



**HARRISON SCIENCE
RESEARCH PRESENTS:**



The 19th Annual

HARRISON HIGH SCHOOL SCIENCE AND TECHNOLOGY SYMPOSIUM

Monday, June 7, 2021

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 [this YouTube playlist](#) 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:

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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.

Roya Azar

Determining the Implications of KRN7000 vs. AH10-3 in hCD1d-KI Mice and the Implications Va24 Genotype on iNKT Cell Expression in VaKI Mice for Cancer Immunotherapy Research

**Location of Research:**

Albert Einstein College of Medicine

Mentor:

Dr. Alejandra Saavedra

Intended Major:

Biology

Fairs & Awards:

WESEF 2021- 4th Place in Cellular & Molecular Biology

Tri-County 2020 - 2nd Place in Biology

Westlake 2019 - 2nd Place in Cellular & Molecular Biology

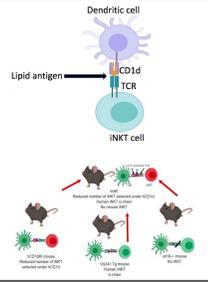
iNKT cells (invariant Natural Killer T-cells), a subset of T-cells in the immune system, activate with synthetic glycolipids and can be used for cancer immunotherapy. But a synthetic glycolipid hasn't been identified as more effective in providing anti-tumoral responses, in terms of iNKT cell activation. The impact of synthetic glycolipids KRN7000 and AH10-3 on iNKT cell proliferation was analyzed in this study. The hypothesized impact was that mice with KRN7000 would proliferate more iNKT cells than mice with AH10-3. In addition, the transition of iNKT cells research to clinical trials hasn't been successful. To create a more accurate mouse model for iNKT cell research, a new strain of mice has been created called VaKI mice. However, a discrepancy found was 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 determine the implications of homogeneity for Va24, 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 double the percent of iNKT cells compared to heterozygous mice. Mice homozygous for Va24 contained an average of 51.35% of iNKT cells while mice heterozygous for Va24 an average of 29.82% of iNKT cells.

Abbreviations/ Key Terms: Va24, human gene for α -chain of iNKT cell receptor; VaKI, Va24 Knock-In mice (mice containing hCD1dKI, mCD1dKO, Va24-T, and Ja18KO)

Determining the Implications of KRN7000 vs. AH10-3 in hCD1d-KI Mice and the Implications Va24 Genotype on iNKT Cell Expression in VaKI Mice for Cancer Immunotherapy Research

Introduction

- ★ Cancer Immunotherapy → invariant Natural Killer T cells (iNKT cells): activated with synthetic glycolipids (ie. KRN7000, AH10-3)
- ★ Discrepancies in iNKT cell cancer immunotherapy research conducted in mice
- ★ **Gap:** The most anti-tumoral cancer immunotherapy treatments in terms of proliferation and activation of iNKT cells has yet to be identified.
- ★ **Hypothesis:** KRN7000 will cause more proliferation of iNKT cells compared to AH10-3 in the liver of hCD1d-KI mice. Mice homozygous for the Va24 gene will show a higher frequency of humanized iNKT cells than mice that are heterozygous for the Va24 gene.



Methodology: Part A

Independent Variable: Synthetic Glycolipid
Dependent Variable: iNKT cell count

PCR → Gel electrophoresis → FISH

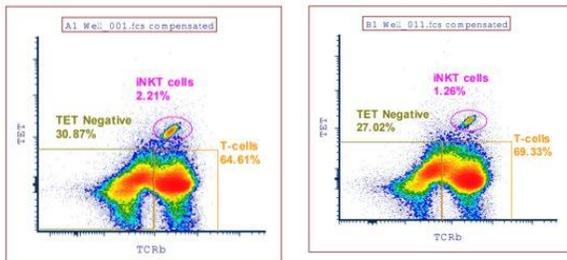
Detect DNA sequence of iNKT cells in liver of mice → Cytometry



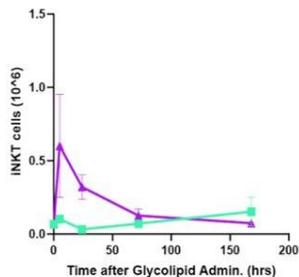
Results & Analysis

KRN7000

AH10-3



iNKT cells/ Liver: AH10-3 vs. KRN7000

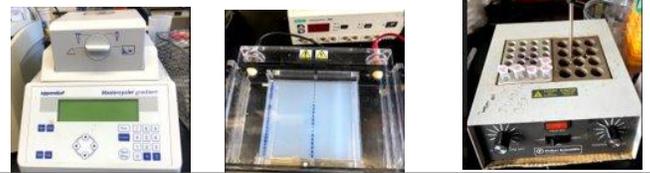


Methodology: Part B

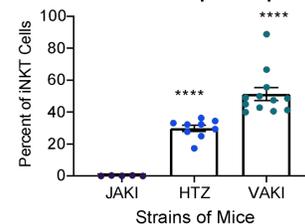
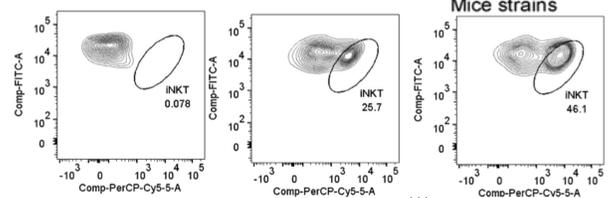
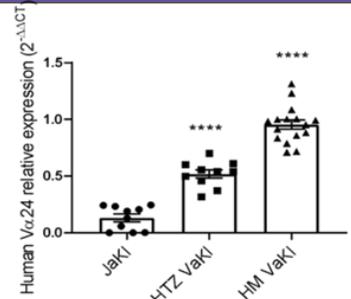
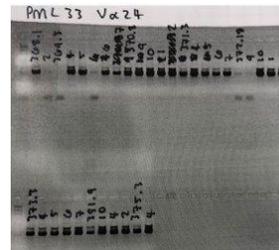
Independent Variable: Va24 Gene Quantity
Dependent Variable: iNKT cell count

PCR → Gel electrophoresis → qPCR

Cytometry → Data analysis: ANOVA and Tukey's testing



Results & Analysis



Conclusion & Future Research

- ★ **Hypothesis supported** → KRN7000 has more anti-tumoral effects than AH10-3 and Mice homozygous for Va24 had more iNKT cell activation
- ★ Future Research: synthetic glycolipid study within VaKI mice

Tyler Burden

Evaluating the Effects of Dance Improvisation on
Brain Activity Using a Battery of Cognitive Tests



Location of Research:
Home/Harrison High School

Mentor:
Ms. Allison Blunt

Intended Major:
Neuroscience & Dance Double Major

Fairs & Awards:
Regeneron STS 2021 Scholar
JSHS 2021
WESEF 2021 - Innovations in Biology Award
NYSSEF 2021

Traditionally, 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). Musical improvisation in the form of dance holds the same definition, but with movement of the body, specifically, as the action which is spontaneously selected and executed. Though studies have utilized fMRI techniques to measure the brain activity associated with musical improvisation in jazz musicians (Donnay, et al., 2012), there are limitations to the use of fMRI with the process of dance improvisation. This study utilizes an alternative method, cognitive tests, to measure changes in cognition in a group of children and teenagers before and after improvisation intervention activities and provides insight into the areas of the brain that are activated during the process. Paired t-tests were used to determine if there were significant differences between pre and posttest scores for each activity. The hypothesis was partially supported, as the results showed that scores on a divergent thinking test were significantly higher after participation in a dance improvisation activity, as well as a verbal, non-physical improvisation activity ($p < 0.05$). These results indicate the activation of the medial prefrontal cortex of the brain during improvisation activity and support the implementation of improvisation activities into primary and secondary education systems as well as therapies for neurodegenerative diseases.

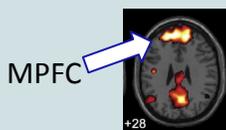
Evaluating the Effects of Dance Improvisation on Brain Activity Using a Battery of Cognitive Tests

Introduction

- *Dance improvisation (improv)*: Spontaneous movement that is not pre-arranged (Savrami, 2017)
- Modes of Thinking:
 - **Divergent**: conceptualizing multiple solutions
 - **Convergent**: choosing the best (1) solution (Ewy, 2018)

Review of Literature

- Improv activities → improvements on divergent but not convergent thinking test scores (Lewis, 2012)
- Activation of the medial prefrontal cortex (MPFC) during divergent thinking (Ellamil et al., 2012)
- Improv causes widespread activations in the prefrontal cortex with focal activations in the MPFC
- Dysfunction of MPFC in neurological disorders (Xu et al., 2019)



Methodology

Pretest

- Battery of cognitive tests administered in randomized order
 - Convergent thinking test (RAT)
 - 2 divergent thinking tests (AUT & W/K)
 - Memory test

Activity

- Participants complete 1 of the 4 activities (selected randomly)
 - Activity A: Control
 - Activity B: Verbal improv
 - Activity C: Technical dance
 - Activity D: Dance improv

Posttest

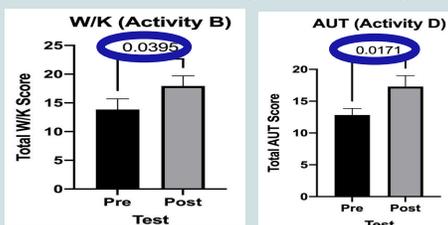
- Different versions of same battery of tests

Evaluation

- Analyze effect of activities on cognitive test scores
- Paired t-tests and ANOVA

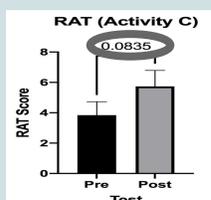
Results & Analysis

Divergent Thinking Test Results



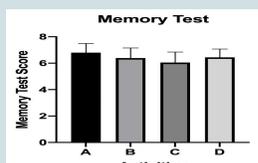
- W/K: Sig. increase for Activity B only
- AUT: Sig. increase for Activity B and D (improv)

Convergent Thinking Test Results



- No sig. differences in scores
- Activity C approaching sig. ($p=0.0835$)

Memory Test Results



- No sig. differences between activities

Conclusion

Hypothesis partially supported:

- Participants' scores on divergent thinking test increased after Activity B (verbal improv) AND Activity D (dance improv)
- No significant differences in memory test scores

Applications

- Educational setting
 - Improv activities can stimulate divergent thinking and creativity in students
- Activate MPFC
 - Divergent thinking → MPFC activation
 - Improv for neurological disorders
- Therapy for neurodegenerative diseases
 - Physical and cognitive benefits of dance improv

Future Research

- fMRI or EEG technology to validate results
- Participants: differences between results for different ages, patients with neurodegenerative diseases, etc.
- Compare different types of improv

David Cross

Modeling The Effects of IUU Fishing of *M.Paradoxus* on the Southern Benguela Ecosystem



Location of Research:
Harrison High School

Mentor:
Adriana E Aquino-Gerard

Intended Major:
Early Childhood/Childhood Education

Fairs & Awards:
Westlake 2019

IUU Fishing is the acronym the UN has given to all commercial fishing operations that occurs through Illegal means, goes unregulated, or is unreported to local authorities. IUU Fishing is a major problem because it destabilizes marine ecosystems by undercutting the fisheries guidelines and regulations set by local governing bodies to maintain a healthy ecosystem. Scientists use reported data in order to establish guidelines for safe amounts of catch that an ecosystem will be able to repopulate itself from by the time of the next season. Because of its illegal nature, IUU Fishing presents variables that are difficult to calculate. These variables have a negative effect on the accuracy of the guidelines set for safe catch. The South Atlantic African nation of Namibia relies heavily on fishing, as it is a major sector of its economy. Unfortunately, Namibia's Exclusive Economic Zone, (EEZ), has suffered from IUU Fishing at the hands of both foreign and domestic fishing operations. The *Merluccius paradoxus*, (*M.Paradoxus*), or Deep Water Cape Hake, is a highly targeted species due to its potential for nutritional value and its abundance within the EEZ. This study uses a qualitative model to show the effects IUU Fishing can have on population distributions within ecosystems. This study also tracks changes in abiotic factors such as acidity, CO₂ concentration, and ocean temperature that are trending in a negative direction as it relates to the health of marine ecosystems. The increase in CO₂, as well as the increase in acidity and ocean temperatures, will certainly have a negative effect on the Northern Benguela Ecosystem. A model is presented quantifying the results of proposed numerical goals to decrease IUU Fishing.

Cooper Danzig

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



Location of Research:

Harrison High School
edX Coding Class: “APP1x – Build your very first iOS app”

Mentor:

Mr. Michael Klein

Intended Major:

Human and Organizational Development at
Vanderbilt University

Fairs & Awards:

Westlake 2019 - 3rd Place in Behavioral
Sciences

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 sports. 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 preventing children with disabilities from getting the necessary physical activity is the lack of communication between stakeholders involved. Adaptive sport programs are competitive or recreational sports for people with disabilities that make the necessary modifications so that these people can participate in sports. Participation in adaptive sport programs is crucial because they adhere to the skill levels of children with disabilities and facilitate participation in physical activity despite the multiple barriers faced. Through further research it was found that many parents of children with disabilities are not aware of the adaptive sport program opportunities in their area and the recreational professionals at the programs struggle to find participants. As a result, the children with disabilities are not getting the needed physical activity to lead a healthy life. To combat this issue, the idea of an app was created that can break down the communication barrier and increase the overall participation of children with disabilities. The app uses information obtained from a survey of the child’s symptoms and data collected about different adaptive sports programs to give the best options that will meet the need of the athletes.

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

Introduction

- 9 in 50 children in the U.S. have a disability or chronic health problem
- Children with disabilities participate in less physical activity due to multiple barriers (Horat, 2017)

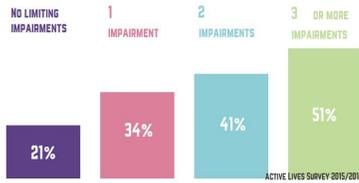


Figure 1- Proportion of people who get less than 30 minutes of physical activity a week (SportEngland, 2017)

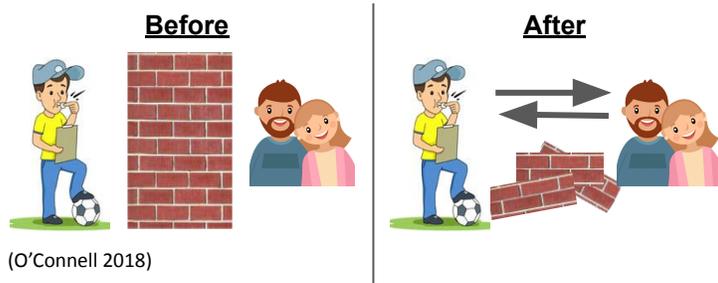
- Participating in sports has physical and psychological benefits for children (Morgan, 2014)
- Long term inactivity can lead to health problems
- Behaviours begun earlier in the life lead daily routine throughout lifespan (Kohn et al., 2006)

Gap in Knowledge

Lack of communication between parents looking for adaptive sports programs and the recreational professionals makes it difficult for children with disabilities to get the physical activity necessary to live a healthy life.

