different aspects and how they impact a knee landing angle. Experiments are being conducted to determine if Body Fat Percentage (BFP) is a factor in the risk of ACL injuries. It is hypothesized that when the Body Fat Percentage is increased the rate of ACL injuries is also increased. Data was taken to compare the landing angles of the knee based on the participants (BFP). Analysis will further determine the effects of BFP on the risk of ACL injuries. The Effect of Body Fat Percentage on The Knee Landing Angle and Subsequent Impacts on The Rate of ACL Injuries



### **Results & Analysis**



As BFP is increased the flexion angles are increased which is shown by a positive trendline on the graph

•As BFP is increased the amount of force (N) is increased which is shown by a positive trendline on the graph

### **Conclusion & Future Research**

- ACL injuries can be decreased by centering injury prevention strategies around these modifiable factors
- BFP is a modifiable and a factor in ACL injuries and prevention strategies should can be centered around BFP
- Hypothesis:
  - People with a higher BFP will have a lower flexion angle when jumping, and therefore experience a high risk of ACL injuries
- Hypothesis was supported by data
- Future research will Examine how different exercises strengthen the knee muscles while lowering body fat percentage
- Athletes will go through different exercises for several weeks and BFP measurements will be taken before and after the study to see the effectiveness

## **Charlie Sheffield**

### Attempting to Overcome Gravitational Forces Acting on a Carbon Particle <u>Through Procedures Used in Optical Trap Displays</u>



Location of Research: Harrison High School

Mentor: Daniel Smalley (Brigham Young University) Dr. Christopher Tyler

> Intended Major: Business Management

An experiment was conducted to test the validity of results found by other studies in the field of optical trapping. Miniscule cellulose particles of 3 main sizes were dropped into the propagation of a 450 nm blue-ray laser and the trap rate was tested. Gravitational force was the only other forces acting on the particle when in free fall and the imminent gradient force was to be tested if it was equal or greater in magnitude to that of the gravitational force acting on the particle to see whether or not the particle would suspend in the laser beam. For each of many trials, the particle would not suspend in the laser beam. It was proven that the processes used in other studies may have been improbable and not simply replicable, showing how dropping particles into the beam was not the most effective method for repeatable capture. The short time that the particle travels through the beam compared to its relatively large velocity proved how the change in momentum was not great enough to bring the particle to rest. This study proves how methods for capture in optical trap set ups are insufficient for practical use and calls into question the validity of the previous studies and their applications for optical trap displays.

### Attempting to Overcome Gravitational Forces Acting on a Carbon Particle Through Procedures Used in Optical Trap Displays



100% Trapped Not Trapped The gradient force is <u>not</u> strong enough to suspend a particle, overcoming the force of gravity

 A laser using a higher wattage may have a greater gradient force, yet can not be too powerful that it is dangerous

## Noah Vass

### Investigating the Relationship between Intensity of Exercise and Post-Exercise Positive Affect Via a Mathematical Model



Location of Research: Harrison High School

> Mentor: Allison Blunt

Intended Major: Undecided

**Fairs & Awards:** WESEF 2019 - Walter Kass Memorial Award JSHS 2020 - 3rd Place Behavioral Sciences

As of late 2016, 39.8% of American adults are obese. Only 1 in every 5 Americans reaches the CDC's recommended amount of daily exercise. This paper proposes that, by fostering a sustainable exercise habit in more Americans, the high rate of obesity in the country can be counteracted. Salmon (2002) found that individuals that reported higher levels of sedentary behavior over physical activity also tended to report higher levels of happiness following sedentary behavior when compared to how they felt following physical activity. This suggested that one reason for Americans not engaging in physical activity was it does not encourage positive emotion. This study attempted to test the factors that dictate a participant's affective response to exercise via the use of a mathematical model. It was hypothesized that as intensity of physical activity went up, so would the average reported increase in positive affect. Participant's first recorded their age, hours of sleep the night prior, most recent meal, and how often they exercise weekly; then completed a Positive and Negative Affect Scale (PANAS) prior to exercise. Participants exercised for 15 minutes at one of three predefined intensities; after completing another PANAS the differences between the pre and post exercise PANAS were compared. The results rejected the hypothesis, there was a significant (P<0.05) negative correlation between intensity and difference in positive affect. The creation of this model allows for a more accurate understanding of the factors that determine an individual's mood following physical activity.

## Predicting Change in Positive Affect Post-Exercise Via the Use of a Mathematical Model

### Introduction Background



#### Intrinsic Motivation:

• In US:

0

- Rates of obesity rising while daily rates of exercise decreasing.
- Behavior driven by *internal* rewards e.g. increased happiness.
  - *Biddle & Marie (2008)* suggests tendency to exercise is based on level of post-activity positive emotion.

### Key Definitions:

- *Positive Affect:* The level to which an individual feels positive emotions.
- *Intensity:* The amount of power used by the body during physical activity (approximated with heart rate).

#### <u>Gap</u>

- Little research has been done on short-term affective responses to different intensities of exercise
  - To account for real-world variance, other variables must be controlled

### <u>Goal</u>

• To test the relationship between intensity of physical activity and instigated positive affect.

### **Hypotheses**

- Physical activity will increase positive affect in participants on average.
- Increases in intensity will correlate to greater differences in positive affect

### Methodology

### **Participants**

- 96 participants sampled from a public park.
  - Filled out informed consent form prior to experimentation.

### **Variables**

#### • Independent:

- Intensity of exercise (150%, 160%, or 175% of resting heart rate based on Coll. 2011)
- Dependent:
  - Change in positive affect (Measured using self-reported scale)



### Analysis

- Average change in positive affect (based on intensity) calculated both with and without controls.
- Controlled analysis with multiple regression.

### Conclusion & Future Research

### Major Findings

- With no controls, physical activity increases positive affect on average across all intensities.
  - Larger difference at higher intensities.
- Opposite result with controls.
  - Intensity and difference in positive affect post-exercise did not correlate.

### Future Research

- To test effect of genetic predisposition to exercise on change in positive affect.
- How do other forms of exercise lead to differing affective reactions?

## Steven Wu

### Impact of Musical Complexity on Concentration



The research looked at the connection between human cognition and musical complexity. 63 high school students aged 14-17 were tasked with completing a concentration test while listening to background music with various melodic complexities. These complexities were rated using a fractal dimension value, which gave a numerical complexity rating. This is calculated by finding the individual complexities of subsequent notes and then averaging the numbers. Afterward, compositions by Mozart were transposed to match with different complexity ratings ranging from 1-8. Furthermore, a silent testing condition was used as a control group. There were a total of 5 randomized trials per participant so that they would not become conditioned to increasing or decreasing complexity in the music. Moreover, a placebo task was implemented to prevent conditioning to the concentration test itself. The results suggested that participants scored significantly higher on the concentration test following the intial increase in musical complexity. However, scores went down during trials with the most complex background music possible. Ultimately, the findings point to the fact that simple music may provide beneficial impacts to human concentration when performing cognitive tasks.

## Impact of Musical Complexity on Concentration

Introduction			า	Methodology		
٦	53 percent of teens do something else when studying and 87 percent of this number listens to music		P1	Develop Complexity Rating D=logf/(1/i) The equation takes individual complexity ratings of each type of note interval Total complexity is calculated by finding the average value of individual note complexity		
Research regarding music and cognition has been inconsistent and difficult to replicate			cognition has been cate	P2	Transpose songs to match with different ratings <ul> <li>Transposed songs include Mozart concertos and sonatas</li> <li>Maintain the same tempos and key signatures through audio editing</li> </ul>	
	Music used in the studies are mostly controlled for length and genre			P3	<ul> <li>Background music with different complexity ratings on concentration and analyze results</li> <li>Background music with different complexities played</li> <li>Placebo test to serve as distractor</li> <li>T-test to analyze results</li> <li>Questionnaire given before and after</li> </ul>	
	Songs are ve quantifiable	ery difficult to repres values	sent with	Indep Melodi Measu	opendent Variable         Dependent Variable         Controlled Variables           xdic Complexity         Concentration         Volume, outside sound, music genre, time limit, music tempo, key signature	
Pr Th col dua com mi com	oblem ere is no nnection etween antifiable nplexity of usic and numan ognition	GOAIS Determine the relationship between melodic complexity and concentration	Hypothesis Music of higher complexity will result in lower concentration test scores	63 High ages 1- Had so educat setting     Sul	igh school students 14-17 some musical ation in an academic ng Subjects studied Materials Results and analysis	
Dis	cussion	Next Steps	Conclusion	Avera	rage Scores for Two Distraction Rectangles	
The r partia supp hypo Signi score from group back musi All pa had a one y musi traini	results ally ort the thesis ficant e increase control p to ground c articipants at least year of cal	Plan on testing different types of musical complexity Look at the relationship between music and other cognitive processes Improving the methodology used in the experiment	Higher musical complexity does not result in lower concentration test scores Multiple factors such as prior musical training can change reception to background music	0.9 0.9 0.1 0.1 0.0 0.7 Figure distract 0.95 0.7 0.95 0.7 0.95 0.95 0.95 0.95 0.95 0.95 0.7 0.95 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7	1.35 0.9 0.8 0.8 0.8 0.8 0.8 0.8 0.8 0.8 0.8 0.8	