Goal

Create an app that can break down the communication barrier and increase children's access to sport programs



Hypothesis

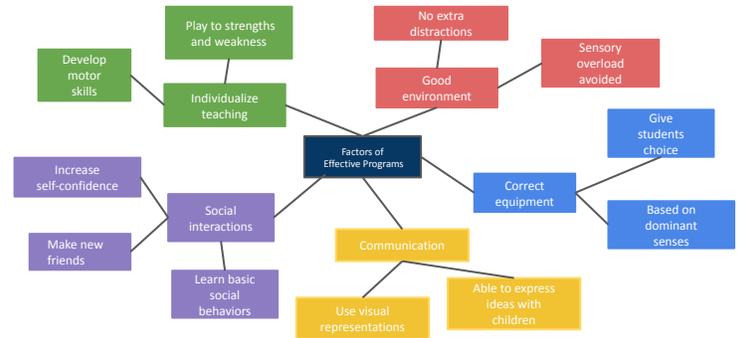
If you break down the communication barrier parents will be more informed and participation will increase



- iPhones are ubiquitous in Northeastern United States and could provide access to parents who are otherwise hard to reach
 - ◆ 100 million iPhone users in the US
 - ◆ Consumers downloaded 204 billion apps in 2019

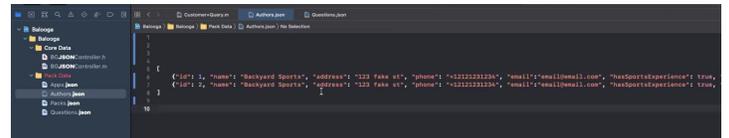
Methodology

Determining Program Factors



Building the App

- Use Xcode for the software and user interface
- Coding class through edX



- Create an entity for all programs
- Each program gets a line with several fields
- Each attribute will be entered as a Boolean
- There will be a fetch request for a perfect match
- Secondary query for the most important

Survey about the symptoms the child shows



Algorithm gives best options for the child



Parents can see specifics about the programs



Conclusion & Future Research

- The app will help parents that are looking for the right programs for their child communicate better with coaches and teachers
- App will be personalized to give best adaptive sports programs based on their children's needs
- Evaluate effectiveness of app over time: look for increase in participation in adaptive sports programs following use of app for 6 months
- Expand app to other regions
- Compare availability of adaptive sports programs in other regions of the US - suburban vs urban & rural, regions other than the northeast, possibly international

Arwen O'Brien

Phenotypic Behavioral Expression of Different Genetic Lines of *Drosophila melanogaster* as measured by the Negative Geotaxis Assay & Their Response to Lithium Chloride:
A Pharmacogenomics Study



Location of Research:
Home/Harrison High School

Mentor:
Dr. Cale Whitworth

Intended Major:
Biomedical Engineering

Fairs & Awards:
ISEF 2021
NYSSEF 2021: Top 15 Projects NYS
WESEF 2021: Excellence in Medical Research
Award
JSHS 2021: 3rd place in Medicine & Health

Annually, adverse drug reactions cause 1.5 million hospitalizations. In practice, medicine is often prescribed by trial and error to determine the best drug and dosage. Genotypes influence the level of enzymes that metabolize medications, meaning different dosages and drugs are required for effective treatment. Pharmacogenomics studies this relationship. Many studies focus research on the Cytochrome P450 (CYP450) enzyme system, as CYP450s are the major enzymes that metabolize medications. Few studies have explored the relationship between CYP450s and the metabolization of antidepressants. This led to the research on how genetic makeup in *Drosophila melanogaster* affects response to the same dosage of known mood stabilizer, lithium chloride. This experiment consisted of three parts. Part 1 involved a genetic screen designed to identify mutations in CYP450 genes that could result in quantifiable differences in behavioral responses that correlate with motivation, used when modeling depression in flies. In Part 2, genetic crosses were used to introduce mutations in Trh[01] into the individual CYP40 mutant backgrounds. Trh[01] is a major enzyme required for serotonin production, a compound known to influence motivation. In Part 3, experimental and control genotypes were given 50mM of LiCl and their motivation levels were tested. The four genetic backgrounds had significant differences in their response to the same dosage of LiCl ($p < .05$) indicating that genetic makeup does influence response to medication. This implies that *D. melanogaster* is a good system for pharmacogenomics studies and could be used to expand our knowledge about the roles of CYP450s in antidepressant treatment.

Phenotypic Behavioral Expression of Different Genetic Lines of *Drosophila melanogaster* as measured by the Negative Geotaxis Assay & Their Response to Lithium Chloride: A Pharmacogenomics Study

Introduction



- ➔ Major Depressive Disorder (MDD)
- ➔ Lithium: Antidepressant for MDD
 - ◆ Enhances serotonin synthesis and release
 - ◆ Large variability in response
- ➔ Cytochrome P450 (**CYP450**):
 - ◆ Metabolizes serotonin (Ahmed et al, 2016)
 - ◆ 80% of medications (Van Der Weide and Hinrichs, 2006)

Methodology

Part I: Genetic Screening

- ➔ Perform best contain least CYP450 using negative geotaxis assay (NGT)

Part II: Genetic Cross

- ➔ Punnett Square (CYP4C3 x Trh[01])
 - ◆ Trh[01]: produce no serotonin
 - ◆ Used balancer chromosomes

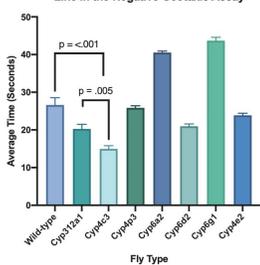
		Mutant	Balancer				
Homocytgous	TRH1	<table border="1"> <tr><td>Mutant</td></tr> <tr><td>TRH1</td></tr> </table>	Mutant	TRH1	<table border="1"> <tr><td>TRH1</td></tr> <tr><td>Balancer</td></tr> </table>	TRH1	Balancer
	Mutant						
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Balancer							
TRH1	<table border="1"> <tr><td>Mutant</td></tr> <tr><td>TRH1</td></tr> </table>	Mutant	TRH1	<table border="1"> <tr><td>TRH1</td></tr> <tr><td>Balancer</td></tr> </table>	TRH1	Balancer	
Mutant							
TRH1							
TRH1							
Balancer							

Part III: LiCl Administration

- ➔ 50mM LiCl to 4 genetic lines
- ➔ Test again using NGT

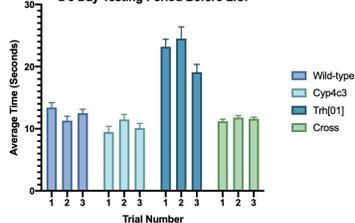
Results & Analysis

The Relationship Between Fly Type and Average Performance Time of All 10 Flies to Cross 8cm Line in the Negative Geotaxis Assay



CYP4C3 = 14.99s sig. faster ($p < .01$)
Wild-type = 26.61s

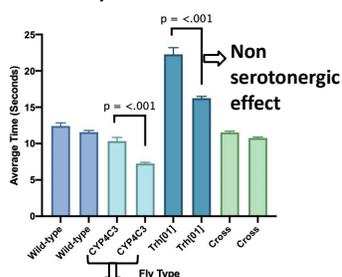
Comparison of Average Performance Time Over a 3 Day Testing Period Before LiCl



No significant difference across 3 days of testing ($p > .05$)

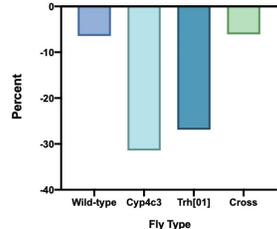
↓
Inotropic mechanism

A Comparison of Performance Time of *Drosophila melanogaster* with different Genetic Makeups in the Negative Geotaxis Assay Before and After Administration of LiCl



Manic state

Percent Change Before and After Administration of LiCl



CYP4C3 and Trh[01] significant change ($p < .01$)

Conclusion & Future Research

Hypothesis

Flies with different genetic makeups performed differently in negative geotaxis assay

Respond differently to same dosage LiCl

Genetic makeup plays role in phenotypic behavioral expression of genes

Human Orthologs (via DIOPY v8.0)			
Homo sapiens (Human) (23)			
Species/Gene Symbol	Score	Best Score	Best Reverse Score
HsapCYP4V2	13 of 15	Yes	Yes

Bailey Fisher

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



Location of Research:
Home/Harrison High School

Intended Major:
Sports Management

Fairs & Awards:
WESEF 2021 - 4th Place in Engineering
WESEF 2021 - David M. Holmes Engineering
and Innovation Award
JSHS 2021 - 4th in Engineering Regional
Competition
NYSSEF 2020 - High Honors

The purpose of this study was to create a device to be able to create a mechanism to measure the speed as a person falls over in their chair and measure the amount of pressure needed to restore the height of an inflatable bag with different weights on it. This study focused on creating a mechanism to measure the acceleration and gathering data about how different weights cause the pressure in a bag to rise and then the amount of pressure needed to increase the height of the bag. 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 both the devices, an Arduino board attached to a MPU-6050 sensor measured the acceleration and a life vest was attached to a mechanism that was built with two pressure gauges and a ball valve to open and close the airpath into the bag. The acceleration device was tested through humans falling over in a chair, while the other device was tested using different weights. From this data, it was found that every ten pounds, the pressure it took to restore the height in the bag was significant. This trend means that in building a device for people to wear, the device would be programmed to inflate for every ten pound the person put on the device.

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

Introduction

- More than 10 million people are affected with Parkinson's Disease (Medical News Today)
- Currently no cure to Parkinson's Disease
- Progressive nervous system disorder
- Caused by loss of dopamine neurons in the substantia nigra
- Symptoms: Tremors, gait/balance, falling while walking or sitting

Gap in Knowledge

No current wearable device to help Parkinson's patients maintain an upright seated position.

Engineering Goal

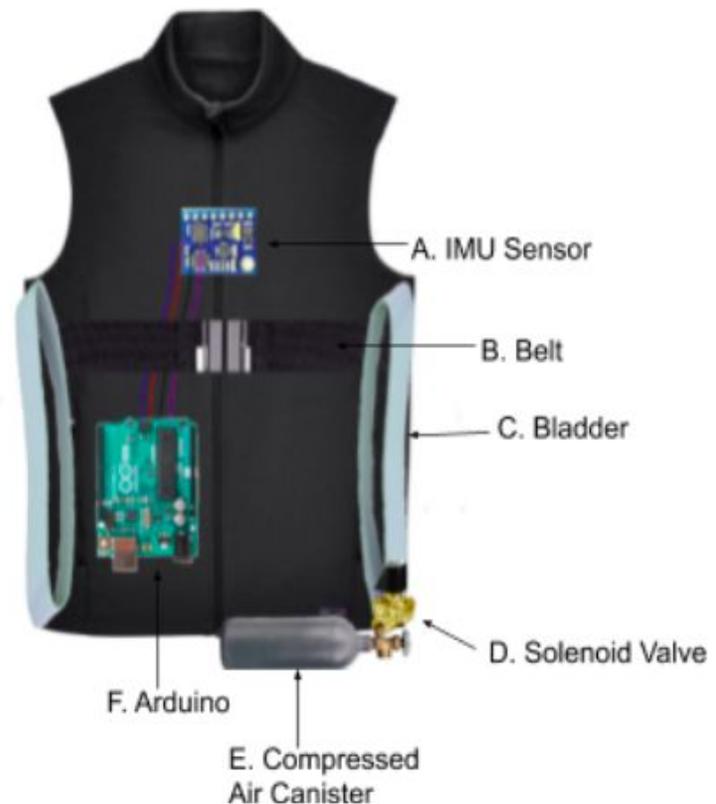
- Create a smart, wearable device to help Parkinson's patients maintain an upright seated position
- Determine an acceleration threshold using an IMU sensor and Arduino during a fall from a seated position

Threshold

Left: -0.2709 to -0.0776 ms^{-2}
Right: -0.2152 to -0.1110 ms^{-2}
Not a Fall & Right Fall: $4.00\text{E}-08$ Significant
Not a Fall & Left Fall: $3.95\text{E}-06$ Significant
Left Fall & Right Fall: 0.437 Not significant

Methodology

- 1) Interface IMU sensor and Arduino Board and Download Code
- 2) Participants were selected
- 3) Participants sat on a chez lounge
- 4) Participants shown an example fall
- 5) Participants did a practice fall
- 6) Participants fell 5 times to the left and right
- 7) Not a fall was also recorded
- 8) Time threshold was determined



Right Averages

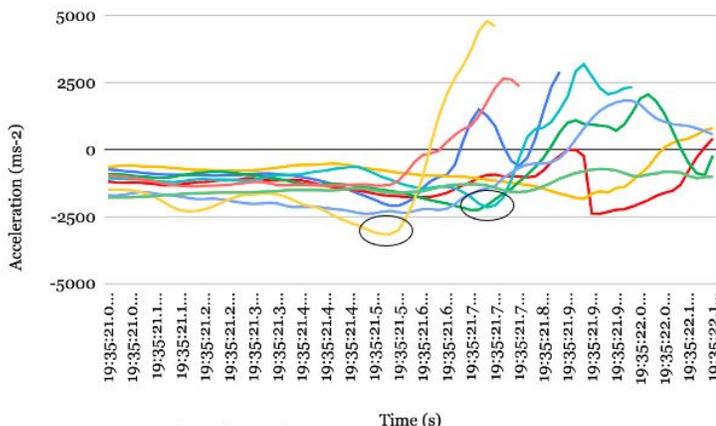


Figure 2: Average Right Fall Graph

Threshold

- Promote safety and allow for normal life functions for Parkinson's patients
- Device needed as falling over is a real threat to safety
- Implemented into lives of others with locomotive disorders

Alexandra Gresham

Studying the Correlation between Screen Time and Anxiety Levels in Adolescents



Location of Research:

Harrison High School

Mentor:

Mr. Randy Gunnell

Intended Major:

Health Studies

Fairs & Awards:

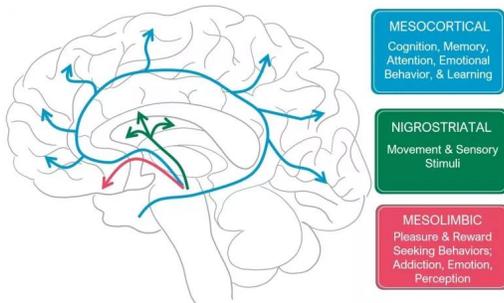
WESEF 2021

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 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, my previous study aimed 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. Thus, based upon the results and limitations of the previous study, it was decided to conduct a second study that would counteract these limitations with the hope that a stronger relationship would be determined by the results. In order to do this, the study was conducted to determine the correlation between the screen time and the anxiety levels of high school students through a survey in which the participants disclosed their average weekly screen time and their anxiety levels.

Studying the Correlation between Screen Time and Anxiety Levels in Adolescents

Introduction

- Problematic phone use is an inability to regulate one's use of the mobile phone, which eventually involves negative consequences in daily life
- Cell phone addiction is caused by a release of hormones oxytocin, dopamine, and cortisol that can create stress and addictive behaviors



- Cell phones cause one to isolate themselves lack of interpersonal connections
- People use their phone as a coping mechanism when in uncomfortable or upsetting situations

Methodology

Development of Assessment Tool

- Google Form

Board Approval

- Human Participants
⇒ Maintain ethical guidelines

Participant Recruitment

- Male and female high school students
- Parents consent

Distribution of Assessment Tool and Data Collection

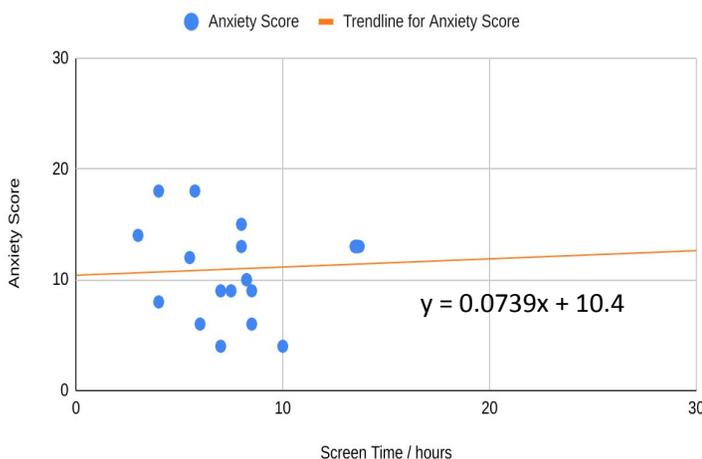
- Male and female high school students
- Parents consent

Debrief and Analysis

- Survey data recorded and analyzed in Google Sheets

Results & Analysis

Anxiety Score vs. Screen Time



Regression Statistics	
Multiple R	0.06575394214
R Square	0.004323580907
Adjusted R Square	-0.04546024005
Standard Error	4.009727081

Conclusion & Future Research

- Positive relationship found
 - As participants increased the amount of time spent on their smartphones per day, anxiety levels increased
- Graph and Trendline → very weak positive relationship; not all of the participants followed this trend
- Limitations
 - External factors contributing to anxiety
- Conclusion: Hypothesis Rejected
- Future Research:
 - Cell phones and sleep
 - 100% of participants sleep with cell phones in the same room
 - Cell phones and social media
 - Does specific content on cell phones contribute to anxiety rather than just screen time?

Larissa Iraj

The Epigenetic Effects of the Antioxidant, Resveratrol, on Prolonging the Lifespan of *Drosophila melanogaster* Over Multiple Generations

**Location of Research:**

New York Medical College, Home

Mentor:

Dr. Frances Hannan, Ms. Allison Blunt

Intended Major:

Biology

Fairs & Awards:

WESEF 2021 - 1st Place in Medicine and Health, Future of Medicine Award

Tri-County 2021- 1st Place in Health and Nutrition

NYSSEF 2021 - 3rd Place

JSHS 2021

Tri-County 2020 - 3rd Place in Medicine and Health

Westlake 2019 - 3rd Place in Cellular and Molecular Biology/ Microbiology

WESEF 2019

JSHS 2019

Resveratrol is a natural phenol and antioxidant found in the skin of red grapes, used in red wine, and has been shown to increase lifespan. Bhullar et al. (2015) found that feeding *Drosophila melanogaster* 100 uM resveratrol extended their mean lifespan by 29%. However, few known studies have explored the epigenetic effects of resveratrol over multiple generations. A dose-response study was conducted over three generations. 10 mL of resveratrol concentrations of 0 uM (control), 10 uM, 100 uM, 200 uM, 400 M, and 1000 uM were added to 3 grams of Formula 4-24® Instant *Drosophila* Medium Blue from Carolina Biological, for the P1 generation of Wild-type *Drosophila melanogaster* (n=25/vial for 6 vials). The F1 (n=30/vial for 12 vials) and F2 (n=40/vial for 12 vials) generations were raised on blue food medium without resveratrol. For all 3 generations, the flies fed 1000 uM in the P1 generation lived longer on average than the control. The F2 generation fed 100 uM and 400 uM diets in the P1 generation lived significantly longer on average than the P1 generation ($p < 0.05$). Also, the F2 generation fed 10 uM diet in the P1 generation lived significantly longer on average than the F1 generation ($p < 0.05$). Kaplan-Meier Curves showed that the F2 generation experienced the greatest percent survival. These results indicated that resveratrol promotes longevity and may have a protective epigenetic effect on subsequent generations.

The Epigenetic Effects of the Antioxidant, Resveratrol, on Prolonging the Lifespan of *Drosophila melanogaster* Over Multiple Generations

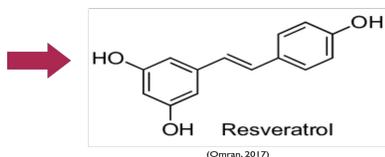
Larissa Iraj

Introduction

- Fountain of Youth = mythical waterfall that restores youth to those who bathe in or drink it
- Resveratrol (3,4',5-trihydroxystilbene), a natural phenol present in skin of grapes and used in red wine



(Krumins, 2015)



Figures 1 and 2: Figure 1 represents the Fountain of Youth. Figure 2 is the chemical structure of a resveratrol molecule.

- Resveratrol shows promise in increasing lifespan in many model organisms (Bhullar & Hubbard, 2015)

Organism	Species	Mean lifespan extension
	<i>Saccharomyces cerevisiae</i>	70%
	<i>C. elegans</i>	10-14%
	<i>C. elegans</i>	9-18%
	<i>D. melanogaster</i>	29%
	<i>D. melanogaster</i>	10-17%
	<i>D. melanogaster</i> (female only)	10-15%
	<i>Apis mellifera</i>	33-38%
	<i>N. fuscus</i>	33-56% (partial)
	<i>N. guentheri</i>	19%
	<i>Mus musculus</i> (2D)	N.O.
	<i>M. musculus</i> (4HTD)	33%*

Figure 3: The mean lifespan extension in model organisms (Bhullar & Hubbard, 2015).

- Possible Mechanism= Histone Modification

Methodology

Drosophila melanogaster

- Short lifespan allows multiple generations to be observed
- Easily manipulated → diet can be changed & quantity alive/dead can be counted daily



Figure 4: A *Drosophila melanogaster* (Masquely, 2017)

Resveratrol

- Non-toxic and in powder form → easily dissolvable into ethanol and distilled water



Figure 5: Bulk Supplements Resveratrol Powder (Bulk Supplements, 2021).

Experimental Design

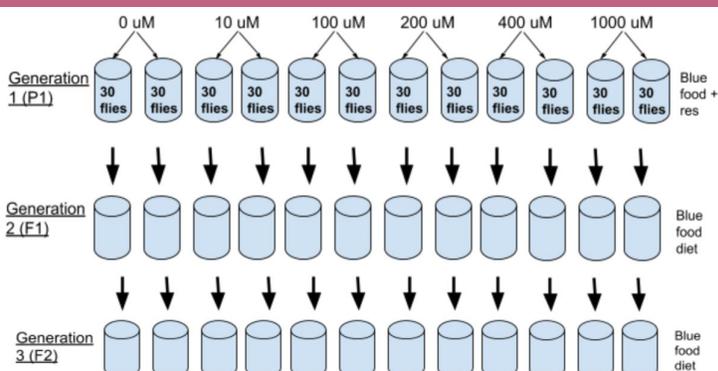


Figure 6: The experimental design and vials of flies for each generation and concentration of resveratrol (Iraj, 2020).

Results & Analysis

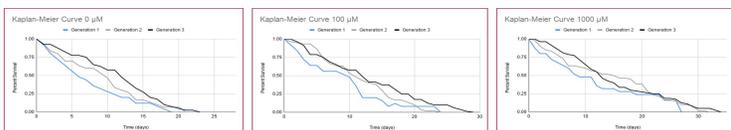


Figure 7 A-C: Kaplan-Meier Curve For Each Diet. (Iraj, 2020). Mortality probability ↓ in F2 generation as the resveratrol concentration ↑.

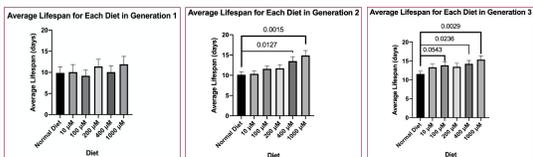


Figure 8 A-C: Average Lifespan For Each Diet in all Three Generations. ↑ dosage of resveratrol in P1 = significant ↑ in lifespan in F1 and F2 (T-tests determined that p < 0.05).



Figure 9 A-C: Mean Average Lifespan Over Three Generations For Each Diet. Longer lifespan in all three generations for each diet when compared to the control.

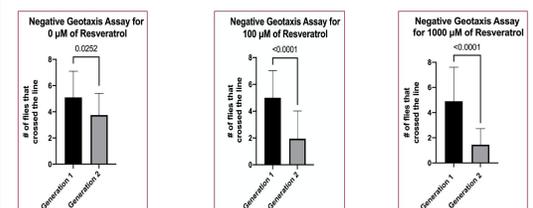


Figure 10 A-C: Negative Geotaxis Assay for Each Dosage in Generation One and Two. F1 performed significantly worse vs. P1 (p < 0.05) possibly due to a slow down in metabolism.

Conclusion

- Hypotheses were supported
 - Flies in F1 and F2 generations lived longer than flies in the P1 generation
 - Flies in F1 generation performed significantly worse than P1 generation in negative geotaxis assay
- Epigenetic mechanism= Histone Modification; mimics Caloric Restriction
- Resveratrol = modern Fountain of Youth
- Resveratrol offers promise in increased lifespan while providing a natural alternative to medicines that often are costly and can have dangerous side effects

Future Research

- Compare flies on a calorie reduced diet to flies on resveratrol diet to see if there are similar results over multiple generations
- Further study in mammals and eventually humans

Jillian Kaplan

Testing Anxiety Levels in a Group Versus Individual Setting

**Location of Research:**

Harrison High School

Mentor:

Mr. Randy Gunnell

Intended Major:

Psychology

Fairs & Awards:

WESEF 2021

JSBS 2021 - 2nd Place in Behavioral Sciences

Westlake 2019 - 1st Place in Behavioral
Sciences

The purpose of this study was to examine phobia based responses in different social settings. It was 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 7 commercials approved for public viewing, 3 of the videos were phobia related (either testing fear of clowns, dogs, or heights) and the other 4 videos were distractors (did not have any phobia related content). After viewing each video, participants rated a set list of emotions (including anxiety and fear) on a scale of 1-5 (5=most). The results showed that anxiety/fear was significantly reduced when participants viewed phobia videos with a friend ($p < .05$). These results warrant examination of group therapies as ways to decrease anxiety levels in anxious patients.

Testing Anxiety Levels in a Group Versus Individual Setting

Introduction

- **Phobia:** an extreme or irrational fear of a specific object, setting, or situation.
- Phobias can be categorized as either specific or complex
 - Specific phobia: fear of spiders/heights
 - Complex phobia: social phobia and agoraphobia
- **Cognitive Behavioral Therapy:** A hands on approach to treat phobias.
- **Amygdala (fig.1):** Part of the brain that acts with fear and stress
- **Hippocampus (fig.1):** Releases serotonin into the bloodstreams

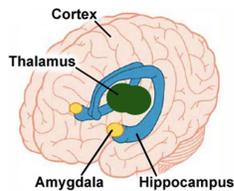


fig.1

Methodology

Recruitment

- 10 females ages 16-17 (individual portion)
- 4 pairs of females ages 16-22 (Partnered portion)

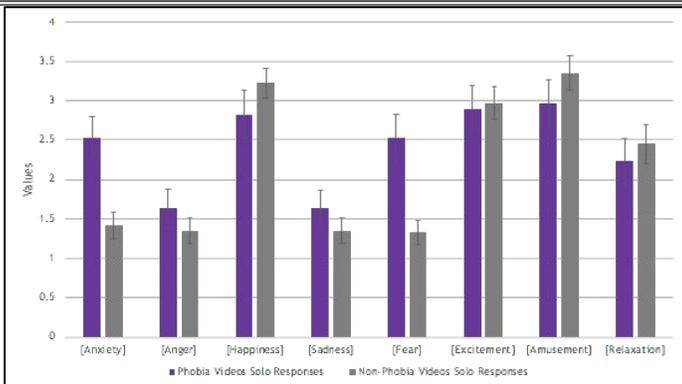
- Participants watched 7, 30 sec commercials
- 3/7 of the commercial were phobia related
- Participants ranked emotions on a scale of 1-5

Individual/partnered

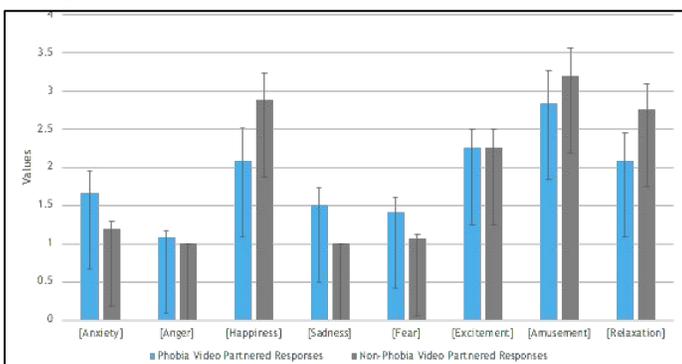
Debrief

Participants were told what the goal of the study was and what their data means in regards to the study

Results & Analysis



Average reported values for the solo responses. P<0.05



Average reported values for partnered responses. P>0.05

Conclusion & Future Research

- Participants felt less anxious in a partnered setting
 - Hypothesis was supported
- Results were significant when looking at solo vs partnered
- Limitation: small sample size
- Future research: looking at how hormones such as testosterone and estrogen affect anxiety
- **The presence of a friend decreases anxiety during phobia related situations**

t Critical one-tail	1.69912703
P(T<=t) two-tail	0.03263305
t Critical two-tail	2.04522964

fig.4

Hannah Karkout

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



Location of Research:
Harrison High School

Mentor:
Mr. Randy Gunnell

Intended Major:
Engineering

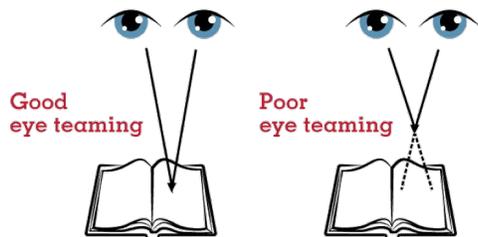
Fairs & Awards:
WESEF 2021 - 4th Place in Medicine and Health
JSHS 2021 - Medicine and Health
Westlake 2019 - 2nd Place in Medicine and Health

Vision therapy is a type of treatment used to improve various vision problems, such as strabismus, amblyopia, convergence problems, and other anomalies. Optometrists, the medical professionals 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's a lack of solid reasoning 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 knowing 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.

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

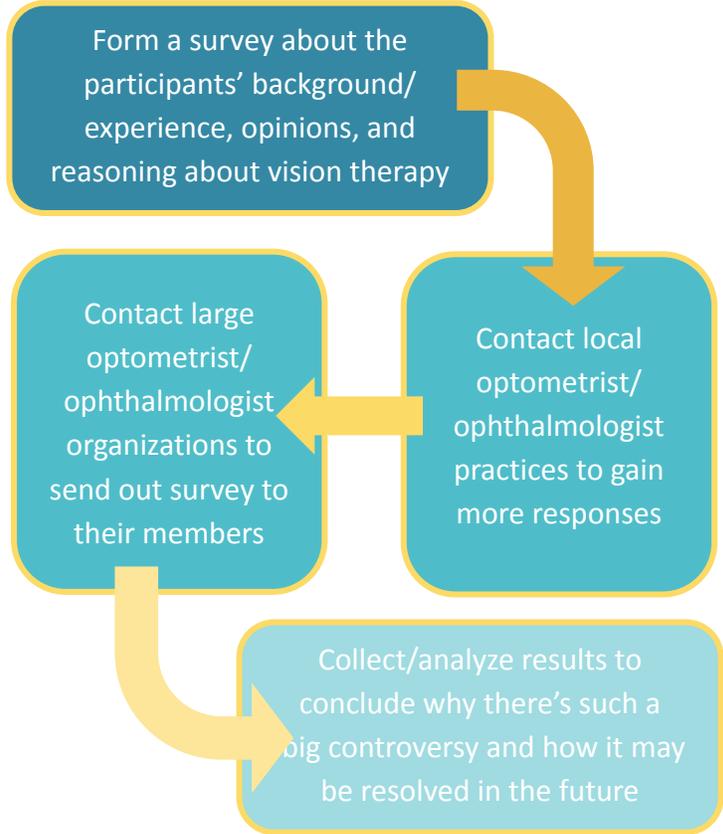
Introduction

- ❖ Type of treatment used to improve various vision problems (e.g. strabismus/cross eye) → described as having “poor eye teaming”; eyes don’t work together well
- ❖ Common symptoms are headaches, eye strain/fatigue, difficulty reading/learning
- ❖ Most commonly performed on children



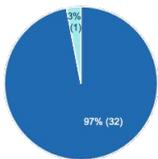
- ❖ A series of exercises performed with/by the patient, often using various tools
- ❖ Optometrists can become specialized in and perform vision therapy, not ophthalmologists
- ❖ Controversy between optometrists and ophthalmologists regarding efficacy of VT

Methodology



Results & Analysis

Optometrists: Opinion on Efficacy of VT



*Support VT □ Oppose VT □ Do Not Support or Oppose VT

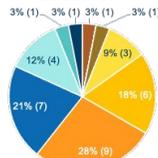
6 optometrists specialized in VT: 100% support

27 optometrists not specialized in vision therapy: significant number (Z-Test for proportions, $p < 0.01$)

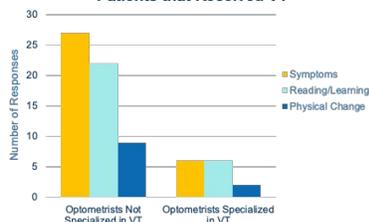
No ophthalmologist responses

Optometrists have strong reasoning behind their support of vision therapy

Optometrists: Percentage Improvement in Patient for VT to be Effective



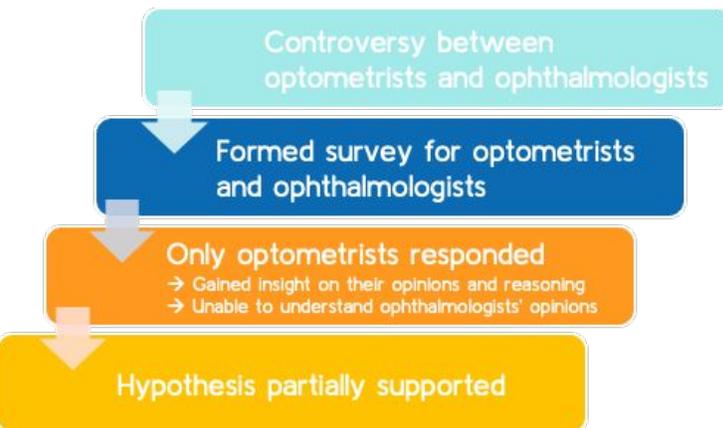
Optometrists: Signs of Improvement in Patients that Received VT



Optometrists have vastly different ideas on what percentage improvement is effective → new problem: need universal definition of effectiveness

Conclusion & Future Research

Conclusion:



Future Research:

- ❖ Continue current research: ophthalmologists
- ❖ Contact past/current VT patients
- ❖ Work with a local optometrist that observes VT:
 - Shadow to observe/collect data
 - Receive data from optometrist

Big Idea: Develop a definition of effective regarding VT

Ellie Karofsky

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

**Location of Research:**

Harrison High School

Mentor:

Mr. Randy Gunnell

Intended Major:

Microbiology and Immunology

Fairs & Awards:

Westlake 2019 - 1st Place in Health & medicine

Bisphenol A (BPA) is a chemical found in hard plastics that is suspected to have negative health effects. BPA was banned by the FDA from the manufacture of 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 would unknowingly consume the BPA upon ingesting the water. Research has been done to determine the effects of BPA on the human body, however, since most research is conducted on animals, any significant threats to humans have not been confirmed. Many are understandably worried about the possible health problems that can occur because of 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.