Figure 3: Graph for average scores for question type 2 with six distractions

Complexity level



## Science Research II









## Roya Azar

### The Use of Va24 in VaKI Mice of Cancer Immunotherapy Research



Class Year: Junior

Mentor: Alejandra Saavedra, Einstein

Immunotherapy is a form of cancer treatment that uses the body's immune system to fight cancer cells. iNKT cells (invariant Natural Killer T cells) are a subset of T cells in the immune system that can be used in immunotherapy treatments. While iNKT cells have shown the ability to cause tumor remission in mice, the transition to clinical trials have not been successful. To create a more accurate mouse model for iNKT cell research, the Department of Microbiology and Immunology at Einstein Medical Center has created a new strain of mice called VaKI mice. However, there was a discrepancy found in the genotype of Va24 in the VaKI mice. Some mice were heterozygous for the Va24 gene while other mice were homozygous for the Va24 gene. Since humans are homozygous for Va24, it was deemed necessary to look into the impacts of being homozygous for Va24, in order for the most accurate mouse model to be created. The hypothesized impact of this study was that homozygous mice would produce more iNKT cells than heterozygous mice. This hypothesis was supported as homozygous mice produced almost double the percent of iNKT cells compared to heterozygous mice. For example, mice that were homozygous for Va24 contained an average of 51.35% of iNKT cells while mice heterozygous for Va24 had an average of 29.82% of iNKT cells.

Abbreviations/ Key Terms: Va24, human gene for a-chain of iNKT cell receptor; VaKI, Va24 knock-in mice (mice containing hCD1dKI, Va24-T, Ja18KO)

## Tyler Burden

#### Measuring the Effect of Dance Improvisation on Brain Activity with a Battery of Cognitive Tests



Class Year: Junior

Mentor: Prof. Marchant

Improvisation has been utilized as a tool for performing artists of all kinds to facilitate creative development and artistic growth. Considered a notably complex activity, musical improvisation can be defined as spontaneous selection and execution of actions that are relevant to the musical context (Landau, Limb, 2017). Furthermore, musical improvisation in the form of dance holds the same definition, with movement of the body, specifically, as the action which is spontaneously selected and executed. Despite its benefits as a practice of the art, studies have assessed the possibility of using dance improvisation as therapy for sufferers of neurodegenerative diseases. According to a pilot study by Marchant, Sylvester, Earhart (2010), individuals with Parkinson's Disease demonstrated improvements on the Unified Parkinson Disease Rating Scale after practices of contact improvisation (a form of dance improvisation involving physical touch and contact) for a two-week period. Though studies have utilized fMRI techniques to measure the brain activity associated with musical improvisation through jazz musicians (Donnay, et al., 2012), there are limitations to the use of fMRI with dance improvisation due to the lack of movement required for clear results. For this reason, it may be more advantageous to use cognitive paper and pencil tests as a method for measuring changes in brain activity before and after dance improvisation intervention. This research aims to evaluate the effects of dance improvisation on convergent thinking, divergent thinking, and memory using a battery of cognitive tests, and thus providing insight into the brain activity associated with the process and its potential application outside of the dance world.

## Katherine Cole

### The Effect of Microaggressions on the Reported Well-being of LGBTQ+ People



It has been found that LGBTQ+ people generally face higher rates of mental illness and suffer overall from a worse well-being than their straight and cisgender peers. This study aims to understand the relationship between the microaggressions an LGBTQ+ person faces and their reported well-being. In this study a survey was used to collect data from LGBTQ+ people over the age of 18. Their responses were then converted to numbers in order to be put into a code, and analyzed. The model created quantified the relationship of microaggressions on wellbeing. The model showed that both direct and indirect microaggressions had a positive correlation with wellbeing. Direct microaggressions had a larger slope showing the had more of an impact on wellbeing. In addition, it was found that LGBTQ+ youth reported more incidents of microaggressions than the older participants, and therefore, typically had a worse well-being. This model could be used to predict the wellbeing of LGBTQ+ people in the workplace or school and could help set appropriate policies to support anti-discrimination.

Class Year: Junior

Mentor: Sarah Blunt

## **David Cross**

#### Using Qualitative Modeling to Predict the Effect that IUU Fishing has on the Biomass of <u>M.paradoxus of the Benguela Ecosystem of Namibia</u>



Class Year: Junior

Mentor: Dr. Adrianna Aquino, AMNH Illegal, Unreported, and Unregulated (IUU) Fishing is the largest problem outside of pollution that is affecting the world's oceans. The Benguela Marine Ecosystem off the coast of Namibia has been destabilized with an Influx of IUU fishing prior to 1995. The purpose of this study was to create a qualitative model that uses biomass to predict the effect of IUU Fishing on the Benguela Ecosystem of Namibia and the Cape Hake Species. The Cape Hake, (*M.paradoxus*), is one of the most valuable economic resources to Namibia, making up a large section of its fishing economy. The methodology employed will be to create a qualitative model to identify the changes in biomass of the Cape Hake caused by the presence/ absence of IUU fishing. Other species such as the Scyphozoan Jellyfish were documented previously as reacting to the targeting of their predators by IUU Fishing by having a rapid increase in population. Future research includes comparing the effects of IUU on the Benguela ecosystem to the effect of IUU fishing on fishery areas located near developed nations and/or other developing nations.

## Giovanni Cutri

### How the Exposure to Caffeine Affects the Photosynthetic Mechanism of Aquatic Biofilms



Class Year: Junior

Mentor: Heather Malcom,Carey Institute

The purpose of this study was to investigate the photosynthetic capabilities of biofilms in the presence of caffeine, a common pollutant in streaming systems. The methodology consisted of using unglazed tiles. These were placed into the stream for the purpose of biofilms growing on the titles. After 3-4 weeks the titles were taken from the stream and placed in a mason jar with just enough stream water to keep the biofilms moist. The titles were then refrigerated overnight and kept in the dark. After this all of the titles were placed in differing photosynthetic tanks, under grow lights. Each tank was filled with 200mg of stream water. Half of the tanks were exposed to 1ng/100 mL of caffeine, this was the experimental group while the other half did not have caffeine, this was the control group. A control variable that was consistent throughout the study was puting the photosynthetic tanks in the light for 3 hours and then in the dark for 3 hours. The dissolved oxygen recorded every second of the 6 hour trial. The full study, when completed, is to include a total of 5 concentrations of caffeine mixed with distilled water, the concentrations are as follows: 0 nanograms, 1 nanogram, 10 nanograms, 100 nanograms, 1000 nanograms/100 mL. One of the major findings in one of the first trials done was with the concentration of 1 ng. In this trial the biofilms exposed to caffeine declined in oxygen production before being placed in the dark. This was major because the control group with no caffeine continuously rose in oxygen production up until it was placed in the dark. And what was further telling was the fact that oxygen production nearly halted while in the dark for the biofilms exposed to caffeine, while oxygen production in the control group was on a slow decline rather than an almost immediate halt. The implication of this is that the photosystem of the biofilm exposed to caffeine was changed in a way that inhibited the once photosynthetic nature of the aquatic biofilms. The larger implication of this is that biofilms, once exposed to common pollutants like caffeine, prevent biofilms ability to carry out photosynthesis and therefore can be damaging to stream ecosystems since the oxygen that the biofilm provides animals within the stream is needed to carry out respiration.

## Cooper Danzig

### Connecting Parents to Recreational Professionals to Increase Participation of Children with Disabilities in Physical Activity



Class Year: Junior Location of Research: HHS Children with disabilities participate in less physical activity which correlates with a non-healthy lifestyle. Low social skills and delayed gross motor development makes it challenging for children with disabilities to participate in physical activity. Many scientists are looking into the barriers of participation for children with disabilities and the best methods to increase participation. An experiment was performed using focus groups to better understand the barriers and facilitators of physical activity. It was found that one major issue that was prohibiting children with disabilities to get the necessary physical activity is the lack of communication between parents looking for adaptive sports programs and recreational professionals. Further research will be used to develop an app that can break down the communication barrier and increase the overall participation of children with disabilities. This presentation will lay out the steps to take in order to develop the app and make it easier for children with disabilities to get the physical activity they need to stay healthy.