My future research includes conducting an experiment to test the concentration of BPA in plastic sunscreen bottles when exposed to ultraviolet radiation over the course of multiple weeks.

Areebah Mehmood

The Correlation between Sleep and Mental Health in Adolescents during the COVID-19 Pandemic



Location of Research

Harrison High School

Mentor:

Mr, Randy Gunnell

Intended Major:

Biology

Fairs & Awards:

WESEF 2021

JSHS 2021

NYSSEF 2021

WESEF 2020

Westlake 2018 - 3rd Place in Behavioral
Sciences

This study looks at the correlation between sleep and mental health of adolescents during the COVID-19 Pandemic. After gaining parental consent and agreeing to be part of the study, participants received a google form in which they recorded their sleeping habits, such as what time they normally sleep, what they wake up and more. They then moved on to completing the mental health section in which they were given 20 statements/questions and rated/answered the question from a scale of 1 to 5 (never - always) respectively. Their mental health was assessed out of 100 points, adding each point of the question. They completed this form during the self-isolation period, as well as after the self-isolation period. As per past studies, mental health should have depreciated as participants began to get less sleep, however the results showed an opposite effect. Although participants began to get less sleep after self-isolation, they still experienced an appreciation in their mental health, suggesting that COVID-19 and the self-isolation negatively impacted the mental health of adolescents.

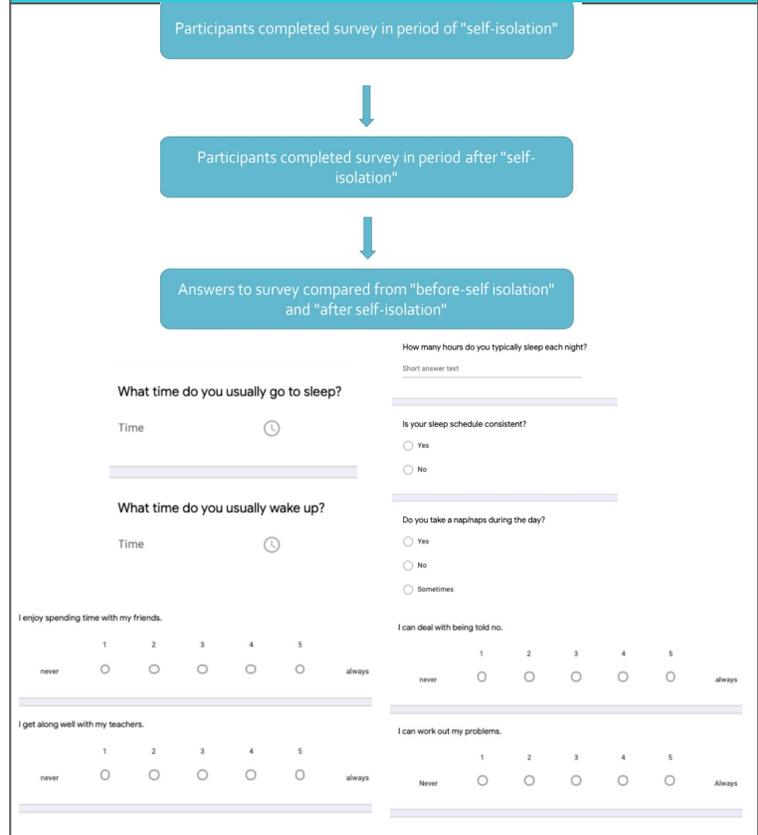
The Correlation between Sleep and Mental Health of Adolescents during the COVID-19 Pandemic

Introduction

- Self-Isolation during COVID-19 Pandemic led to virtual learning and decreased social interactions
- Virtual school led to shifted sleep schedules
- Sleep and mental health are closely related (harvard medical school, 2019)
- "U" shaped correlation between sleep and mental health (Kanieta et Al, 2007)
 - <7 hours = poor mental health
 - >9 hours = poor mental health
 - 7-9 hours = optimal mental health
- Few studies examine correlation b/w sleep and mental health due to a pandemic
- Hypothesis: A shift in sleep schedule due to the self-isolation will lead to a decrease in mental health's core on a modifies 12-item General health Questionnaire survey in adolescents



Methodology



Results & Analysis

Participant 86 results:

Participant 86	Self-Isolation	Non-Self Isolation
What time do you normally go to sleep?	2:30AM	12:30 AM
What time do you normally wake up?	10:30AM	6:50 AM
How many hours do you typically sleep?	8	5
Mental Health Total Points /100	86	90

Correlation Test: Change in deviation from optimal sleep and change in mental health score:
Correlation Coefficient → -.3344



Conclusion & Future Research

Conclusion:

- Self Isolation
 - Optimal Sleep
 - Lower mental health
- After Self Isolation
 - Less than optimal sleep
 - Increased mental health
- Sleep deprivation + oversleep SHOULD → depreciation of mental health
- Self-Isolation during pandemic negatively impacted mental health

Future Research:

- Current Research Conclusion → COVID-19 impacted mental health
- There is still continued shift to virtual learning
- Does this have a similar effect to "self-isolation?"
- Short term vs. Long term impact of virtual learning

Tochi Onwuasoanya

The Effect of Vitamin D3 on the Physical Performance of *Drosophila melanogaster* in the Negative Geotaxis Assay.



Location of Research:

Harrison High School

Mentor:

Ms. Allison Blunt

Intended Major:

Undecided

Fairs & Awards:

NYSSEF 2021 - 2nd Place

WESEF 2021 - 2nd Place

Animal Science

JSHS 2021-Regional Speaker

Westlake 2019

This study investigated how supplemental Vitamin D3 affected the performance of male and female *Drosophila melanogaster*. Vitamin D3 has been correlated with improved performance in humans but few studies have explored the effect of supplemental Vitamin D. *Drosophila melanogaster* possesses over 70% similarity with human genes and shares similar metabolic functions making them ideal for the study. A dose-response study was conducted using 25mcg, 2.5mcg, 0.25mcg, 0.025mcg, and 0.0025mcg of Vitamin D3. 0.0mcg represented the control group. The negative geotaxis assay was performed to test the natural tendency of flies to move against gravity when agitated and hence measure the locomotor capacities of the flies. 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 *Drosophila melanogaster* to cross the 8cm was faster than the females ($p < 0.04$). The 2.5 mcg group performed best overall in both male and female groups compared to 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 ($p < 0.01$). The improved performance in *D. melanogaster* 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.

The Effect of Vitamin D on the Physical Performance of *Drosophila Melanogaster* in the Negative Geotaxis Assay

Introduction

- Vitamin D is a group of secosteroids that affects many biological processes
- Vitamin D3 is primarily found in the skin fish liver oils, and fatty fish flesh and Vitamin D3 supplements.
- Higher serum levels of vitamin D are associated with reduced injury rates and better sports performance. Halliday et al (2011)
- 72.0% (n = 695) of males and 64.0% (n = 1191) of females had levels < 50 nmol/L (deficiency). Alyousefi (2018)
- Through Vit D receptors, Vitamin D initiates myocyte proliferation and growth. Abrams et al, 2018

Gap in Knowledge

Limited research on the role of supplemental Vitamin D in physical performance

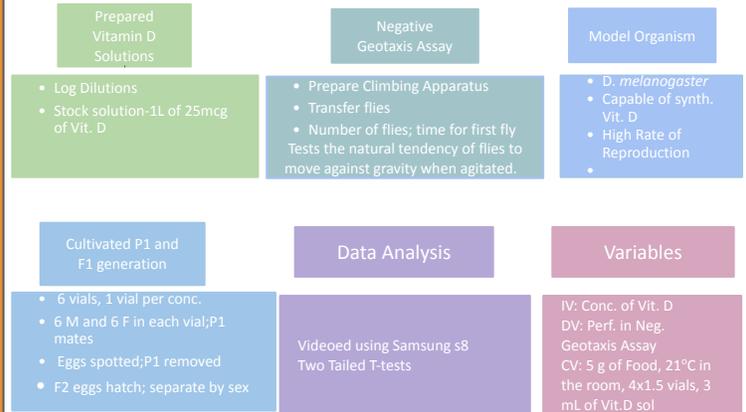
Goal

The purpose was to determine whether supplemental Vitamin D3 enhanced the performance of *Drosophila melanogaster*

Hypothesis

The higher the concentration of Vitamin D3 the better *Drosophila melanogaster* will perform and female flies will perform better than males.

Methodology



Results

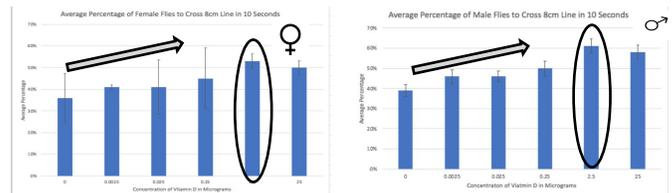


Figure 1 and Figure 2

- Flies performed sig better at 2.5 mcg concentration of Vitamin D3 ($P < 0.001$) and performed sig worse in control group (0mcg) ($P < 0.01$).
- In all cases, male *D. melanogaster* performed significantly better at every concentration compared to female *D. melanogaster* ($P < 0.05$).

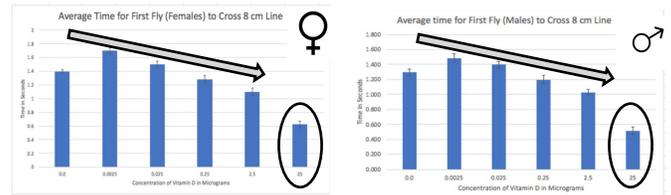


Figure 3 and Figure 4

- Increased Vit.D= Less time (25 mcg-sig faster than control ($P < 0.01$))
- Fastest male sig faster ($P < 0.01$) than fastest female (25mcg)

Conclusion & Future Research

- As the Vitamin D concentration increased so did %of flies that crossed the 8cm line
- Exp groups performed sig better than control ($p < 0.01$) → vitamin D did have effect
- Improved performance in *Drosophila* suggests studying effect in humans;

Future Research

- Determine the mechanism by which Vitamin D improves performance
- Conduct clinical study in humans to determine the effect of Vitamin D and performance
- Conduct a longitudinal study that aims to assess the role supplemental Vitamin D on physical performance across lifespans

Julina Paruta

The Effect of the New Western Diet on the Metabolite Concentration on the Epithelial Cells and the Microbiome of the Small and Large Intestines: A Study of Factors that Could Lead to Tumor Development



Location of Research:
Einstein College of Medicine

Mentor:
Dr. Leonard Augenlicht

Intended Major:
Biology on the Pre-Med track

Fairs & Awards:
Tri County 2020-2021- 3rd place in Nutrition and Health
WESEF 2021- 2nd place in Medicine and Health
JSHS 2020 - 3rd place

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 metabolites (specifically amino acids) in the intestines are linked to the NWD establishing higher risk for the development of growth of tumors in the mouse, and how is this related to potential alterations in the gut microbes, which can participate in the metabolism of nutrients in the gut? The purpose of this study was to examine metabolites in the small and large intestines of wild-type C57Bl6 mice fed a rodent version of the New Western Diet (NWD) compared to a control diet (American Institute of Nutrition Diet or AIN76A). DNA was also isolated from fecal pellets of the mice and a Bray-Curtis model was constructed to quantify the abundances of bacterial species in the colon. The purpose of this was to determine if altered microbial species may be important in altering amino acid metabolism and hence representation of these amino acids in the host intestinal epithelial cells. The results showed that NWD significantly altered asparagine, tryptophan and valine in the large intestine ($p < .05$). In the small intestine, tryptophan and arginine were significantly altered compared to the AIN76A ($p < .05$). In addition sex and diet were strong signals for diversity of bacterial species in the microbiome of the intestine. Understanding the key elements and mechanisms of how NWD affects intestinal mucosa and flora can have a potentially enormous impact on reducing the worldwide impact of this disease.

The Effect of the New Western Diet on the Metabolite Concentration on the Epithelial Cells and the Microbiome of the Small and Large Intestines: A Study of Factors that Could Lead to Tumor Development

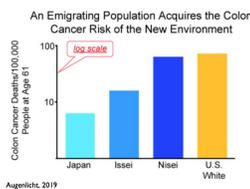
Introduction

- Colorectal cancer is cancer that starts and grows in the colon and rectum and metastasizes to other tissue in organs
- Third most common cancer diagnosed in both men and women in the United States (American Cancer society, 2019)

Uncontrollable:
Age, genetic mutation

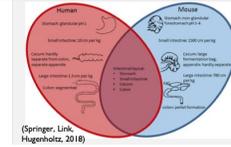
Controllable:
Exercise, diet

- New Western Diet (NWD): Diet consumed in westernized countries which is high in fat and low in nutrients
- Low risk ethnic groups increase cases of colorectal cancer when migrated to high risk areas (Bishehsari, 2014)



Methodology

Model organism:
Wild-type C57Bl6 mice
85% identical genome to humans



Experimental diet NWD:

- 20% of fat (corn oil, %)
- 2% of fiber (cellulose)
- 0.5% of calcium

Control diet AIN76A:

- 5% of fat (corn oil, %)
- 5% of fiber (cellulose)
- 5% of calcium

Metabolomic Study:

Used data bank of metabolomic data

Independently conducted analysis: P-Values, average, standard deviation, ratio

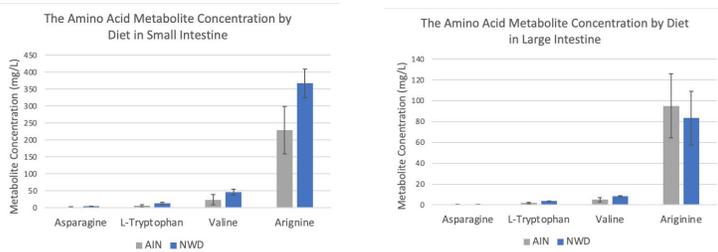
Focus on amino acids

Fecal Pellet Study:

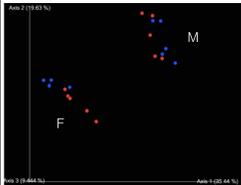
Performed full fecal pellet analysis independently

Independently interpreted results of Bray Curtis model

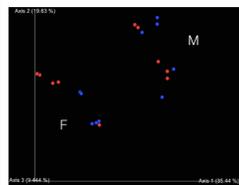
Results & Analysis



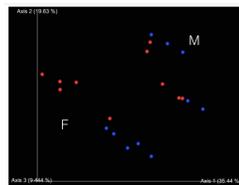
Week 2



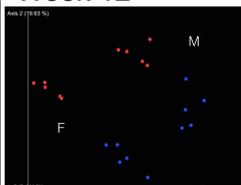
Week 4



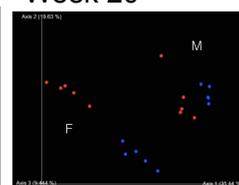
Week 8



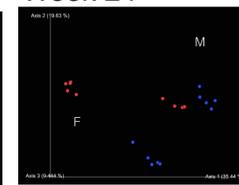
Week 12



Week 20



Week 24



Conclusion & Future Research

Metabolomic Study:

- Hypothesis supported, amino acids increased statistically significantly in the intestines
- Essential and nonessential amino acids may have role in for this increase
- Essential: Tryptophan
- Nonessential: Asparagine, valine, arginine

Fecal Pellet Study:

- Hypothesis supported, over the weeks there was an increasingly clear separation
- Hormones may affect females and males gut microbiota differently for example testosterone
- Testosterone may impact the males gut microbiome negatively since less separation
- Less separation = less diversity = unhealthy gut microbiome

Future Research:

- Find a cause and effect between the amino acids and the diets
- Establish and evolution history of the gut bacteria
- Examining the difference between males and females gut microbiota

Maria Saes

Psychological Theories that Best Describe Crime Patterns in a Northeastern Suburban U.S. Town



Location of Research:
Harrison High School

Mentor:
Mr. Heath Kaplan

Intended Major:
Public Health

Fairs & Awards:
WESEF 2021: 3rd place in Behavioral Sciences
JSHS 2021 - 2nd Place in Behavioral Sciences
Westlake 2019- 3rd Place in Behavioral
Sciences

Various psychological theories have been utilized in describing crime patterns in cities throughout the United States. Studies lacked research on utilizing these theories in suburban neighborhoods. This study uses an environmental theory (temperature-aggression hypothesis) and a sociocultural theory (broken windows theory) to examine which would be the best in describing crime patterns in a local suburban neighborhood. Temperature-aggression hypothesis states that higher temperatures lead to an increase in aggression and crime. Broken windows state that visible signs of civil disorder encourage further crime. To measure the environmental theory, local police assault data and temperature data from all months of the years 2000-2019 were analyzed. To measure the sociocultural theory, systematic observation of police beats (1-6) and a rating system from 1-5. The hypothesis was partially supported. The temperature-aggression hypothesis was not supported as the months with the highest temperature did not have the highest total number of assaults. The correlation was close to zero showing no effect of temperature on assaults. As for the broken windows theory, it was supported suggesting that areas with high signs of crime led to more crime. In the beats with the highest average rating, the percentage of assault by beat increased as well. The R squared value was 0.9999, R-value 1 and the P-value was <0.0001. Results indicate that the broken windows theory is best to describe crime patterns in a suburban town.