## Arwen Fernandez O'Brien

### <u>Pharmacogenomics - Determining the Role of Naturally</u> <u>Occurring Genotypes for Medical Advances</u>



Class Year: Junior Mentor: Cale Whitworth

The field of pharmacogenomics is exploring the relationship between pharmaceuticals and genetics. Genes play a role in how an individual interacts with drug intake, as levels of enzymes, the protein which metabolizes medicines, differs between each individual. An increased amount of enzymes versus a decreased amount causes adverse reactions to the same medication throughout patients, making recovery rates slow and making patients exposed to the risk of unwanted side reactions. To better understand how to personalize medications based on the genotype of an individual, fruit flies can be used as their genes parallels those of humans, such as being susceptible to euphoric and depression like states and carrying CYP450, an enzyme responsible for drug and serotonin metabolization. Antidepressants were the studied medication for this reason. Using fruit flies, the role of naturally occurring enzyme levels can be determined as the flies genes play a role in how they respond to stimuli. Fruit flies with varying levels of CYP450 were put through a negative geotaxis assay. It was hypothesized that the flies with the lowest levels of CYP450 would be more motivated as serotonin would be broken down at slower rates and therefore remain in the bloodstream for longer. The flies that performed the best in the negative geotaxis assay would show higher motivation levels than the flies that performed the worst with the slowest time. The hypothesis was confirmed as the flies that performed the best had the lowest levels of CYP450. This would mean that patients with higher levels of CYP450 would require a higher dosage of medication as otherwise the CYP450 would break down the medication too quickly and the medication would not stay in the bloodstream for long enough. On the contrary, if a patient had low levels of CYP450 they would require a low dosage or else their body would become overwhelmed and reject the excess medication.

## **Bailey Fisher**

### Creating a Wearable Device to Help Parkinson's Patients Maintain an Upright Seated Position



Class Year: Junior Location of Research: HHS

The purpose of this study was to create a device to be able to measure the acceleration of a person as they fall over in their chair to be able to find a threshold for the speed at which people fall over in their chair. This was all done to ultimately create a device to help people with Parkinson's Disease be able to maintain an upright seated position in a chair to reduce harm. In order to be able to create the device, an arduino board and an IMU sensor were interfaced and mounted to a vest to be worn by participants. Participants were shown a demonstration of a "model fall" and were then asked to fall five times to the left and five times to the right. The main variable tested was the persons acceleration when they began to fall in their chair. From this data, through analyzing graphs and finding the averages of the trial for each individual participant it was found that for the left side the threshold was -0.2709ms-2 to -0.0777ms-2 and for the right side was -0.2152ms-2 to -0.1110ms-2. This threshold means that in building a device for people to wear, the device would need to be able to recognize this threshold and be programmed to inflate when it senses an acceleration in this threshold.

## Mburucuya Gomez

### The Relationship between a Parent's Culture and the Way a Child Learns



Class Year: Junior

Location of Research: HHS

Cognitive learning is the mental process behind how you perceive things and learn. Over the years, there have been multiple studies conducted to learn more about the process of learning and what impacts the way people learn. One way that your learning can be shaped is by the way you were raised and your culture. Saxe G. (1979) found that children and their mothers had similar ways of doing simple math when solving a complex problem. The purpose of this research is to learn more about how the cultural environment that one is raised in impacts the way that someone learns. The methodology employed will be to survey parents and their children from varying cultural backgrounds. Then the parent and child will be asked separately to solve different problems; they will also be asked to explain the mental thought process behind every decision that they made when solving the problem. This research is relevant to understanding more about the way children process information in a classroom setting. In other words, the cultural background of the parent may shape the child's cognitive development.

## Alexandra Gresham

### The Effects of Limiting Screen Time on the Anxiety Levels of High School Students



Mentor: Mr. Gunnell

Seventy seven percent of people own smartphones in the U.S., according to Pew Research, and as the number of people that own smartphones increase, the dependency on smartphones increases as well. This growth in mobile phone use has caused people to question how these devices are affecting our mental and physical health. Also, the short amount of time since cell phones have been available has resulted in limited data on the long term effects of smartphone use. In the study, Effect of Use of Mobile Phone on Mental Health of Higher Secondary School Students, it was found that cell phones cause a change in the mental health of high school students. Additionally, in the study Effects of Sleep Quality on the Association between Problematic Mobile Phone Use and Mental Health Symptoms in Chinese College Students, it was found that that those with problematic mobile phone use (PMPU) have increased levels of anxiety and depression, as well as poor sleep quality and other mental health issues. Alternatively, in the study An Analysis of the Impact of Cell Phone Use on Depressive Symptoms among Japanese Elders, it was found that cell phones reduced depressive symptoms in women and had no effect on the mental health of men. These opposing results led to the question: how does limiting cell phone use change the anxiety levels in high school students? Through limiting the screen time of high school students, this study aims to determine whether the anxiety levels of the participants are increased or reduced. A study was conducted in which participants limited their screen time over a four week period while taking an anxiety survey before limiting their screen time and after each week of limiting their screen time. Through this study there was no clear relationship found between limiting screen time and anxiety level but because of these results a study is planned to assess the same hypothesis with a larger sample population and more limited screen time.

## Larissa Iraj

### The Effect of the Antioxidant, Resveratrol, on Prolonging the Lifespan of Drosophila melanogaster Over Multiple Generations



Class Year: Junior Location of Research:HHS

The incidence of cardiovascular disease has been on the rise over the past decade as heart disease is the leading cause of death worldwide. One way to promote longevity of life is through the natural antioxidants in diets and supplements. Resveratrol is a natural phenol and antioxidant found in the skin of red grapes, used in red wine. Resveratrol has been found to increase the lifespan of fruit flies, which possess similar genetics to those of humans. In this experiment, the lifespan of Drosophila melanogaster was measured to see the effect of different dosages of resveratrol on flies who were fed diets high in fat and diets with various dosages of resveratrol. Wild-type flies were the model organism for this experiment. The flies were divided into different groups- a normal diet which served as the control group, normal diet with resveratrol, diet with 200 µm resveratrol, diet with 400 µm, diet with 425 µm, diet with 500 µm, high fat diet, and high fat diet with resveratrol. The results demonstrated that resveratrol increased the lifespan of flies fed diets high in fat with resveratrol. The flies on the normal diet for the first generation lived the longest. The second generation of flies on the resveratrol diet lived longer than the flies on the normal diet, demonstrating a potential epigenetic effect of resveratrol.

## Jillian Kaplan

### Anxiety Ratings and Emotional Responses in Group vs. Individual Settings



Mentor: Mr. Gunnell Location of Research: HHS Learning about why we experience certain emotions has always interested me. New treatments and therapies are evolving everyday for people with phobias, and the science behind these treatments are always changing due to new research. Experiments are being done on how anxiety levels are impacted by various "distractions." I hypothesized that anxiety levels will decrease when a person is in a group setting compared to anxiety levels in an individual setting. Data was taken by comparing the results from two surveys: an individual survey and a partnered survey. Participants were asked to watch a series of commercials and answer the questions that follow. Each survey consisted of 3 phobia related video and 4 "distractor" videos. It was shown that for the phobia video, when the participant was in a group setting their levels of anxiety levels were lower than when they were in an individual setting. This paper will detail the results of anxiety levels for phobia and non-phobia related videos in both group and individual settings. Further study will include analyzing how estrogen and testosterone levels may impact anxiety.

## Hannah Karkout

#### Analyzing the Perspectives of Optometrists and Ophthalmologists on the Efficacy of Vision Therapy



Class Year: Junior Location of Research:HHS Vision therapy is a type of treatment used to treat various vision problems, such as strabismus, amblyopia, convergence problems, and other anomalies. Optometrists, the doctors who can specialize in vision therapy, generally support the use of vision therapy while ophthalmologists contrarily oppose this type of treatment. Despite holding these strong opinions, there are not solid reasons as to why each side holds their opinion, and it seems that the controversy is not being resolved. As a result, a survey was formed and distributed to optometrists that do and do not perform vision therapy, as well as ophthalmologists. A total of 33 optometrists responded, 6 who are specialized in vision therapy and 27 that are not, while no ophthalmologists have participated. It was found that optometrists generally support the use of vision therapy for reasons such as having past experience with successful patients or knowling of published research, and have additionally noted improvement in their own/other patients that have received vision therapy. It was also found that many of the optometrists had differing opinions on the percentage of improvement required to categorize the treatment as effective. This implicates that the optometrists are able to support their opinion with a series of evidence, however define effectiveness differently, which may be the gap leading to confusion over the use of vision therapy.

## Ellie Karofsky

### The Potential of Exposure of Plastic Sunscreen Bottles to Ultraviolet Radiation Resulting in Bisphenol A (BPA) Leachate



Mentor: Mr. Gunnell Location of Research: HHS Bisphenol A (BPA) is a chemical that is found in hard plastics that is suspected to have negative health effects. BPA was banned by the FDA from being in baby bottles and sippy cups because of its supposed effects on young children and infants. BPA has been found to leach from plastic water bottles that have been left in the sun for extended periods of time. People then unknowingly consume this BPA because it would be in the water. Research has been done to determine the effects of BPA on the human body, however most research is conducted on animals so there is not necessarily prominent threats that are confirmed. Nevertheless, many are still worried about the possible health problems that can occur because of the exposure to BPA. Minimal research has been conducted to test the amount of BPA in plastic sunscreen bottles that are regularly exposed to the sun. Sunscreen is another substance this is used daily and also contains chemicals that can absorb into the skin. Research has shown that chemicals in sunscreen can infiltrate the bloodstream. This presentation will outline what BPA is and how it can be transmitted to substances that can be consumed by humans. Additionally, this presentation will establish future research that will include conducting an experiment to test the concentration of BPA leached from plastic sunscreen bottles when exposed to ultraviolet radiation over the expansion of multiple weeks.

## Areebah Mehmood

### How Emotions During the Day Impact Dream Content



Mentor: Mr. Gunnell Location of Research: HHS Dreams are conducted each night in a sleeping person. They are impacted by daily life activities, experiences and incorporate wakefulness categories such as people, objects and places. Some dreams are more frequent in men than women, who have different hormones that impact their emotions during the day. Through the use of a survey, participants were able to identify their emotions during the morning, afternoon and evening. Through the use of a survey, they were also able to identify the dream emotions they felt. After three weeks of filling out the survey, their emotions during the day and the dream were sorted into a chart and a correlation test was conducted. The correlation between the two emotions were compared using a correlation test ranked on a scale from -1 to 1. The total overall correlation between the morning emotions and dream emotions was 0.832773354. The overall correlation between afternoon emotions and dream emotions was 0.887498160. The overall correlation between evening emotions and dream emotions was 0.9215189176. Since all correlations were very close to 1, it suggests a strong direct relationship between emotions during the day and those experienced in dreams, supporting the original hypothesis of the study.

## Sonali Nicola

#### <u>The Effect of Glycine and Sarcosine on P-Akt, P-AMPK, P-S6, and</u> <u>GNMT Signaling in MIHA Cells, 3T3 Cells, and SH-SY5Y Cells</u>



Mentor: Derek Huffman, PhD

Location of Research: Albert Einstein College of Medicine Glycine and sarcosine have been found to increase mice lifespan. This proposal looked at the effect of 500 µM on P-Akt, P-AMPK, P-S6, and GNMT signaling in MIHA Cells, Sh-SY5Y Cells, and 3T3 Cells. It was predicted that the cells of each cell line treated with 500 µM of Glycine or Sarcosine would have higher concentrations of P-Akt, P-AMPK, P-S6, and GNMT than the control groups. The cells were treated and incubated for 24 hours. Then, they were scraped for protein and used in a Protein Assay to determine the concentrations of protein. The concentrations were used to determine the dilutions of the samples for the Western Blot Test. The gel electrophoresis was performed, and then the samples were treated with Rabbit Antibodies specific to each signaling protein. The samples were placed into a ChemiDoc machine which read the intensities of the signaling proteins using an arbitrary unit scale. The study used replicates, meaning two samples per condition for each cell line, so statistical tests could not be performed. After the data was collected, it was organized into bar graphs which were used to observe trends. Generally, the hypothesis was supported. When looking at P-Akt, the SH-SY5Y control group had a higher concentration of P-Akt signaling than the Glycine condition and the Sarcosine condition. When looking at P-AMPK, the SH-SY5Y Glycine condition had a lower intensity of P-AMPK than the SH-SY5Y control while the Glycine condition had a higher concentration than the control. When looking at P-S6 signaling, the SH-SY5Y Glycine condition was lower than the SH-SY5Y control. When looking at GNMT signaling, the MIHA Glycine condition was lower than the MIHA control, the SH-SY5Y Glycine and SH-SY5Y Sarcosine conditions were lower than the SH-SY5Y control, and the 3T3 Glycine condition was lower than the 3T3 control.

## Tochi Onwuasoanya

### <u>The Effect of Vitamin D3 on Physical Performance of Drosophila melanogaster in the</u> <u>Negative Geotaxis Assay: A Dose Response Study</u>



Class Year: Junior Location of Research: HHS

This project was an investigation into whether supplemental Vitamin D3 plays a role in the performance of Drosophila melanogaster in the Negative Geotaxis Assay. Drosophila melanogaster possesses over 70% similarity with human genes and shares similar metabolic functions which made them the ideal model organism to use for the study. The independent variable was the concentration of Vitamin D that was fed to the flies and the dependent variable was how the Drosophila performed in the Negative Geotaxis Assay. The concentrations of vitamin D used in the dose response were: 25mcg, 2.5mcg, 0.25mcg, 0.025mcg, and 0.0025mcg. 0.0mcg represented the control group which had no vitamin D. The F1 Generation was studied, where 6 male flies and 6 female flies were placed into each of the vials. Following this was sexing & dividing the Drosophila where once the eggs became adult Drosophila they were separated by sex and placed into tubes that were labeled by their respective sexes. Next, the negative geotaxis assay was performed to test the natural tendency of flies to move against gravity when agitated. It was utilized to observe if supplemental Vitamin D3 would play a role in improving locomotor capacities. Data was recorded digitally and analyzed using t-tests for significance. In all concentrations male Drosophila melanogaster had a higher percentage of flies cross the 8cm line (p<0.01). In all concentrations, the time for the first male to cross the 8cm was significantly faster than the females (p<0.05). The 2.5 mcg group performed the best overall in both the male and female groups compared to the other groups. Additionally, in general as the Vitamin D concentration increased so did the percentage of flies that crossed the 8cm line in the negative geotaxis assay. All the experimental groups performed significantly better than the control group (p<0.01), thus vitamin D may have had an effect on the performance of Drosophila melanogaster in the negative geotaxis assay. The improved performance in Drosophila suggests studying the effect in humans; Supplemental Vitamin D may have uses for increasing physical performance, and correcting for Vitamin D deficiencies could lead to better physical performance and improvement for people with locomotion issues.

## Julina Paruta

### The Effects of NWD and AIN Diets on the Large and Small Intestine



Class Year: Junior

Mentor: Prof. Augenlicht, Einstein Colorectal Cancer is a cancer (cells that grow out of control) that starts and grows in the colon (large intestine) or the rectum and kills over 50,000 people per year in the US. While these colon and rectal tumors appear later in life, long-term dietary patterns are fundamental in how probable it is that they will develop. The question studied was: What changes in the amino acids in the intestines are associated with increased probability of these tumors to develop? The purpose of this study was, therefore, to examine metabolites in the small and large intestines of wild-type C57BI6 mice fed a rodent version of the New Western Diet (NWD) compared to a control diet (American Institute of Nutrition Diet or AIN). Specific amino acids were found to be altered in levels in relation to altered stem cell function and with the probability of tumor development. DNA was also isolated from fecal pellets of the mice. Libraries were constructed and sequencing is underway representation of microbial species of the gut flora of the mice. The purpose of this was to determine if altered microbial species may be important in altering amino acid metabolism and hence the representation of these amino acids in the host intestinal epithelial cells. The result of these investigations was that the specific amino acid levels did characterize the intestinal small and large intestine in which there was the elevated probability of tumor development caused by changing the nutritional environment of these mice, that is, in those mice fed the western purified NWD diet compared to the control purified AIN diet. The results were then put into a Bray-Curtis model. The graphs show that females had a greater separation meaning that the microbiomes were affected more by the diets in the females compared to males.

## Maria Saes

### Psychological Theories that Best Describe Crime Data from a Suburban US Town



Class Year: Junior Location of Research: HHS

The purpose of this study was to investigate the correlation between temperature and assault in a small suburban town. The temperature aggression hypothesis states that as temperatures are warmer, the number of assaults would increase and was used as the motivation for conducting this study. This is part of a larger study that is investigating psychological theories that could explain crime patterns in a suburban town. Monthly temperature data was gathered from www.wunderground.com for the years 2000-2019. The website uses meteorological data from the White Plains Airport. Assault data was gathered from the local police department from years 2000-2019. Assault data included beat assignment, date, time, reporting officer, and case number. Findings included that May, June, and September were the months recorded to have the highest number of assaults six times although they were not the warmest months. Findings also included no correlation between average yearly temperature and total number of assaults. Therefore, the temperature - aggression theory did not seem to explain trends in data. Further research includes gathering local neighborhood data and researching more psychological theories can explain crime in a suburban neighborhood.