Psychological Theories that Best Explain Crime Patterns in a Northeastern Suburban U.S. Town

Maria Saes

Introduction

- CDC, 2020: Violence is among leading cause of death in the U.S.
- Gramlich, 2020: Aggravated assault is the highest in suburban neighborhoods

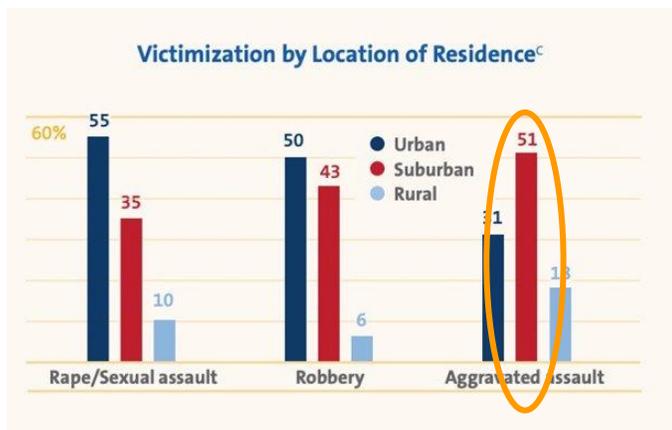


Figure 1: Surprisingly higher aggravated assault in suburban neighborhoods (National Crime Victims' Rights, 2017)

Methodology

Harrison Town Data

Town with population of 27,838
Poverty rate of 5.43%
Median household income of \$124,000

Harrison Police Data

FOIL form filled out
Assault crime: 2000-2019
Included police officer name, beat assignment, date, & case number

Variables

Independent: Temperature + ratings of police beats

Dependent: Number of assaults reported

Controlled: Time + date ratings were taken (2000-2019), Systematic observations recorded at same time, month, & season

Testing the Theories

Temperature - Aggression

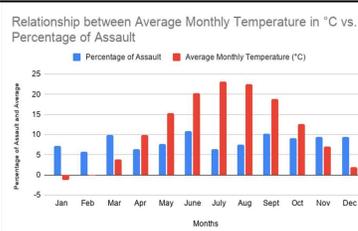
Temperature data from Wunder-ground.com from years 2000-2019
Police crime data obtained from FOIL request form from years 2000-2019
Data analyzed and put into graph Z-Test for proportions

Broken Windows

Physical list of items systematically observed
Likert Scale (1-5; 1 = not present, 5 = clearly present)
4 raters used in this study
Rated: Graffiti, vacant lots, physical decay, litter, storefronts, cars parked, construction, trash cans

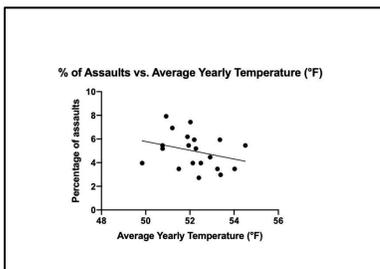
Results & Analysis

Temperature - Aggression Test Results

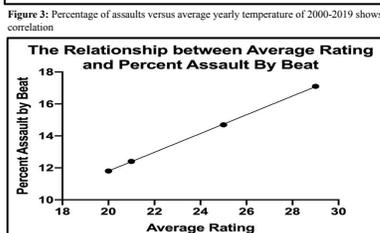


- Percentage of assaults in July = significantly less than in January
- **No consistent trend**

Figure 2: Average Monthly Temperature vs. Percentage of Assault 2000-2019



- R-squared = 0.08594 - **High Variance**
- P- Value = 0.2097 - **Not significant**



- R-squared = 0.9999 - **Close to regression line**
- P- Value = <0.0001 - **-significant**
- **Shows consistent trend**

Figure 4: Average rating of physical items and percentage assault by beat.

Conclusion & Future Research

Conclusion

- Number of crimes committed in places where disrepair is more evident seems to correlate with more crime reported
- Findings are on the assumption that police are recording all crimes equally in all beats and citizens are reporting all crimes equally
- Temperature had no significant effect on crimes

Future Research

- Aim to look at different types of crimes to find correlation in temperature and ratings of physical disorder
- Look at neighborhoods in different geographical regions testing same theories
- Future Research Question: Is there implicit bias in the way crime is reported and recorded?

Madison Schiro

The Effect of Social Isolation on Aggression in Female *Drosophila melanogaster*



Location of Research:
Harrison High School/Home

Mentor:
Dr. Groneberg/Ms. Allison Blunt

Intended Major:
Undecided

Fairs & Awards:
WESEF 2021 - 3rd Place in Animal Sciences
JSHS 2021 - 1st Place in Animal Sciences
Westlake 2019 - 1st Place in Animal Sciences

The purpose of this study was to determine if social isolation increases or decreases the aggressive behaviors exhibited by female *Drosophila melanogaster*. This has already been shown to be true concerning male *D. melanogaster*. Not as many studies and experiments have been done with females. Aggressive behaviors can include lunging, flicking of the wings, and movement of their front legs. They were separated into groups that were subjected to different forms of isolation. Each *D. melanogaster* from each group was pitted against another from the control group (crowded and social, which is standard behavior), and then recorded for their behaviors to be observed. It was found that the isolated *D. melanogaster* exhibited a significant amount of aggressive behaviors compared to the control group. The isolated *Drosophila melanogaster*, however, also showed signs of little flying, were closer to the bottom of the vial, and stayed away from the other one, behaviors which may be interpreted as more depressed behaviors, or exhibiting a deficit in locomotion. The results found imply that different environmental factors induce different behavioral patterns in male and female fruit flies. The causes of aggressive behaviors may be worth investigating the effects of social isolation on female humans based on these results.

The Effect of Social Isolation on Aggression in Female *Drosophila melanogaster*

Introduction

- COVID-19 → social isolation
- Determining cause of aggression → controlling/predicting violent behaviors
- *Drosophila melanogaster* → fruit fly, ideal organism, easy to observe, minimal ethical concerns

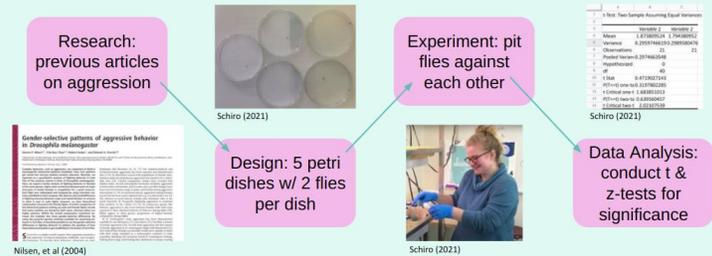


Source: Katja Shultz, Garden's Supply Company

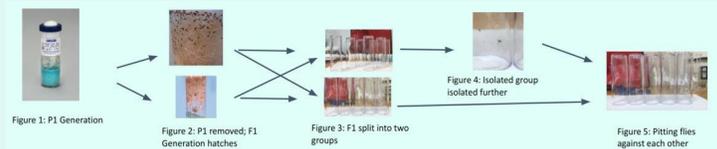
- Nilsen et al (2004) & Stevenson et al (2013): mated female *Drosophila* > virgin female *Drosophila* & social isolation → aggression

Methodology

My Role



Protocol



Results & Analysis

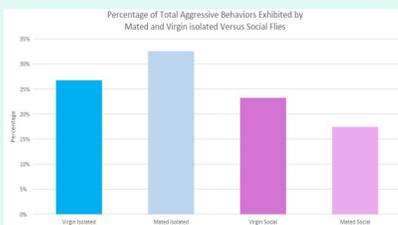


Figure 1: Significant difference ($p < 0.05$) b/w mated isolated and mated social

Figure 2: % of aggressive behaviors by type of behavior

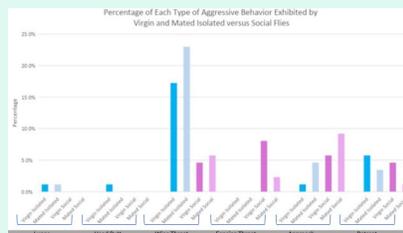


Figure 3: Significant difference ($p < 0.01$) b/w isolated vs. social

Conclusion & Future Research

Future Research

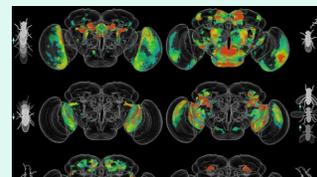
- Human research → surveys & questionnaires
- COVID-19
- Police records → increase in crime over pandemic

Massive 1-Year Rise In Homicide Rates Collided With The Pandemic In 2020

January 6, 2021 - 5:00 AM ET

Source: npr

- Genetics (*Drosophila*)



Source: The Scientist

Conclusion

- Female *Drosophila* demonstrated aggressive behaviors after social isolation
- No significance in aggressive behaviors b/w mated & virgin
- Significant distance kept between isolated *Drosophila* & opponent

Christian Spadini

Adjusting for Political Geographical Bias in Congressional House Elections to Quantitatively Determine the Real Gap Between the Popular Vote and Electoral Outcomes



Location of Research:

Harrison High School

Mentor:

Ms. Allison Blunt

Intended Major:

History/Politics

Fairs & Awards:

Regeneron STS: Scholar/Semifinalist

JSHS: Regional speaker

Elections for the U.S. House of Representatives are meant to directly reflect the will of the people. As such, Congressional districts are small and geographically contiguous, have relatively uniform population sizes, and are designed to capture cohesive local interests. This design has not, however, prevented the overall party composition of the House of Representatives from deviating materially from the national popular vote. It has been known for decades that Democrats tend to win their districts, which are primarily in more ideologically uniform urban areas, by larger margins than Republicans do. But the quantitative impact of this structural bias is not fully understood, partly because controlling for asymmetrical distribution of political bias requires understanding its effects on voter turnout. This study creates a model of voter turnout based on a multivariate regression analysis of the demographic, social, and economic drivers of 2018 House election turnout by Congressional district. Selection of drivers for testing is informed by decades of census data on what drives turnout in state and national elections. This model is used to adjust the popular vote by Congressional district and party by controlling for differences in political bias. It estimates that, in 2018, skewed distribution of political bias depressed the popular vote by over 6 million votes, 5.6% of the total. Surprisingly, these additional votes are distributed evenly across the parties given that Republican turnout is particularly depressed in the roughly 10% percent of House elections in urban districts where they chose not to run a candidate. Nonetheless, taking this adjusted popular vote and simulating House electoral outcomes with normally distributed political bias across districts shows a large swing of electoral outcomes in favor of the Democrats. If the average 2018 House Democrat win share (9%) and the standard deviation of win shares (19%) are held constant, Democrats gain an average of 57 seats across twenty-five simulations for an increase of 13%. Since Democrats have never lost the House by more than 6% of the seats since 1996, the results imply that this structural bias has had a decisive impact on electoral outcomes.

Madison Stagg

The Correlation Between the Great White Shark's Proximity (*Carcharodon carcharias*) to Shore and the Lunar Cycle Phases



Location of Research:

Cape Cod

Mentor:

Dr. Gregory Skomal

Intended Major:

General Biology

Fairs & Awards:

WESEF 2020 - NOAA Pulse of the Planet Award
JSHS 2020
Westlake 2018

Since 2004 there has been an increase in the number of great white shark sightings in the Cape Cod Bay Area. These recent increases of sightings have alarmed many locals and tourists of the Cape Cod area. The increase in the number of seals, one of the great white's main food sources, along the shores of Cape Cod is possibly the main reason the great whites are coming closer to shore. The moon has various effects on the marine ecosystem and the ocean tides, including the great white's proximity to shore. There are eight lunar cycle phases of the moon. Depending on the position of the earth the moon reflects different amounts of light from the sun onto the ocean, illuminating the ocean. A data set obtained from Marine Biologist Greg Skomal was used to determine the correlation between the lunar cycle phases and the great white shark's proximity to shore. In the data set acoustic tracking was used to record the locations of 12 sharks during the months of May to December 2013 in the Atlantic Ocean surrounding Cape Cod. ArcGIS was used to make a frequency map depicting all the times any of the twelve sharks were tracked/recorded at an acoustic receiver and what the lunar cycle phase was. The study resulted in the sharks coming closer to shore during the darker phases of the moon.

The Correlation Between the Great White Shark's (Carcharodon carcharias) Proximity to Shore and the Lunar Cycle Phases

Madison Stagg

Introduction

- In recent number of years the number of great white sharks being spotted off and near the coast of the Cape Cod Region has increased



Image from Tripsavvy

- Acoustic Telemetry:** collect information about marine organisms' environments
- Acoustic tags:** surgically implanted, injected, fed, or externally attached to a fish. The tags transmit a high frequency "ping" which can be heard as far as half a kilometer away
- Acoustic receivers:** receivers strategically placed around the area of interest to listen for and record pings



Image from secoora

- The lunar cycle of the moon has various effects on the ocean's ecosystem
- Full Moon → Most amount of light illuminating the ocean
- New Moon → Least amount of light illuminating the ocean

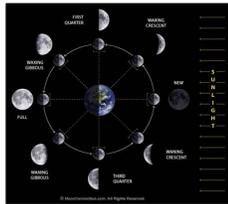


Image from moonconnection

Methodology

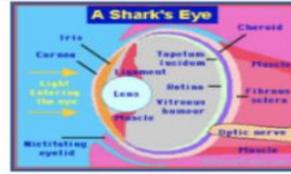


Image from enchantedlearning

- Sight:** The great white's retina of its eye is divided into two areas – one adapted for day vision, the other for low-light and night (Smithsonian, 2018)
- Low-light and night → help the great whites hunt during the night, during

Station Names	Distance from Shore (km)
#2 Chatham Harbor ATON	0
Chatham New Inlet	0.1448
S. Shark Cove	0.1931
Chatham Harbor #4	0.2253
S. Monomy	0.338
Nauset Beach 2	0.3862
Chatham Hbr Inlet South	0.4023
Nauset	0.5313
Nauset Beach 1	0.5472
Shark Cove	0.6226
Chatham Hbr Inlet North	1.3159
N. Shark Cove	1.5772
Nantucket	3.0738
Chatham Hbr Offshore	3.9957

- Location:** Cape Cod Bay Area
- 12 acoustic stations
- May - December 2013
- 12 sharks → 5 female, 3 male, 4 unknown

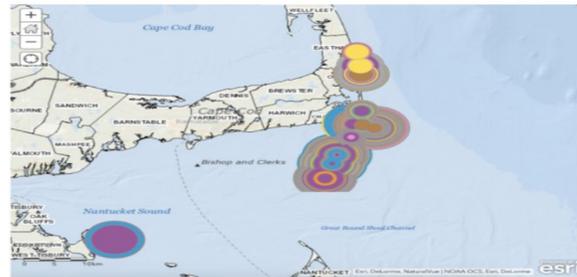


Figure 1: Screenshot of ArcGIS Acoustic Station Frequency Map. The colors represent the phases of the lunar cycles. The larger the circle, the more shark pings at that location. The larger the color of the circle, the more the sharks have been pinged at an acoustic station during a specific lunar cycle phase. Above is the map's legend correlated with the color of the circles. Each different color represents a different lunar cycle phase.

Problem

How do the lunar cycle phases affect the great white shark's proximity to shore in the Cape Cod Bay area?

Goals

Determine if there is a correlation between Great White Shark's proximity from shore and the lunar cycle phase.

Hypothesis

Great White Sharks will be closer to shore during a new moon and farther from shore during a full moon.