## Madison Schiro

### The Effect of Social Isolation on the Behavior of Virgin Female Drosophila melanogaster



Class Year: Junior Location of Research:HHS

The purpose of this study was to determine the effect of social isolation on the behaviors of the social organism Drosophila melanogaster. Specifically, virgin females were studied to draw a comparison to the more often studied virgin males. The flies were separated into groups that were subjected to different forms of isolation. Each fly from each group was pitted against a fly from the control group (crowded and social, which is standard for flies), and then recorded for their behaviors to be observed. The distance between the flies, the types of aggressive behaviors, and quantity of locomotion was measured. The isolated flies had a significantly greater distance between them and the control flies than the social flies (p<.01) and a greater deficit in locomotion was observed. Aggressive behaviors for flies include lunging, flicking of the wings, and movement of their front legs. It was found that isolated female flies were significantly more aggressive than the social female flies (p<.01). Isolated flies displayed a greater amount of each aggressive behavior other than retreat, despite their deficit in locomotion. Stevenson et al (2013) found that male virgin fruit flies exhibited more aggressive behaviors when socially isolated. The results found implied that social isolation induce different behavioral patterns in male and female fruit flies. Given the genetic similarities between Drosophila and humans, it may be worth investigating the effects of social isolation on female humans, especially given the recent practices of social isolation due to Covid-19.

## Madison Stagg

### The Relationship Between the Lunar Cycle Phases and the Great White Shark's Proximity to Shore



Class Year: Junior Mentor: Dr. Greg Skomal

There has been an increase in great white shark sightings near the Cape Cod Bay area, as well as, an increase in the seal population sightings in that region. The moon and its phases are a primary factor as to how much light is illuminated on the ocean at night, possibly affecting predator/prey interaction rates. The goal of this research was to determine if there was a correlation between great white shark's proximity from shore and the lunar cycle phase. The hypothesis was that great white sharks will be closer to shore during a new moon and farther from shore during a full moon because the sharks have great eyesight in the dark and would be better camouflaged during darker phases of the moon. Acoustic tags were used to track individual sharks when they passed close to an underwater receiver. The data of 12 shark's locations from May 2013 - June 2013 was provided by Dr. Gregory Skomal, Biologist. Lunar cycle dates were gathered by calendar-12.com, and ArcGIS maps were used to determine the distance of the acoustic stations from shore . The research concluded that the new moon and waning crescent phases showed the highest number of pings out of any other lunar phase. Great white sharks may come closer to shore during darker phases of the moon due to their visual and tactical advantages. Predator/prey interaction increases closer to shore during darker phases of the moon.

## **Jillian Williams**

### Comparing Weight Changes in the Post-Acute Setting Across Different Diagnoses



Mentor: Carolin Dohle, MD

Location of Research: Burke Rehabilitation Hospital

Stroke is the leading cause of disability in the adult population. Approximately two-thirds of patients do not fully recover after strokes and one third cannot walk on their own. Despite weight loss after stroke being reported in literature, it is still unclear whether this is due to stroke specific sarcopenia or due to deconditioning as a result of hospitalization. Obtaining this information will help deepen the understanding of why bodily changes in weight occur following a stroke, and possible ways as to how to prevent these transformations. This experiment investigates whether weight loss differs between stroke, traumatic brain injury and debility patients. This is a retrospective study that concerns stroke, traumatic brain injury, and debility patients previously admitted to Burke Rehabilitation Hospital. Medical records were examined for values such as acute care weight, weight upon admission to Burke, and discharge weight. These measures were analyzed to explore similarities in weight loss between patients with debility, stroke and traumatic brain injury. Statistical significance was shown through a paired t-test for stroke and TBI patients however there was no significant weight loss recorded for debility patients. ANOVA testing revealed no statistical significance however fluctuations in mean values at each stage of recovery was observed for stroke and TBI patients which implies that these groups experienced a much greater weight loss than debility patients. There is significance in weight loss in both the Stroke and TBI patients which calls for a deeper analysis of the effect of rehabilitative treatment on stroke and TBI patients.

## Science Research I



## Annie Chen

### The Dependence of Temperature on the Age of A Neutron Star

Neutron stars, extremely dense celestial bodies, intrigue scientists because of their behavior. These stars are ordinarily studied in Binary systems, which scientists have deduced to be the best way to learn information because these neutron stars in these systems emit stronger radio-waves, which scientists need to determine more definite conclusions. Radio-waves are helpful to scientists to determine properties of neutron stars, including temperature and brightness. The temperature and brightness of the neutron star can be used to theoretically determine the composition of the star. Usually, the older age of a neutron star is correlated with a cooler surface temperature; however, an extremely odd neutron star, PSR J0427–4717 is hotter than scientists expected for it's age. Oleg Kargaltsev, George G. Pavlov, and Roger Romani concluded that this neutron star is hotter for a passively cooling one, at this age, for any reasonable composition. They looked towards possible explanations including complex internal processes, different concentrations of different particles inside the neutron star's center, and the possibility of dark matter inside the neutron star. Despite these hypotheses, scientists have been unable to clearly say, for sure, why this star exhibited behavior that strayed away from the prediction. For future research, data will be analyzed to further explore the dependence of neutron star temperature on age.

## Natavia Dickinson

#### Investigating the Therapeutic Efficacy of Tetryhydrocannibinolic Acid (THCA) in Neuropathic Pain and Determining if Cannabinoid Receptor Binding Sites are Conserved between Mice and Humans

Neuropathic pain is characterized as abnormal hypersensitivity to stimuli, known as hyperalgesia, and nociceptive responses to non-noxious stimuli, known as allodynia in the PNS and CNS. Neuropathic pain has numerous treatments including Cannabinoids such as THC and CBD, but these treatments have limited efficacy. Recently, scientists have compared THCA to THC, a highly investigated cannabinoid, so they can evaluate the similarities and differences of them and how effective they are in pain treatment. THCA, THC's precursor, does not have the psychoactive effects that THC does while preserving the analgesic properties and potency. THCA seems to currently be an ideal treatment for neuropathic pain, and will hopefully help many in their pain management. Published data has suggested effective use of cannabinoids small molecules in alleviating neuropathic pain in animal models. With mice models in testing the efficacy of drugs on humans, the efficacy of THCA and if its binding sites are preserved in both humans and mice needs to be evaluated. Although mice studies do not supplement clinical trials, they are great complements to the clinical trials as all substances exert effects at its cellular and molecular levels, even in rodents. This is consistent in mammals. Animal studies such as the use of mice, are quite effective. Though animal studies cannot completely inform us about all the effects of cannabinoids on humans, the pattern and density of binding sites distributed in the brains of mammals, including rats and humans, were quite exceptional. It was shown that there were high concentrations of cannabinoid binding sites in the basal ganglia, the hippocampus and the cerebral cortex (Joy JE, Watson SJ Jr., Benson JA Jr.,) This also correlates with the effects of cannabinoids observed in laboratory animals. Animal research has shown that cannabinoid dependence does exist and withdrawal symptoms are possible (Joy JE, Watson SJ Jr., Benson JA Jr., ). Scientists hope that THCA bypasses this and does not become a dependent drug. Future research will be directed to expanding the analgesic effects of this compound after single dosing, including making it more potent for more long lasting, but not psychoactive effects and investigate if there are minute psychoactive effects of THCA.

## **Eileen Dockery**

### Using Citizen Scientists to Assess Risk Factors for Wildlife-Vehicle Collisions

Roadkill is the result of wildlife-vehicle collisions (WVC), which are detrimental to both humans and the environment. It's not only a major contributing factor to the decline of local animal populations, but billions of dollars are spent each year in the United States to repair damage sustained from wildlife-vehicle collisions. Factors which impact roadkill must first be identified before roadkill mitigation tactics can be implemented. According to Brooks and Farmer (2012), increased speed limit, increased maximum daily temperature, increased habitat diversity, and closeness to wetlands increases WVC risk in vertebrates. However, there are conflicting results on what variables impact roadkill of all organisms. For example, while increased speed limit increases roadkill risk in vertebrates, it does not increase roadkill risk on serval (*Leptailurus serval*) roadkill, despite servals being a vertebrate (Williams et al., 2019). Future research aims to further clarify which factors have an effect on WVC and discover which mitigation tactics are the most effective in preventing WVC.

## Sloane Englander & Veronica Moloney

### The Effect of Quarantine and Isolation on Romantic Relationships

Love is one of the most studied yet least understood concepts in the world, relating to every living being on the planet. Love/romantic relationships are necessary for the survival of species. The concept of love relates to a multitude of factors such as physical contact, eye contact, usage of social media, presence/lack of a mental disorder, and age/gender. Scientists are still trying to completely comprehend what causes a person to fall in love along with gestures a person demonstrates when they are truly in love. To do this, scientists study brain activity, when activity is present in frontal areas, the typical love "symptoms" are seen. The hormones that are most closely related to this process are dopamine, norepinephrine, and serotonin. Levels of dopamine and norepinephrine rise, while serotonin levels decrease. Also, scientists are able to recognize activity in the ventral tegmental region and caudate nucleus that indicate pleasure, focus, attention, and the motivation to acquire rewards which indicates that love can be seen as a prize to many people. Future research includes evaluating romantic relationships during quarantine as well as analyzing the impacts of social media/dating apps.

## **Rachel Farias**

#### <u>The Effect of a Digital Environment vs In-Person</u> <u>Interactions on Students' Likeliness to Lie</u>

In this age of social distancing, people are interacting less face to face, so are they more likely to lie? Given COVID-19, it is important to understand students deceptive behaviors to minimize cheating, and capitalize on learning. Not many studies have shown students deceptive motives when depiction is playing in an in-person setting versus a digital setting. This is where scientists need to do more research. Monica T. Whitty and Siobhan E. Carville, researchers from Sydney, Australia, conducted experiments to see when people would tell self-serving lies versus other-oriented lies, told across different media such as via email, phonecall, and in-person interaction. The researchers found that participants were more likely to tell self-serving lies to people close to them, rather than face-to-face. it was also found that participants were more likely to lie in emails rather than face to face. Other-oriented lies told to people close to participants, this did not vary according to the type of media. The study concluded that distance links directly in the occurrence of self-serving and other-oriented lies and just lying in general. Future research must be conducted to further test the role of the digital versus physcial settings impact on frequency of lying in students.

## Jolie Ferber

### <u>Analysis of APOE-ε4 and MAP2 Protein Expression in Patients</u> <u>Suffering from Chronic Traumatic Encephalopathy (CTE)</u>

Chronic Traumatic Encephalopathy (CTE) is a brain disease caused by repetitive head trauma. CTE starts to develop during the ages 20-30 and can cause symptoms similar to Alzheimer's Disease. A major problem is that CTE can only be diagnosed through a tissue brain analysis after death. There is no way of knowing someone has CTE while they are alive. There are obvious symptoms of CTE however concussions do not show up on a CT or MRI. A diagnosis requires evidence of injured brain tissue and tau clumps and other proteins to be seen only under a microscope. There is currently no cure for CTE, but there is some treatment to help manage the symptoms such as therapy. The most important findings of CTE are the symptoms. Even though many of the symptoms are similar to someone with AD, the symptoms start to show in different orders, making it somewhat easier to differentiate between CTE and AD. Future research would be conducted to observe if higher levels of proteins extracted from the brain could lead to a diagnosis of CTE.

## Anna FitzPatrick

### The Effect of Sculptural Art Therapies on Sensory Memory Retainment in Patients with Dementia

Dementia is a neurological disease impacting memories and the ability to retain information. Dementia is a non-curable, but treatable disease which can be treated through medicinal and physical approaches. Currently, scientists are attempting different methods of treatment to impact memory retainment, as well as prevent progression of the disease from occurring too rapidly. There has been slow moving interest into different styles of art therapies, and using malleable tactics for treating this in geriatric patients. Based on a pilot study from Heliyon, 12 patients living through a day with dementia were tasked with creating human-size trees out of clay and other materials. This task showed improvement in functioning skills as well as ability to remember certain things based on reuse of these materials. With this information in hand, the group created a set up of a study involving sculptural therapies over an extended period of time. Branching off of this, 3-dimensional arts may be seen as insight into a good alternative treatment for patients suffering from dementia. Future research may include collaborating with a rehabilitation facility to administer this treatment for a more extended period of time while analyzing the effects of this therapy on the patients.

## Magdalena Gianaris

## The Effect of Coffee Shop Aroma & Ambiance on Productivity & Focus

Coffee is a drug and inhaling a coffee fragrance once will improve short-term working memory, enhance alertness, and has the capability of increasing productivity when consumed at moderate amounts. The science of coffee is that it stimulates the blockage of adenosine which essentially inhibits sleep impulse. Adenosine is created in the brain and its binding with adenosine receptors causes drowsiness and the slowing down of nerve cell activity as the body prepares for sleep. A few problems scientists such as Thaneeya Hawiset, Pedro B. Judice, Diana A. Santos, and Astrid Nehlig have tried to solve is the effect of one time coffee fragrance inhalation on working memory, mood, and salivary cortisol level in healthy young volunteers (Thaneeya Hawiset). Other scientists have investigated how ambient noise, most commonly in coffee shops, can affect creativity (Pedro B. Judice, Diana A. Santos, etc). Another research study done was to investigate whether caffeine is a cognitive enhancer (Astrid Nehlig). The most important finds of various research has been that coffee can improve short-term working memory and enhance alertness. It was also found that a moderate level of noise enhances adoption of innovative products meaning that noise in a coffeeshop is helpful with focus and ability to adjust to new spaces when working. Lastly, it was found that caffeine cannot be considered a 'pure' cognitive enhancer. This means that while coffee may affect someone's ability to think there is not a direct correlation. For further research I would like to further look into the science of coffeeshops. Many people go to coffeeshops to complete work and I would like to look into if the atmosphere has any impact on someone's mood and ability to complete basic tasks. In order to research this I would give out an anonymous survey to willing participants who go to a coffee shop and try to complete a few basic tasks. There would be two groups in the trial and one of which would be placebo/ the group that does not go to the coffeeshop so that I could compare the results.

## Macarena Hesse

#### <u>The Effect of Gold Nanoparticles Used in Cancer Treatments</u> on the Toxicity of Model Organism, Planaria

Nanotechnology is a field of science that deals with very small particles, specifically Nanoparticles. Nanoparticles have unique physicochemical properties that are easy to modify and can efficiently target cells through active or passive targeting. Nanotechnology is constantly being used in research as scientists look into it as a form of cancer treatment with less side effects due to its specific targeting capabilities. However, nanoparticles hold many limitations that must be overcome in order to make it more efficient and safe. As few as 0.7% of the injected dose of nanoparticles reach their intended target due to biological barriers. In order to overcome this, it is crucial to look into the unique properties that make nanoparticles so individualized to target cells. By looking at the shape, material and size of nanoparticles, amongst other factors aided by mathematical models, research can be conducted to determine the most successful and safe combination of factors that allow nanoparticles to extend far beyond certain limitations. A specific limitation faced by nanoparticles is toxicity. As most research concerning nanotechnology is relatively new, research on the toxicity levels of nanoparticles and the harm they may cause to humans, animals and plants is largely unknown. The most commonly distributed nanoparticles are gold nanoparticles and it has been determined through research with Zebrafish that Gold Nanospheres are the least likely to have lethal effects. This creates the question of how the size of a gold nanosphere will impact its success rates and toxicity levels as it travels through the bloodstream. By placing Planarians in a gold colloid solution and observing the nervous system reactions of the Planaria through Planarian seizure-like movements, future research will be able to take into account a wide variety of factors when designing nanoparticles. Through this experiment, future research may focus on causing less of these seizure-like movements in Planaria and focus on reducing side effects for Planaria and humans in the future in order to create a safe and efficient drug delivery option that is easily modifiable.

## Madeline Hymowitz

### A Systematic Review of the Effectiveness of Surgery versus Medicine for Ulcerative Colitis in Adolescents

Ulcerative Colitis is an inflammatory bowel disease (IBD) that causes long-lasting inflammation and ulcers/sores in one's large intestine (colon) & rectum. Inflammatory bowel diseases impact up to 780,000 Americans each year, and it is becoming more prevalent in adolescents as years go by. Although there is no medication cure for UC, there is in fact a surgical cure. However, many people don't opt to go straight to the surgical option, but instead explore the many different medications and see if they are effective. The main issue with this is the medications do not always give the best effect, and people end up getting surgery anyway. The solution that is trying to be found is if it is more effective to go straight to the surgical option, without attempting to allow the medications to work. It has been shown in numerous experiments in the past that the probability of avoiding surgery will always decrease even with medications trying to treat the disease. 39% of people with the disease will go in almost a circle, from diagnosis to medication to right back to where they were before they began medications, such as stunted growth, development, permanent stretch marks, weight gain, weight loss, etc. In the future, A Systematic Analysis will be conducted to determine if there are conditions under which medication could provide an acceptable alternative to surgery for adolescents.

## Jack Kelly

### Nuance in America's Binary Political System: A Mathematical Regression Approach to Quantifying the Relationship Between Ideological & Linguistic Partisanship

Partisanship refers to what extent a political figure supports their own political parties policies and governmental ambitions. Partisanship can be measured through both ideological partisanship, based on voting records, and linguistic partisanship, based on how a politician speaks. Political scientists are interested in quantifying partisanship because an objective number is useful for studying changes in political climate overtime and for studying if our current political system is effective. Moreover, the study of partisanship can indicate larger truths about the climate of society and how actual voters are behaving. Poole and Rosenthal (1984) initially developed the most widely accepted way of measuring ideological partisanship. Their Dynamic Weighted Nominal Three-step Estimation (DW-NOMINATE) takes a spatial approach and quantifies partisanship through voting records and cut offs. Gentzkow and Shapiro (2019) have taken a different approach to partisanship and have used machine learning methods at Stanford University to quantify partisanship through how likely you could guess a speaker's party based on a single bigram they used. In order to bridge the gap between ideological and linguistic partisanship, research and a mathematical model is needed to quantify the relationship between these two types of partisanship. Through running a regression and using statistical data analysis, the results of a math-based study on these two partisanship types can give us even more insight to how our political system operates.