The dates when the shark's movement was recorded was correlated with the lunar cycle phase of the specific date

Frequency map was designed using ArcGIS

Acoustic stations were placed in order of their proximity to shore from closest to shore to farthest from shore

Data normalized by percentages

Data graphed into line graphs and a bar graph

Statistical analytics run using t-values to discover which data is significant

Results & Analysis

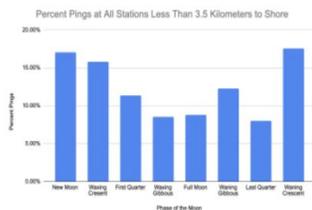


Figure 2: Percent Pings at All Stations Less Than 3.5 Kilometers to Shore. Figure 4 shows the most amount of pings during the Waning Crescent and New Moon which are darker phases of the moon.

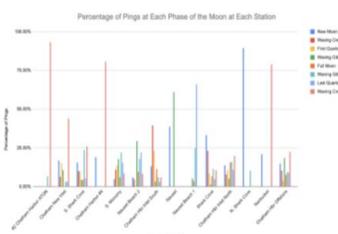


Figure 3: The percentage of each phase of the moon at each station. Notice the Waning Crescent and the New Moon have the highest percent of pings at multiple stations.

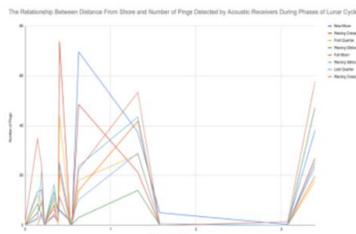


Figure 4: The Relationship Between Distance From Shore and Number of Pings Detected by Acoustic Receivers. Notice the shift at 0.6 km offshore at New Moon and Waning Crescent.

Conclusion & Future Research

- Hypothesis was supported → great white sharks will be closer to shore during a new moon and farther from shore during a full moon.
- Sharks swim closer to shore during the darker the darker phases of the moon
- Females swim closer to shore
- Collect more data with a higher number of sharks
- Collect more data on different variables → age, length, tail length, gender, weight, etc.
- Male migration habits VS. Female migration habits
- Migration of female great white during different stages of female life

Image from Brandon Cole



© Brandon Cole / www.brandoncole.com

Jillian Williams

Comparing Weight Changes During Treatment Epochs in Stroke, Traumatic Brain Injury, and Debility Patients



Location of Research:
Burke Rehabilitation Hospital

Mentor:
Dr. Carolin Dohle, Dr. Christopher Tyler

Intended Major:
Comprehensive Science

Fairs & Awards:
WESEF 2021 - 4th place in category,
Community Impact Award
Tri-County 2021 - 3rd place in category

Strokes typically cause disability in individuals as a result of muscle inactivity and overall weight loss, and rehabilitation programs are often insufficient to reverse this disability and weight loss. TBI (traumatic brain injury) and debility patients similarly endure forms of weight loss while being treated. In attempt to investigate whether weight loss varied amongst these patients, patient weights were analyzed across different treatment epochs (acute care and rehabilitation hospitalization) by measuring patient weights at acute care hospitalization admissions (AAW), rehabilitation hospital admissions (RAW), and rehabilitation hospital exits (REW). Weights were gathered for each population at a rehabilitation center using OnBase and MediTech. Percent differences between each stage were calculated and ANOVA and t-tests were conducted within and between diagnostic groups for the patient weights at the end of each treatment period to examine any statistically significant differences between the weight fluctuations these populations experienced. Within groups, many stroke and TBI patients experienced the majority of their weight loss in the acute care phase. Significant differences ($p < 0.05$) in weight loss were found during acute hospitalization TBI and debility patients and TBI and stroke patients, suggesting that TBI patients experience a more severe form of weight loss while at acute care facilities compared to during their convalescence at rehabilitation facilities. Analysis implies that a significant loss of weight occurs in TBI and stroke patients during their acute care stays and clinical protocols in such a setting may need to take this into account in promoting beneficial outcomes for these patients.

Comparing Weight Changes During Treatment Epochs in Stroke, Traumatic Brain Injury, and Debility Patients

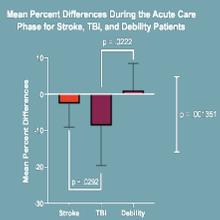
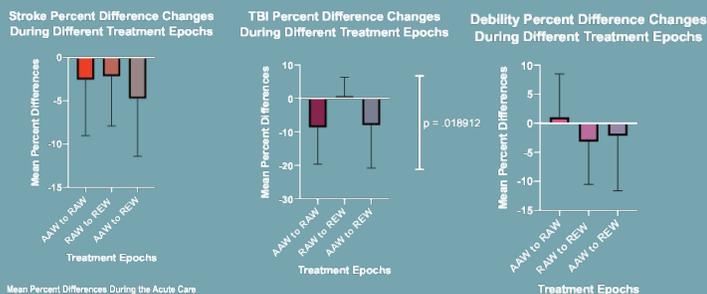
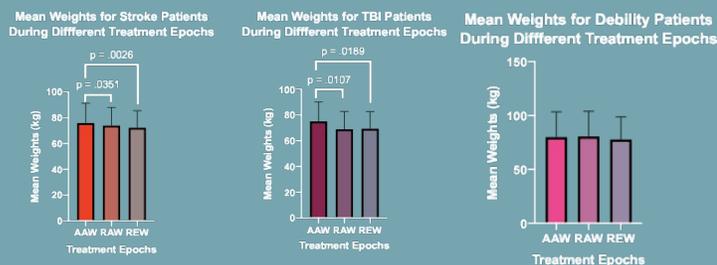
Introduction

- Stroke → currently the leading cause of disability in the adult population
- Decrease in nerve stimulation → muscles inactivity
 - Leads to weight loss post-stroke
- TBI & debility → debilitating diseases
 - Similar to weight loss in stroke patients
- Why study weight loss?
 - New preventative measures
 - Modifications to rehab programs
 - More successful recoveries

Hypothesis

Stroke patients will endure a more extreme form of weight loss than TBI and debility patients due to inflammation as well as the lack of nutritional supplementation that contribute to the severity of stroke patients during different recovery phases

Results & Analysis



- Rehabilitation phase → no significance
- Total treatment phase → no significance

Methodology

Selected patients from rehab center (stroke n=25, TBI n=17, debility n=27)

OnBase - acute care weights

MediTech - rehab admission & exit weights

Within Group Testing

Between Group Testing

-ANOVA: percent differences
-T-test: percent differences

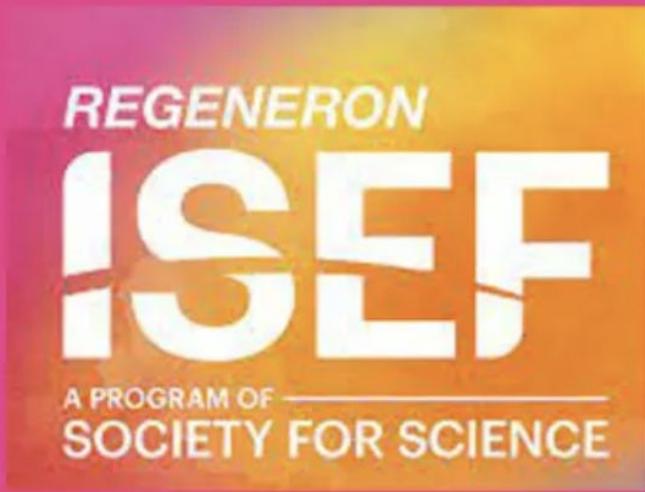
-ANOVA: percent differences
-T-test: percent differences

Conclusion

- Hypothesis → not fully supported
 - TBI: most severe form of weight loss
 - Stroke: lost weight throughout recovery
 - Debility: minimal weight fluctuations
- Limitations → overall weight, age/demographics
- Role of acute care & rehab facilities → vital in weight maintenance
- Rehabilitation programs → tailored towards specific conditions
- Emphasis on nutrition in the acute care setting
 - Specifically TBI patients
- Emphasis on rehabilitation in the post-acute care phase
 - Specifically stroke patients

Future Research

- Compare muscle and fat loss in stroke patients
- Different pathways in the body affected by stroke
- Effect of caloric and exercise intervention on weight loss



Science Research II

Mai Blaustein

Developing a detector for the date-rape drugs Gamma-butyrolactone and Gamma-hydroxybutyrate using IR Spectroscopy



Class Year: 2022

Mentor: Dr. Julian Silverman

Drug Facilitated Sexual Assault is a term used to describe instances of sexual assault where the victim is unable to provide consent due to drug/alcohol consumption. As of 2017 nearly 11 million women in the United States had been recorded to be raped while drunk, drugged, or high. Date rape drugs are substances used to inhibit a person's ability to consent and can prevent them from remembering the assault. Two of the most commonly used date rape drugs are Gamma Hydroxybutyric Acid (GHB) and Gamma-Butyrolactone (GBL). Although there are current technologies that test for these drugs, they have many limitations and few exist that can detect for GBL. The purpose of this study is to determine whether IR spectroscopy can be used to detect GBL/GHB, and ultimately prevent the use of date rape drugs by developing a detector for the drugs. Infrared Absorption spectroscopy is the measurement of the absorption of mid-infrared light which can excite molecular vibrations to higher energy levels. IR Spectroscopy provides information about the molecular structure of a material. This study will contain 2 parts. In Part 1, various ethanol-water solutions will be created with different doses of the drugs stimulating spiked beverages. The spectra ranges of those concentrations will be recorded using a bench-top instrument, and the signal and concentration of the solutions will be used to create a calibration curve. In Part 2, the calibration curve will be used to program a portable spectrometer that detects only those wave-lengths specific to the drug. The expected result of the study will be a portable, built spectrometer that tests specifically for GBL and GHB in drinks.

Annie Chen

Factors that Explain Internal Versus External Heating of Neutron Stars



Class Year: 2022

Mentor: Dr. Oleg Kargaltsev

Limited technology surrounding neutron stars (NS), highly dense celestial objects formed through the collapsed core of a supergiant star, results in a knowledge deficit. Two plausible explanations for how NS are heated are: NS are heated through complex internal heating from changing non-uniform concentrations of different particles throughout its volume; NS are externally heated through energetic particles that precipitate from the NS magnetospheres. The purpose of this study was to examine whether external or internal heating better explains differences in characteristics of NS, such as temperature and radii, looking overall at how heating relates to the age of the star. Although both internal and external heating likely influence all subsets of NS, older NS are expected to be predominantly externally heated, whereas younger stars are expected to be predominantly internally heated. Blackbody radii of NS were calculated using Stefan Boltzmann equation, then graphed radii versus known characteristics of each respective star (P ; spin periods, dP/dt ; the pressure change ratio; B_{dip} ; magnetic field, t_c ; characteristic age, L_{33} , and t_{inf}). The hypothesis is that older stars will have a faster spin period, a bigger polar cap, and a bigger magnetosphere which points to external heating. Younger stars are hypothesized to have internal heating and will exhibit a more miniature magnetosphere.

Natavia Dickinson

To What Extent Does Medical Marijuana Target Pain Versus the Anxiety Surrounding Pain



Class Year: 2022

Mentor: Mr. Gunnell

Medical marijuana has been changing the medical field with its ability to help individuals treat their chronic pain. It may be administered in many different forms for various different illnesses, however most have proven to be quite effective. On the other hand, there has been research that suggest an individual's mental state, such as having severe anxiety or depression, may alter their perception of the pain they are experiencing. This is extremely interesting, and should be considered when treating pain by administering Medical Marijuana. Now, there is inquiry on the role medical marijuana plays when treating pain in regard to impacting the pain-related anxiety an individual is experiencing. Researchers such as Joseph Ditre, Lance McCracken, and Daniel Feingold have all conducted studies that suggest various outcomes. These conclusions include that treatment may induce anxiety, reduce it, or not have an impact at all. These findings are vital as they point to idea that the dosage given, strain, and illness being treated may all impact the drug's effects on pain-related anxiety.

Eileen Dockery

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



Class Year: 2022

Mentor:

Roadkill is the result of wildlife-vehicle collisions (WVCs), 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 WVCs. Despite the risk to biodiversity and human economic activity that roadkill poses, not much is clear about its causes, and studies may present conflicting results. Factors which impact roadkill must first be identified and clarified before roadkill mitigation tactics can be implemented. For example, increased speed limit increased WVC risk in vertebrates according to Brooks and Farmer (2012), yet Williams et al., (2019) found that increased speed limit does not increase roadkill risk on serval (*Leptailurus serval*) roadkill, despite servals being a vertebrate. Utilizing citizen scientists to collect the roadkill data necessary to identify risk factors would potentially allow for a wider range of data to be collected. With the data that was collected so far, the hypothesis that increased speed limits would increase roadkill was not supported, as 57% of roadkill across all species happened on 25mph roads. Future research will be done to clarify if the speed limit causes the roadkill or if there is another factor causing the roadkill and the low speed limit, such as a twisty road shape. Once the risk factors are determined, roadkill mitigation tactics may be implemented and to help preserve local biodiversity.

Rachel Farias

The Effect of Real Life, Video, and Digital Text Environment on Students' Likelihood to Lie in an Educational Environment



In this age of social distancing, people are interacting less face to face, and may be more likely to lie. Whitty & Carville (2008) found that people lie more on text, email, and in other digital settings rather than in-person, because people feel a sense of guilt more often when trying to tell a lie face-to-face. Given COVID-19, it is important to understand students' deceptive behaviors to minimize cheating, and capitalize on learning. Not many studies have shown how students' deceptive motives differ in an in-person setting versus a digital setting. This is a gap where scientists need to do more research. The purpose of this study is to assess whether students are more likely to lie to their authority figure(s) in educational environments over zoom or text (digitally written documents like email, edpuzzle, google docs, chats, etc.) rather than in person. The methodology involves surveying suburban high school students in the Northeastern US. Students will be tasked with rating how likely they are to lie via real life, video, and digital text environment using likert scales. Preliminary results support the hypothesis that students are more likely to lie in digital settings, especially when it involves text where you cannot see your teacher's face.

Class Year: 2022

Mentor: Dr. Joan O'Keeffe

Anna FitzPatrick

The Effect of Sculptural Art Therapies on Sensory Memory Retainment and Visuospatial Functioning



Sensory memory retainment and visuospatial functioning are mechanisms of the brain which impact the ability to manipulate and judge materials based on texture, weight, and spatial distancing. Sensory memory retainment is defined as the transfer of information of five senses from short term to long term memory. Visuospatial functioning can be defined as cognitive processes for identifying & analyzing form, details, and spatial relations. In patients with dementia and other neurological issues, memory retainment and visuospatial functioning may be compromised. Scientists are exploring ways to improve these abilities to help patients live more normal lives. For example, Heliyon (2017) tasked 12 dementia patients with creating human-size trees out of clay and other materials. The results showed that the patients' improved functioning skills as well as ability to remember certain things based on reuse of these materials. In a following study, Heliyon (2017) studied sculptural therapies over an extended period of time. However, these studies were limited in the number and type of participants they studied. Adolescents' brains may show improvement more efficiently. Future and ongoing research includes presenting a study within a group of recreating a sculpture based on a picture or pre-made model out of play-doh for a span of 4-5 weeks; once a week with a reflection study following the activity. The reflection will include a scale which will help determine impact on sensory memory retainment and visuospatial functioning in high school students.

Class Year: 2022

Mentor: Ms. Christine Vitarello

Macarena Hesse

Maximizing Revenue for Nonprofits by Analyzing Fundraising Strategies



Class Year: 2022
Mentor: Valeria Hesse

Annually, nonprofits use wealth screening as a financial tool used to locate target donors and fundraising locations by predetermining donors' capacity to give. Wealth screening services look at both philanthropic indicators and wealth markers, including past donation data, to form their conclusions by finding similarities in donor patterns. Financial studies have conducted research using wealth screening technology to help non-profit organizations locate donors with an increased gift-giving capacity. Few studies have used machine learning tools to create more accurate models of future donation patterns. This led to the research on how donation amount impacts customer lifetime value in target fundraising areas. The experiment will consist of two parts. Part 1 is determining future customer lifetime value using a linear regression model and cluster model to account for multicollinearity. Part 2 will compare the future customer lifetime value predicted in part 1 against the current customer lifetime value and fundraising expenses as a benchmark. The expected results will showcase how focusing on areas with a greater density of donors with higher future customer lifetime values will maximize revenue for nonprofits in the future by providing a narrower group of target donors. In the future, I hope to research how fluctuations in the economy impact predictive models.

Maddie Hymowitz

A Systematic Review of the Effectiveness of Surgery vs. Medicine for Ulcerative Colitis in Adults



Class Year: 2022
Mentor: Mr. Gunnell

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 adults 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. Performing a systematic review, the experiment assesses the effectiveness of different medications and treatment options for patients with UC to determine which is the best option. In order to conduct this review, the steps include, performing a systematic approach, dividing studies into groups and creating a PRISMA flow diagram, qualitatively and quantitatively analyzing the data including a forest plot, and establishing an outcome. By using a PRISMA flow diagram and a forest plot, the data will be organized and shown in a clean matter to be easily understood. The major findings of the results included the fact that the majority of the medications were successful, but only to an extent. For example, some medications were used and tolerated for a few months, but then the patient became worse after being on the medication long term. Some common trends also included different side effects, which varied for each medication but were severe enough to not allow for the medication to be used long term. That being said, the most effective long term treatment would be surgery. In the future, more studies that demonstrate the effect of surgery and how successful it is should be assessed. With those results, one could then compare the two and add them into one large analysis. Especially because of the fact that adults are less responsive to medication, the results of this study demonstrate that surgery is the most effective treatment for adults with Ulcerative Colitis

Jack Kelly

Polarized Politics: Using Machine Learning Methods and Mathematical Analysis to Measure How Primary Challengers Affect the Linguistic Polarization of Democratic Congressional Incumbents



Class Year: 2022
Mentor:
Dr. Chris Stout

This study aims to use Twitter and machine learning methods to see how progressive primary challengers in the 116th Congress resulted in linguistic polarization of Democratic Congressional incumbents. Based on Poole and Rosenthal (1984) establishing a means to quantify ideological polarization, Getzkow, Shapiro, and Taddy (2016) creating a computer based measurement system for linguistic partisanship, and Stout (2021) exploring how Black primary challengers linguistically polarize Congressional incumbents, it was hypothesized that supervised and unsupervised learning techniques could be effectively used to track progressive linguistic polarization. Moreover, based on Kamarck and Podkul (2018) demonstrating a significant post-2016 increase in progressive House primary candidates, it was hypothesized that progressive primary challengers would significantly polarize Democratic Congressional incumbents, especially incumbents in high Democratic PVI districts. Twitter was utilized in this study because of its compatibility with machine learning method techniques and its representative communication of policies and beliefs of Representatives. Initially, 6000 tweets from the 116th Congress were hand coded as progressive (1) or not progressive (0) with adherence to a strict criterion guide. 7 different forms of machine learning were then used to code a larger sample of 500,000+ tweets and an internal comparative analysis and review of unsupervised learning was conducted to maximize veracity. While this study has not yet been finished, mathematical analysis of the data produced from machine learning methods will be conducted to see if viable progressive challengers (ones that receive more than 5% of the primary vote and a major progressive endorsement) linguistically polarize incumbents. The mathematical analysis will focus on before and after the date of a challengers' first endorsement and then Bayesian statistics will be utilized to create a predictive model for future races. At its core, the study investigates how an electoral threat to power causes Representatives to speak about policies differently in order to preserve their power.

Danny Mandell

A Study on the Adoption of Artificial Intelligence into Healthcare



Class Year: 2022
Mentor: Mr. Gunnell

Artificial Intelligence is a system of algorithms that are used to create a definite conclusion to a specific question. These systems can be used in various fields such as business, farming, marketing, and medicine. Specifically, in medicine, the technology can be used to diagnose, treat, or classify diseases more efficiently than humans. With the use and need of Artificial Intelligence in medicine rapidly increasing, it was important to determine exactly who uses the algorithms and to what extent those medical professionals are using them. To achieve this, a questionnaire was sent to various medical organizations, hospitals, and specific medical professionals where the participants were asked questions regarding their specialty, knowledge of Artificial Intelligence, and types of Artificial Intelligence they use. Then, a comparison was made between the medical professionals in specific practices and those who are general practitioners. After a careful analysis, it was determined that most medical professionals know what the term "Artificial Intelligence" means in the context of medicine, yet there are still some who don't. Those who don't mostly work in hospitals rather than offices, yet there is a variance between those who know what the term means. It was found that the number of respondents who use Artificial Intelligence is somewhat even to the number of respondents who don't even if they know what the term means. Furthermore, how long ago Artificial Intelligence was implemented for those who use it differs as some have been using the algorithms for more than 3 while others have been using it for less than a year. Lastly, it was found that Artificial Intelligence was commonly appreciated in the medical field as it improved the quality of the medical professionals' work. The results support the argument that there is an overall knowledge gap of Artificial intelligence in the medical field as many respondents stated that they knew what the term "Artificial Intelligence" meant in the context of medicine, yet stated types of technology that doesn't classify as Artificial Intelligence when asked what specific types they used. However, there is a common understanding that using the technology improves the lives of medical professionals and makes their jobs easier.

Gabby Marraccini

The Relationship Between a Human's Mood and a Dog's Emotional State



Class Year: 2022
Mentors: Dr. Katherine
Albro Houpt & Dr. James
Serpell

“Dogs are man’s best friend” is a familiar saying but how often do we consider if man is dog’s best friend. Dogs are employed by humans to assist in mental health therapy, to guide blind people, and to comfort veterans. Researchers at Alliance of Therapy Dogs have shown that the presence of a comfort animal can help individuals control daily anxiety, regulate emotional arousals and improve mood. However, little research has explored how these types of companionship and/or the simple owner/pet relationship affects the dog mood or behavior. Previous studies have demonstrated associations between aspects of dog owner personality and psychological status and the expression of behavior problems in their dogs. For example, Podberscek & Serpell (1997) found that owners of aggressive cocker spaniels were significantly more likely to rate themselves as “tense, shy and emotionally unstable” on the Catell 16 Personality Factor Questionnaire. However, few known studies have looked at how a dog owner’s mood influences the dog’s body language and behaviors. The purpose of this study is to survey dog owners to determine if they report a relationship between their moods as measured by the Positive and Negative Affect Schedule (PANAS) and their pet dog’s body language and behaviors. It is hypothesized that the dog’s emotional state will correspond with the human’s mood.

Eleanor Millard

Factors Which May Affect the Purchase of Gluten-Free Products



Class Year: 2022
Mentor: Mr. Gunnell

Currently, the only treatment for celiac disease is to go a completely gluten-free diet, which means that you are cutting out soy, malt, rye, barley, and wheat from your diet. For many people, having to turn to this diet can be difficult. There are many factors that one needs to consider when going on this diet, like economics. Gluten free food is slightly more expensive than non-gluten free food and it is hypothesized for those with an annual income of less than \$40,000 may struggle to purchase gluten free food. Based on past knowledge, it was understood that the main reason gluten-free food is so more expensive starts at the source. First, as wheat can not be used in gluten-free products, other grain must be utilized like rice and quinoa. Both of these are less commonly grown than wheat, making them more difficult to obtain and therefore more expensive. On top of that, factories need to keep clean and well maintained so that there is no cross-contamination, however, that is hard in itself to guarantee. Finally, Gluten-free food gets certified by groups such as Generation GF. Regardless, cost differences hurt someone who is getting paid low wages or living check to check. This observation led to the creation of the hypothesis, the presence of a family member with celiac disease in a household will result in a larger grocery budget. However once research was conducted, it was found that was actually not the case and I was able to reject my null hypothesis and turn to my alternate hypothesis, which was the presence of a family member with celiac disease in a household will not result in a larger grocery budget. Those who make less than 40,000 spent about the same on groceries whether or not one or more family members had celiac disease. Most families, including those who have someone with celiac disease in their family, spend about \$200 to 300 as their weekly shopping budget. I was able to come to this conclusion after completing a z-test. After determining a Z-value of 0.5688, I could safely say that there is not a statistically significant difference between the shopping budget of the families in the community whether they had a member with celiac disease or not. 0.5688 fits into the category of alpha/2 and as such I can say that I am 95% positive with my results. In the future, I would like to explore other impacts that celiac disease may have on the economics of a household.

Katie Pflieger

Synthetically Improving the BNM-111-170 Molecule to be a Better Inhibitor for the HIV-1 Entry Enzyme gp-120



Class Year: 2022
Mentor:
Dr. Cameron Abrams

As of 2020, approximately 38 million people are living with HIV, an autoimmune virus that may eventually progress into a final stage of AIDS causing the affected person to die. However, despite the immense number of people who have HIV there are few methods of treatment, and no known cure. In order to prevent the transmission of HIV in the first place, there is an effort to create an HIV vaccine through the use of protein based inhibitors. The success of these inhibitors could help protect people from getting HIV as well as potentially aid in the long term eradication of HIV. Mellilo (2016) synthesized the BNM-III-170 molecule which has shown to be a promising inhibitor to prevent the fusion of the HIV entry enzyme gp-120. However, this molecule is at present only somewhat effective. The purpose of this study is to determine a way to improve the BNM-III-170 inhibitor by the addition of an alternatively effective functional group to the surface of the inhibitor. The methodology entails a computer aided drug design approach. Specifically, a detailed analysis of the 3-D structure of gp-120 binding site, followed by the proposal and digital simulation of organic functional groups that have complementary structures to the binding site, allowing data to be obtained to determine their effectiveness through a docking server and a screening process. Effective synthetic designs will be crystalized and tested in a laboratory, allowing conclusions to be drawn in regards to the success of the addition of functional groups.

Amelia Rasmussen

Different Treatments of Early Breast Cancer



Class Year: 2022
Mentor: Dr. Tiffany Traina

Breast cancer is an invasive disease that impacts 1 in 8 women in their lifetime. Many different subtypes of breast cancer are extremely difficult to treat and are highly susceptible to relapse. Doctors and researchers are testing different treatments that they hope to be effective with minimal side effects. There has been a large focus on looking at predictive values and gene signatures in order to get a better sense of how to treat cancer. Much recent research has been looking at neoadjuvant and adjuvant therapies as a way to minimize the tumors and prevent relapse. With a rise of many new treatments coming out in the past 2 weeks and several more planned to come out shortly there is a rise of skepticism in oncologists and patients as the NCCN has not established treatment recommendations nor the standard of care for breast cancer regarding these treatments. These treatments are also not FDA approved but have been used for other cancers and shown success. Therefore many doctors must go through different paths to obtain these treatments. Because of this there are many different questions revolving around whether or not it is safe and effective. The risk benefit analysis is also in question as this has been researched in early stages of breast cancer with low risk BC and therefore are more likely to survive and less likely to take new treatments that may involve more side effects for a higher chance of survival. The current knowledge gap is how willing both patients and oncologists are to recommend and pursue these new treatment paths. The future path is to analyze and record general perceptions surrounding new treatments which are coming out weekly. This presentation will outline multigene assays in early breast cancer and outline a future study of public perception of novel treatments.

Morgan Remeza

Use of Solar Panel Staging to Reduce Propellant Mass and Time for Spaceflight Missions Approaching the Sun



Class Year: 2022
Mentor:
Oliver Jia-Richards

The objective of this research was to determine how spacecraft missions approaching the Sun can be optimized using solar panel staging. One method of optimization uses staging mechanisms to deploy depleted thrusters. This has been shown to theoretically reduce fuel mass and time of flight (ToF) by 12.7% for a 3U cubesat. This study investigates how staging can be applied to solar panels for missions to Venus which is closer to the Sun. Levels of solar radiation increase as the spacecraft approaches Venus. Solar panels are designed to produce sufficient energy near Earth resulting in excess energy being produced in later parts of the mission. Therefore, it may be beneficial to “stage” or eject unneeded solar panels as the spacecraft approaches Venus. To determine the effectiveness of this idea, representative missions were designed. A minimum energy requirement for thruster operation was set and an equation that modeled energy production per unit of solar panels relative to the distance from Venus was formed. Analysis comparing energy requirements, solar panel energy production, and amount of solar panels showed that more than 40% of solar panels could be ejected before reaching Venus. Depending on the ejection times and specific mission, fuel savings were determined to be between 3-10%. Furthermore, applying the staging idea to 26 real life cubesat missions consistently produced sizable fuel mass savings in a wide range of spacecrafts. These findings support the use of solar panel staging to maximize mission efficiency for space exploration.

Yuiko Suzuki

A New App to Build Memories Among Adolescents and to Boost Positive Affect



Class Year:2022
Mentor: Michael Klein

Shelter-in-place orders during COVID19 forced teens to disconnect from peers which led some to experience feelings of anxiety and depression. This resulted in an increase in the usage of social media, which provided a way for teens to connect even if they are physically far apart. Cuberghe et al (2021) found that teens who experienced more feelings of loneliness tended to try to connect via social media. Therefore, it is important to encourage teens to reconnect in the post-pandemic world both on social media and off-line. The purpose of this study is to design an app to help post pandemic teens feel connected to their peers by encouraging them to create new memories together. The app would allow groups of teens to make a common bucket list of experiences and then post photos as they engage in those activities on social media. To test the effectiveness of the app, the Positive and Negative Affect Scale (PANAS) will be administered both before and after the participants use the app to evaluate changes in mood. It is expected that positive affect will increase after using the app.

Jack Vandersteeg

The Impact of Glacial Flows on Communities in the Himalayas



Scientists are currently investigating why the glaciers in the Himalayas are melting at a rapid rate. The research indicates that the expansion of proglacial lakes may be due to environmental factors such as calving of glaciers. Calving has a significant impact on the geography around it as it affects how ice melts. Studies have shown that the frequency of proglacial lakes (a lake formed by a retreating glacier) forming has increased over the last two decades. The purpose of this study is to determine how change in snowfall affects the ice slope which can contribute to glacial hazards. Heavy snowfall can create calving conditions that can contribute to avalanches. The methodology involves examining time series data from Google Earth images of the Himalayan range. In addition, lines and polygons will be drawn to examine how conditions change over time. It is expected that the more snowfall is documented in a year, the larger the proglacial lake.

Class Year: 2022
Location of Research:
HHS

Keelan Vaswani

Analyzing the Relationship between Types of Thinking and Academic Performance in High School Students



Cognitive distortions are individually generated thoughts or feelings that are negative, persuasive and usually inaccurately based in reality. There are several types of cognitive distortions that all share the commonality that they represent an individual's private negative thinking about themselves and may cause them to interact negatively with others. In past studies, the Types of Thinking Scale was used to examine cognitive distortions in college students and in collegiate athletes but rarely in high school students. A major source of stress and anxiety for adolescents is academics. The purpose will be to analyze whether a relationship exists between reported cognitive distortions and GPA of high school students; and between reported cognitive distortions and whether the student is enrolled in higher level academic courses such as IB and AP level classes. The study will employ the Type of Thinking Scale developed by Dr. Roger Covin (2011), a questionnaire that analyzes 10 common cognitive distortions including all or nothing thinking, overgeneralization, mental filters, discounting the positive, jumping to conclusions, magnification, emotional reasoning, should statements, labeling, and personalization. Each question includes a type of cognitive distortion, its definition, and two possible real-life scenarios evaluating social and academic interactions. It is expected that the higher the student's GPA and the higher the level of academic coursework, the more they will report experiencing cognitive distortions.

Class Year: 2022
Mentor: Dr. Roger Covin

Science Research I

Anasofia Arango

The Relationship Between Form of Government and Women Politicians Receiving Uncivil Messages on Social Media

Women possess leadership qualities such as being compassionate, empathetic, working out compromises, and being a suitable role model for children which all make them effective politicians. However, the political system that the woman politician is part of may determine how effectively they can do their jobs. For example, female politicians often face issues such as lack of representation, lack of recognition, discrimination and workplace issues. These issues connect to social media because women politicians tend to be targeted more aggressively for their political views on social media and it may have to do with the governmental system that they may pertain in. This research will explore the types of comments female politicians get on social media and whether the type of government influences whether those responses are negative or positive. I will conduct this research by collecting negative responses from women and men politicians on social media. I will then create a rating system that ranges from 1 to 5, 1 being the least severe and 5 being the most severe, to examine the severity of the comments and arrange them in the appropriate rating. From the collected data I will analyze the common customs in the different governmental systems and use that to analyze the differences and similarities from the different types of governmental systems. It is hypothesized that countries that have very strict led governments will have more restricting factors on women's participation in political positions while less strict led governments will offer more participation and opportunities for women politicians.