## **Danny Mandell**

### Improving Healthcare with the Implementation of Artificial Intelligence and Deep Learning

Artificial Intelligence(AI) is a system of algorithms that are used to make decisions. These decisions are made by data being implanted into a system of algorithms where the system finds patterns and is then able to apply more data to match the patterns of the existing data with the new data. Scientists, doctors, and researchers who use AI are always trying to figure out new and better ways to diagnose, classify, treat, and cure diseases. New improvements in AI and its use in healthcare are constantly being worked on and solved. New AI systems are being made along with new data points and algorithms to allow for healthcare to be as easy as possible. Every day, new improvements are being made and healthcare as a whole is improving. However, healthcare isn't 100% perfect and improvements still need to be made. Some of the most important findings that come through AI involve the diagnosis of diseases. Many diseases such as Alzheimer's Disease are much easier to treat when identified quickly. This is why many recent AI findings have been based on the topic of diagnosing diseases early so the patient can be treated quicker. Here, AI is used to find patterns in patients with Alzheimer's and identify the pattern quicker in a person. Also, there have been recent findings in classifying and diagnosing appendicitis in children as well as predicting acute heart failure mortality. Research in the future must be conducted at an institute in order to keep improving AI in healthcare and make the lives of millions of people better.

## Alex Marino

<u>The Relationship Between the Busyness of a Road, the Amount of Particulate Matter in</u> <u>the Air, and the Lung Health of the Residents Living There</u>

Air pollution is the presence of deadly and hazardous substances in the air. Air pollution is a very big problem in today's world and causes many illnesses and deaths. Scientists are trying to solve many problems relating to air pollution. One of these problems is how the size of a particle of pollution affects the people who inhale them. Scientists are also studying the biological effects of air pollution on the human body. Perhaps the most important issue that scientists are trying to solve is what diseases are caused by exposure to air pollution. In 2011, Arden Pope concluded that smokers or people that inhaled second hand smoke on a regular basis were more likely to develop Lung cancer, cardiovascular disease, and Ischemic heart disease. In 2003, Nicole Janssen found out that children who went to school near a highway with heavy traffic were more likely to have breathing problems. In 2000, Joel Schwartz found out that there were many confounding variables in air pollution including the altitude of the location. Future research will be necessary to find out how the busyness of a road and the proximity of the road to a living quarters correlate with the residents' lung health. This presentation will illustrate the correlation between many different variables of the resident's house and the busyness of their road.

## Gabriela Marraccini

### How Exposure to Human Emotions Affects Dog Behavior and Emotions

Dogs contribute to a human's happiness and can improve a person's health by reducing stress, anxiety, and loneliness. Humans and dogs have a symbiotic relationship that can be beneficial as well as detrimental to both species. Few known studies have explored how dog emotions correlate to human emotion. Typically scientists primarily focus on discovering new information that they can use to deepen discovered information on humans. However, scientists such as Odendaal, Siniscalchi, and Katayama have conducted experiments that focus on finding results and data on dogs. They collectively discovered that when Humans directed different emotions at dogs they responded specifically in terms of heart rate and anxiety. Siniscalchi's experiment further states that when various human emotions were displayed in front of dog anger produced the most pronounced effect. This is important because it shows that human emotion or responding to human emotion. Therefore, testing how the dog responds to different human interactions would be interesting. This testing will focus on the increase and decrease in cortisol levels, heart rate, and behaviors as ways of measuring dog emotion when human emotion is presented in front of them.

## **Eleanor Millard**

### Correlation Between Celiac Disease and Lactose Intolerance

Celiac Disease is a genetic autoimmune disease that affects the digestive system, specifically the villi. The villi are finger-like projections that live on the inside of your small intestines, the villi's main job is to absorb nutrients and fluids. When villi are functional, they would be up straight and tall absorbing all the vital nutrients we need into the bloodstream. When the villi that have been affected by celiac disease are stubby and incapable of absorbing nutrients. The immune system attacks gluten, as foreign material, and as a result, the person gets very sick. They may stomach cramps, feel fatigued, feel nauseous, and have difficulty going to the bathroom. The more chronic effects included high fever when ill and a bloated stomach. As the immune system is attacking the body, other functions may be affected as well such as the nervous system, endocrine system, and other parts of the digestive system. With the body more prone and vulnerable, it is possible to get multiple other ailments other than celiac disease some of which included the inability to digest lactose, cancers, dermatitis hepitaformis (a large rash on the skin). You may also be more prone to get the flu and other viruses. Other studies have looked at the correlation between lactose intolerance and celiac diseases such as the study of Mucosal Reactivity to Cow's Milk Protein in Coeliac Disease conducted by Hallgren, Venge, and Kristjansson. In this study, it was concluded that there was an "Increase in rectal luminal nitric oxide (ΔNO) and rectal mucosal concentration of myeloperoxidase (MPO) (ΔMPO) in patients with coeliac disease (n = 20) 15 h after rectal milk challenge." This just means that after patients with Celiac disease, took the milk challenge, there was an increased amount of rectal luminal nitric oxide. The patient was producing a higher range of Nitrogen Oxide during the inflammatory response that was produced by drinking milk. This proves that the digestive system is vulnerable on multiple levels not just in terms of celiac disease. These conclusions will later help create better ways to detect and diagnosis celiac disease without making the mistake.

## Graham Napack

### Inducing Hypocrisy to Motivate Socially Responsible

### Behaviors During the COVID19 Pandemic

The Hypocrisy Paradigm is a variation of Leon Festinger's original Theory of Cognitive Dissonance that takes advantage of the negative emotions associated with assuming a hypocritical position in order to motivate social and behavioral change. The Hypocrisy Paradigm takes advantage of the underlying dissonance between an individual's previous public statements and their past behavior in order to alter future behavior. The rapid spread of the novel coronavirus across the globe and the current COVID-19 outbreak in the United States, provides an opportunity to utilize this technique for social influence to motivate more socially responsible behavior. A major component of the United States effort to flatten the epidemic curve is encouraging social and physical distancing. However, despite widespread knowledge of the importance of social distancing in slowing the spread of COVID-19, many individuals continue to go out in public and practice unsafe behaviors. This dissonance between the knowledge of socially safe practices and the socially unsafe behavior of many individuals represents a major challenge that public health organizations must overcome. However, this underlying hypocrisy provides an opportunity to harness the power of the Hypocrisy Paradigm. The Hypocrisy Paradigm was developed by Elliot Aronson and his study on the effect of induced hypocrisy on condom use showed that the Hypocrisy Paradigm could be used to motivate behavioral change. By manipulating both a subject's public commitment to practice responsible behavior as well as the subject's awareness of their hypocrisy, it is possible to successfully alter behavior. These findings can be applied to the current Pandemic as a significant underlying hypocrisy currently exists in individuals who are aware of proper social distancing procedures as well as the importance of following these procedures yet do not follow them in public. Future research could exploit this Hypocrisy in order to motivate Socially responsible behavior.

## Katherine Pflieger

### The Impact of Antiviral Medications on HIV Elite Controllers

Human autoimmune deficiency, otherwise known as HIV, is a virus that causes the disease AIDS which currently is treatable but not curable. While most people infected with HIV take Antiviral medications to slow the progression of HIV and live a longer and healthier life, there is a small group of people, called Elite Controllers, who have the ability to naturally maintain low levels of HIV. Ideally, the natural controlling ability of Elite controllers could be used to find a solution to HIV/AIDS, however there are some issues with Elite controllers. Although this natural ability prolongs the life span of Elite controllers and requires no medication, Elite controllers still eventually may die of AIDS and they represent only 1% of the population. In addition, Elite controllers are at higher risk than non-controllers for Atherosclerosis, stenosis, and other opportunistic diseases. Elite controllers produce high levels of immune activation which means they may not show that HIV is progressing. Despite these challenges, there have been many ideas on the way in which Elite controllers could be used for treatment purposes. In a case in which a man was diagnosed with HIV and Acute Myeloid Leukemia, the man, known as the Berlin patient, was given a series of bone marrow transplants from elite controllers. The man became the first person to be successfully cured of HIV and is still alive and HIV and cancer free today. This process has only been successfully replicated one other time however it still demonstrates major progress and a great use for elite controllers. There is evidence that shows that the exposure of Antiviral medications, the treatment for non-controllers, to Elite controllers may have positive results and prolong the lifespan of Elite controllers significantly. If elite controllers were to take ART, it has the potential to lower the risk of Atherosclerosis and other opportunistic diseases which would significantly improve the lives of many Elite Controllers. This presentation will discuss the positive impacts that ART has on Elite controllers and the potential use of this information to provide long term solutions for Non-controllers as well.

## Amelia Rasmussen

### The Impact of Epigenetic and Cocktails of Drugs on Triple Negative Breast Cancer

Cancer is a disease that is made up of mutated cells that are mutating uncontrollably. Triple Negative Breast Cancer is an extremely heterogeneous cancer that is made more difficult to treat with the influence of epigenetics. TNBC is a very difficult cancer to treat and 4/10 women have a rapid relapse and there is a 77% 5 year survival rate in comparison to 93% for other breast cancers. There are many different subtypes of TNBC and there is no specialized treatment for this type of cancer because of how heterogeneous the cancer cells are. Scientists are trying to understand which epigenetic drugs undo specific epigenetic changes and what combinations of drugs function the best. However this is difficult because with increasing the amount of drugs you use there is also an increase in side effects. Epigenetic drugs are able to undo epigenetic changes and methylation groups on the DNA, meaning that the cancer is more homogeneous and easier to treat. A siRNA screening gives scientists an idea of what metabolisms the cell uses and gives a clear pathway of what to target to minimize harm to healthy cells and reduce side effects. Many cells also have multiple cell and metabolic reserves and can switch between different metabolic reserves which is why a combination of drugs is useful in preventing cancer cells from using different metabolic reserves. Cocktails of drugs are proven to be effective because they target more cells, however this can also mean more side effects. Combinations of drugs such as BCL2 and BCL(X)L selective inhibitors and 2-deoxy-D-glucose has proven to be a promising combination of drugs to treat TNBC as well as many others. The more research that is done on the combinations leads to more successful outcomes and combinations of drugs that are able to get rid of all the different subtypes of the cancer in the patient. This research will lead to finding out which abnormalities to target leading to less side effects in the patient as the treatments are no longer targeting as many healthy cells. Additionally advances in new medications and epigenetic drugs will make them more successful and efficient. This presentation will discuss the effect of epigenetics on TNBC and how epigenetic drugs in combination with other drugs will prove to be the most successful in combating TNBC.

## Morgan Remeza

## The construction of a Peltier based Thermal Electric Generator (TEG) system and an analysis of its performance onboard spacecraft.

The objective of my experiment is to test the functionality of a Peltier TEG system in generating electricity from the motor burn during the flight of a high power solid fueled rocket. Sufficient energy supply is essential onboard spacecraft. Stored energy is effective for short time spans, but will eventually run out. Currently there are many renewable sources of energy used on spacecraft, including solar power. But these have been proven to have immense limitations because of their dependencies on specific atmospheric conditions that are not always present during spaceflight. If energy is to run out, the spacecraft will be lost and the mission may fail. By using Peltier TEGs, it may be possible to maintain an alternative renewable electrical power supply for spacecraft, therefore allowing them to complete longer duration missions without the loss of power supply. This is important, especially as we enter a modern space race era, when mankind is attempting to travel beyond where we have ever gone before, such as the Mars. Peltier TEGs are capable of producing energy from both the heat generated by onboard rocket systems (such as propulsion systems) and when temperature differentials may occur naturally within the environment which the spacecraft is traveling through. I have chosen to use a Peltiere TEG system as my design, and will collect the data from the test launches in order to perform the necessary research for my studies. The experimentation involves a set of 20 Peltier modules affixed around the propulsion system of the rocket. They will generate electricity during the motor burn which will be recorded within the data collection section of the vehicle. The rocket will experience different motor burn rates which will impact the temperature differential, acting as the independent variable, 12 volts and 400 mA of electricity was generated under the burn of an CTI K660 rocket motor with 10 Peltier plates. This was near my expected results, and has supported the hypothesis. This test supports that when implemented properly, Peltier TEG systems have the ability to be somewhat functional onboard spacecraft despite the current state of technology.

## Jolie Roshco

### The Relationship Between Grafts and Transplant Survival

Transplant of any kind places the body under immense amounts of stress that can cause the transplants to fail. Scientists and doctors have been collaborating in efforts to make transplants easier on the body and more effective in general. All transplants have their own specific struggles which make them tough on the body, it is even harder to ensure that each person can handle the stress and ensure that they don't fail. Using graphs is a technique in transplantation, and doctors are trying to find a way to be helpful in order to save the grafts and the entire transplant. In a collaborative study by a group of doctors they discovered the use of insulin treatment alongside transplanted cells increases the production and overall use of the transplanted cells. In a separate study it was seen that the use of steroid withdrawal protocol with Sirolimus used as a part of long term immunosuppression improved the survival of the transplants in the greater number of patients. In the future I would like to study the stress of transplant on the human body and evaluate the impact a transplant makes on the body. This presentation will outline the importance of graft survival on a transplant and give different examples of the graft and transplant relationship.

## Kate Rube

### Developing Eco Friendly Bioplastics with Cellulose Derived from Food Waste

Plastic and food waste pose numerous threats to humans and the environment, such as microplastic pollution and greenhouse gas emissions respectively. In order to minimize these effects, bioplastics made from food scraps can be engineered and used in order to limit plastic production while simultaneously cutting back on food waste buildup in landfills. In order to solve this problem, scientists have begun to create alternatives in order to avoid the use of non sustainable materials such as petroleum. While some entrepreneurs and scientists have invented different forms of bioplastic material, not all are biodegradable/compostable and none have used food waste as a material. Therefore, it does not solve any problems that food waste sent to landfills generate, such as the production of gases such as methane and carbon dioxide in dangerous quantities and horrible living environments for people who live close to trash dumps. Ideally, the bioplastics have been made out of by products such as cocoa husk and wood lignin, cellulose is another example that is promising, as it is a molecule often found in many common foods. Cellulose is a strong carbohydrate that is found in foods such as corn cobs, celery, and apple skins. Future research could entail finding the most sustainable and useful foods for use and what foods contain the highest amount of cellulose. It could also mean bringing the technology into households so that plastic bags could be produced in the home, and then the bags could be composted on sight, so that it would be a closed loop system, in which all food waste is converted into bioplastic material which is later composted in the home. Also, finding the cheapest, most sustainable, and most eco-friendly methods of production would also be a future goal.

## Keelan Vaswani

### Exploring The Evaluation of the Ideals of Cognitive Psychology and their Major Branches and Concepts

On the topic of Cognitive Psychology, there are various branches that are connected to the following subject. The following relate to the way an individual thinks and expresses emotions on more of an emotional rather than educational level in more evaluating aspects including the types of moods, cognitive distortions, stress management, and so forth. On the following subject, scientists are continuing to research how to support an individual with the following issues like how cognitive distortions will impact an individual's state on factors of depression or anxiety and how cognitive behavioral therapy can support an improvement on their mental state. Another problem includes the test of how ADHD/ADD medications perform on different students impacting their ability to retain information or socialize with others. Significant findings include how cognitive behavioral therapy supported the depletion of self-hatred/distortions to the mind and as well as allowing others to learn about being able to adjust in alternatively difficult environments including school of all levels, working areas, and so forth. The following represents the following concepts briefly in depth about cognitive behavioral therapy supporting stress management and self-deprecating thoughts, the impact of cognitive disorder medications on an individual's performance, and as well as the way scientists are finding out how to learn about the origin of depressive symptoms in college students.

## Daniella Zumbo

### The Effect of Dietary Intake on the Recovery Period of Patients with mTBI

Mild traumatic brain injuries are some of the most common injuries seen in pediatrics. Scientists have done research to figure out what exactly happens when a child gets a mTBI and how to assess the severity of it to predict the recovery period for patients. This research is very important in coming up with the inquiry of how to decrease the amount of time it takes to heal a mTBI. Since these injuries are so common in children, it is important that they are healed as quickly as possible. The brain doesn't stop developing until mid-20s and even sometimes early 30s, and the adolescent years are crucial to developing one's brain. In Rausa's study, she focused on finding factors that could help foresee the recovery of adolescents with mTBI. Her research presented that cognition, proteomics, and pre-injury/injury related factors should be examined to help predict recovery in patients. Dhaem's research focused on creating a survey-like set of questions for the patient to answer. The set of questions focused on evaluating the patient's physical and emotional pain, as well as discrepancies to before the injury occurred. Similarly to Rausa's work, Dhaem's work allowed doctors to work out a period of recovery for the patient. The work that people are doing to find out this period of recovery is great, but there is not much that has been linked to decreasing that period. Future research must be conducted to allow for patients to heal as quickly as possible and decrease the risk for symptoms to persist past the allotted time to heal.

# HARRISON HIGH SCHOOL SCIENCE AND TECHNOLOGY SYMPOSIUM

#### **Special Thanks:**

The students and teachers of the Harrison Science Research Program thank you for "attending" this year's *Virtual Science Symposium*. We hope you enjoyed viewing the students' work!

Thank you to Andy Nicol, Michael Hauer and Joan Tiburzi for helping make this virtual presentation of the 2020 Science Symposium possible.

We would also like to thank the High School Administration, Faculty, Secretarial, and Custodial Staff for supporting our program throughout the year.



#### Questions . . .

If you have any questions about the Research Program and/or the events of tonight, please feel free to contact either of us: Mr. Randy Gunnell at: gunnellr@harrisoncsd.org Ms. Allison Blunt at blunta@harrisoncsd.org.