Ariella Blackman

Growing Plants in Martian Regolith to Produce Oxygen for Human Life Support

When considering a potential manned Mars mission, life support systems are necessary to provide astronauts with the resources they need to survive. In-situ resource utilization technology can be developed to reduce the materials launched from Earth, reducing the mission's launch mass, and therefore cost. It is too difficult to launch resupply missions from Earth to Mars due to the distance between the planets, so a fully closed system must be developed to support such a mission. When considering potential life support systems, plants have the ability to be used for oxygen production, carbon dioxide removal, and food production. However, it is important to determine if plants can grow successfully in Martian regolith. The use of regolith would allow a mission to reduce the mass of Earth materials launched. A. Eichler, N. Hadland D. Pickett, D. Masaitis, D. Handy, A. Perez, D. Batchelder, B. Wheeler, and A. Palmer examined how viable three Martian regolith simulants are for plant growth. They determined that in the simulant most molecularly similar to Mars regolith, MGS-1, plants were unable to survive for a long time. This demonstrates the difficulties of growing in Martian regolith. The issues found were that Martian simulants lack copper, zinc, and boron; have a high pH; aggravate when watered; and most importantly, lack nitrogen and contain perchlorates. Several of these issues, including the nutrient deficiencies and pH, have the ability to be improved by adding supplements to the regolith. These supplements must be determined before plant growth on Mars using regolith is possible. Future research must be conducted on determining if the use of Earth soil in combination with the regolith has the potential to be enough of a supplement to support plant growth. If so, the ideal ratio of Earth soil to Mars regolith must be examined to ensure that enough resources are produced to create a life support system, while still reducing the mass launched from Earth.

Ava Cefaloni

The Effect of Ankle Ligament Trauma on Ankle Stability and Sports Mentality

Sports injuries affect athletes both physically and mentally. Often, a dedicated athlete may heal physically but may struggle to regain their pre-injury prowess on the field. Ankle ligament trauma is one of the most common sports inflicted injuries and may result in some chronic pain and weakness. However, more damaging may be the effect of the injury on the athlete's sports mentality. The purpose of this study is to determine the effect of ankle ligament trauma in high school aged athletes on ankle stability and sports mentality. The methodology entails 2 parts. The first is to test post-injury ankle stability. Part 2 involves evaluating post injury sports mentality. It is hypothesized that athletes who are committed to their sport will have better ankle stability post-injury because they will work harder to regain their strength and flexibility, but will struggle psychologically because their injury may affect their identity as an athlete. Future research will examine if return-to-sport for committed athletes will be more difficult because even if their body is ready, the possibility of reinjury will hold them back.

Rachel Conti

An Analysis of the Consumption of Calories in Young Ballet Dancers Compared to Other Dancers and Other Athletes

Although exercise is necessary for a healthy life, it can lead to unhealthy habits. Ballet dancers are a prime example of this as they spend hours looking at themselves in the mirror perfecting their technique and bodies. The purpose of this study is to to know if younger ballet dancers consume fewer calories than other young dancers and if dancers consume less calories than other athletes. Scientists have connected ballet to eating disorders for years now;it started with George Balanchine when he opened the American Ballet Theatre in NYC. He wanted all of his dancers to be extremely tall and skinny while on pointe to make them look like an unattainable creature. This concept has stuck with, and became the new standard. Due to ballet dancers looking in the mirror so often commonly leads to eating disorders, perfectionism, and body dysmorphia. Looking in the mirror to see if their body changed the way that they believe it did becomes an unhealthy obsession. However there is a gap in the research that has been done, there's nothing on the differences between ballet dancers, other dancers, and other athletes' caloric intake. The methodology will involve ballet dancers, other types of dancers, and other types of athletes logging their food intake over a four day period in food diaries. The average caloric intake between these groups will be analyzed to see if the hypothesis, that ballet dancers consume less calories than other types of dancers and other types of athletes and therefore may be more likely to have an eating disorder or some type of body dysmorphia, is supported.

James Cox

Using a Mathematical Model to Expose Inherent Flaws in Private Prisons

According to The Sentencing Project, over 2% of the United States population has been incarcerated at some point. Given that one of the goals of incarceration is rehabilitation and reintegration into society, it is important to understand the effectiveness of prisons. One of the methods of this system of incarceration is Private Prisons. Private prisons are built for profit by large corporations who then contract out the prisoners as a workforce. This was seen as a solution to overpopulation in prisons but has quickly turned into a cycle of reincarceration, violence among prison inmates, and exacerbating the current overpopulation problem in prisons. The purpose of this research is to quantify whether private prisons decrease reoffending rates and prevent future violent crimes. The methodology entails building a mathematical model comparing public state-run prisons to private corporate-run prisons. Specifically, the rates of reincarceration, prisoner violence, and quality of life variables (medical services, living spaces, psychological services, food, etc.) will be analyzed. It is expected that results will show that private prisons inherently do not alleviate the problems that set out to solve.

Lauren Davidson

The Effects of sir-2.4 Knockdown on GFP Fluorescence Levels and RPL-29::GFP Concentration

Using the strain CZ18550, this research analyzed how the knockdown of the gene sir-2.4 affected GFP fluorescence levels, GFP localization and RPL-29::GFP concentration. The major questions researched were the effect on GFP localization and fluorescence level after sir-2.4 knockdown and 30°C heat stress, the effect on GFP after double knockdown of sir-2.4 and daf-16, the effect on GFP after knockdown in different stages of development, and the effect on GFP after mdt-28 RNAi. Overall, it was found that the knockdown of sir-2.4, when placed under heat stress, caused an increase in the fluorescence of the GFP. Along with this, the heat stress caused the worms to undergo a developmental delay. However, this interestingly occurred in both the control, L4440, and the sir-2.4i worms that were placed under heat stress. Additionally, the knockdown of sir-2.4 caused an increase by almost double in the concentration of RPL-29::GFP when compared to the control, L4440. The knockdown of sir-2.4 in the egg stage versus Day 1 of adulthood caused an increase in worm size of the Day 1 adulthood worms, while there was an increase in fluorescence levels in both experimental groups of worms. Similarly, with the knockdown of sir-2.4 and daf-16, there was an increase in fluorescence level, as well as much larger worms and larger than normal intestines in the worms. This study is important to future research because sir-2.4 has a human homolog, so any results that could lead to stress resistance or lifespan could be interesting to research and compare to possible effects in humans. In addition, any research that was found could lead to further research and even more discoveries that could affect how we know *C. elegans*, as well as many other eukaryotes.

Luisa de Oliveira

The Epigenetic Effects of Isolation on the Exploratory Response through Generations

Trauma is an emotional response to dire events such as accidents and drastic changes that can modify one's actions. These events can be physical, such as jarring injuries or mental such as abrupt isolation; yet both can result in genetic changes that can be passed down to future generations. Changed genes throughout a parent's life can lead to a higher chance of their offspring's death or cause serious disadvantages in life that they would likely not have otherwise. It's been found that trauma and early stress can lead to depressive-like behaviors that can be transmitted as far as four generations with different impacts depending on the sex of the child. Observing these changes are essential to understanding why some characteristics and genes can be seen in descendants. However, no evidence shows whether an offspring is more likely to inherit a changed gene from a parent if its passed by the mother or the father. And, whether it will be passed down at all depending on what was changed in one's DNA. This presentation will discuss the possible modifications in an offspring's genes if only the father was put through stress (isolation) by comparing the offspring's behavior to that of their father and mother.

Fjord Deda

Analyzing the Effects of Complex Stimuli and Emotional Recognition for Individuals with Autism Spectrum Disorder

Autism Spectrum Disorder, or ASD, is a neurological disorder that impairs one's social abilities, communication abilities, and interactions with other individuals. With this disorder, individuals might have difficulty recognizing someone else's emotions or social cues because of how subtle a human face is, which increases the difficulty for someone with ASD to read their emotions effectively. This symptom influenced scientists to find a way to make faces, particularly human emotions, more comprehensible to an individual with Autism. A study performed by Rosset et al. found out that using human like cartoon faces was more straightforward for individuals with ASD to recognize than when presented with a human face to observe. This is because cartoon faces have more minor details that decrease one's need to infer what the individual is feeling. This study made it more known to others that individuals with ASD better understand any less complex stimuli; however, this study was done only for more fundamental emotions, such as happiness, sadness, and anger. Future research must use more complex emotions, such as embarrassment, disgust, or surprise. This presentation will describe the relationship between the complexity of the stimuli and how it affects an individual with ASD's perception of a particular emotion.

Zaynab Faisal

How Visitor Effect Impacts the Lifespan of Large Zoo Animals and Their Offspring

Visitors are a vital part of zoos because their admission fees provide necessary funding for zoo research and maintenance. In addition, zoos provide necessary education about conservation and biodiversity which enable people to better understand how to coexist with animals in their natural environments. However, visitors can also be a source of stress for animals because of the noise and other disruptive behaviors people engage in while visiting the zoo. According to Sherwen (2019) the Visitor Effect is the auditory and visual interaction that animals have with humans who visit their enclosures in the zoo. Zoochosis is unusual behavior by animals in captivity caused by frustration. Zoochosis and its resulting stress in animals can be related to hormonal and immunological changes that could lead to disease and shortened lifespan. Therefore, it is possible that the Visitor Effect contributes to animal zoochosis and could possibly contribute to a decreased lifespan of large animals. The purpose of this study is to investigate the effect of visitor's on the length of a zoo animal's lifespan. Specifically, big cats will be studied because large mammals experience more intense zoochosis. The study will consist of researching zoos and the number of visitors that come to their enclosure. Then, that information will be analyzed to see if visitor interactions affect the lifespan of the zoo animal. It is expected that visitors will have a greater impact on zoo animals' lifespan.

Ella Farago

The Response to Virtual Reality Exposure Therapy on Fear of Heights

Specific phobias can develop discreetly or abruptly, but the way you face these mental barriers can result in either ignoring it, or treating it. Virtual reality exposure therapy has been observed to be an effective way to treat most phobias. 9.1% of Americans endure a specific phobia. Most of the time, these phobias aren't even recognized by professionals because people hide them in fear. Another part of the issue is that these phobias are rarely guaranteed a permanent treatment. Along with virtual reality exposure therapy, there is in vivo, imaginal, and flooding. A lack of treatment can lead to a person's life, relationships, physical health and mental health, to be completely ruined. The research field has concluded that Exposure therapy is the most effective Psychotherapy for confronting a phobia. It focuses on altering your response to the object or situation that you fear. Consistent and repeated exposure to the source of your specific phobia and the related thoughts, feelings and sensations may help you learn to manage your anxiety.

Emma Fischer

How Blue Light Strains Our Eyes

Blue light has a short wavelength that contains more energy compared to the other wavelengths. As blue light is prominent in many everyday objects, such as televisions, computers, cellphones, LED lights, and other fluorescent lights, people are exposed to this lighting, causing their eyes to strain. In an article written by Geral Schmidinger, titled "*Intraindividual comparison of color contrast sensitivity in patients with clear and blue-light-filtering intraocular lenses*", he discussed the difference between filtered and unfiltered glasses and the effect that the blue light has against both of the glasses. Schmidinger studies how the blue light glasses work and how much of an impact they really have. Schmidinger chose to study eye implantations that were selected randomly and used a lens to study how the eye becomes strained with color contrast tests. Schmidinger found there to be no significant difference between the two tested eyes. While my experiment would be very different, as I plan to have people physically wear the glasses and take eye strain tests, this research is very similar to mine and I can make a small assumption that the results could be similar. For my future research, I would be having a group of people wear blue light filtered glasses and a control group wear unfiltered glasses for a certain amount of time, then both groups would take a survey I developed. In this survey, participants would answer questions on symptoms they could be experiencing from eye strain, take a test on eye strain, and then read a passage during which they would be interrupted to look at an eye test, which will allow me to see how long it takes their eyes to adjust and refocus on something else after looking at a screen.

Emma Fitzgerald

The Impact of Dietary Modifications on the Lifespan of Parent and Later Generation Offspring in *Drosophila melanogaster*

Epidemiology is a study that deals with turning genes “on” and “off” in your DNA. Heavily influenced by your environment and the DNA your parents carry, epigenetics defines a lot of things in our life, by influencing how healthy you are or physical traits you portray. Scientists are trying to define to what extent epigenetics play a role in our life, and how it connects to our family heritage. Some findings show that mother and offspring epigenetics have a big correlation and influence a lot of different aspects of the offspring's life. Fruit flies are commonly used as test subjects in studies because of their genetic similarities to humans. With this in mind, researchers are investigating and experimenting changes in their diet to find how it can increase or decrease the lifespan of their life and future generations. Furthermore, future research can be done to identify other factors that can influence the life of a fruit fly and eventually discover if diets can be altered enough to increase the lifespan of humans as well. This presentation will discuss previous research from existing literature and plans to create a diet intervention study with fruit flies.

Nicole Giandomenico

A Genetic Screening to Identify Genes Associated with Autism and Motor Delay

Autism Spectrum Disorder (ASD) is an developmental disorder that mostly affects intellectual and motor development, as well as social skills. ASD could impact a child's motor development through balance, walking, focus or the ability to do something as simple as picking up a pencil and writing their name. The major problem that scientists are trying to solve is which genes are associated with motor delays found in autism. This is important because once specific genes are discovered, scientists could try to figure out a rescue. Because genes are impossible to study directly in humans, the model organism, *Drosophila melanogaster* will be used for this study. *Drosophila* has been shown to be an model system for ASD studies to define novel genes linked to ASDs and decipher their molecular roles. Three genes: CSDE1, BAZ2B and CNTNAP2 have been identified as possible candidates for motor delays in autism patients. Through Flybase, orthologs of these genes have been identified in *Drosophila melanogaster* and will be tested for issues associated with motor delay using the negative geotaxis assay and the locomotor developmental assay. After identifying mutant flies that express phenotypic motor delay, this study will find a way to rescue the fly either through overexpression of the human ortholog. This will make a case that these flies are good models for human motor delays. Future research will include further characterization of the fly mutant phenotypes including muscle loss and neuronal degradation to determine the reason for the motor delay.

Rei Ishii

The Effect of Temperature on the Perceived Texture of Food

Because biological systems are heat sensitive, it follows that our taste perception may also be affected by temperature. For example, Temperature and Sweet Taste Integration in *Drosophila* (Qiaoran.2020) found that *Drosophila melanogaster* preferred warmer sweet foods. This is important because the temperature of food and of our mouths may play a role in our consumption and in the nutritional content of our diet. Green (1993) stated that how tactile sensitivity affects the perception of foods and beverages has never been studied directly. He reasoned that chewing produces mechanical vibrations of different frequencies in the tongue and skin of the mouth. Green (1979) found that temperature affects the quantity and quality of mechanical vibrations. Therefore our perception of tactile stimulation should change with temperature. This study aims to determine how touch (roughness, smoothness, thickness and creaminess) changes at different temperatures. It is expected that the colder the food/oral temperature, the less smooth, thick, creamy and rough the food will be perceived to be by study participants.

Andre Joubert

The Effect of COVID-19 on Protected Areas in South Africa and on the Communities Around Them

The COVID-19 pandemic has had a huge effect in South Africa, costing the tourism industry over 4.5 billion dollars in revenue. Conservation is the process of protecting animals who are threatened or endangered, South Africa is one of the world leaders in conservation and houses some of these endangered species. Due to the COVID-19 pandemic, South Africa has been greatly affected economically because of a lack of travel and both local and international tourism, which provides a major stream of revenue and keeps conservation efforts funded. As a result, two different perspectives could possibly drive future policy decisions. The first entails realizing that people, animals, and ecosystems are connected in terms of health and that if one is affected, so are the others. The second entails sacrificing conservation efforts to restore the ailing economy; this means defunding conservation efforts, and also the future economy of the local surrounding communities. The purpose of this study is to understand the impact of COVID-19 on protected areas in South Africa and their local communities. The methodology will consist of a survey that will be distributed to protected areas management, community leaders, industry leaders, and community members to assess their perspectives on the importance of conservation.

Rachel Kindler

A Comparative Model to Assess the Agricultural Sustainability of Plant-Based Milks

Agriculture has a larger influence on the surface of the Earth than any other human activity. Land is continuously being converted for crop and livestock production. Additionally, there is an increased demand for plant based milk with the rise of veganism and abundance of information on the effect of cows on the environment. According to UC Davis, the goal of sustainable agriculture is to meet society's food needs in the present without compromising the ability of future generations to meet their own needs. Sustainability is important in order to ensure the health of our ecosystems and that the ability to produce enough food in the future isn't threatened. The purpose of this study is to assess the agricultural sustainability of different kinds of plant milks and predict which milk will be the most sustainably viable for consumption. The methodology involves assessing consumption habits of the US population of different plant based milks. Then identifying the average yield of the 'main ingredient' of each milk. Next, the yield data will be utilized to calculate how many acres of plants are used to produce enough milk for one person. Lastly, a mathematical model will be constructed to predict the agricultural sustainability of milk products for the next 20 years.

Ariana Majlessi

Improving Access to Decentralized Wastewater Treatment Systems

Water reclamation is the process of converting wastewater into water that can be reused for other purposes. Reclaimed water reuse includes landscape irrigation, agricultural irrigation, industrial applications, non irrigation applications, environmental and recreational applications, and indirect and direct potable uses. In light of population growth, an increase in the agricultural use of water and less freshwater being available, water reuse will become an important part of daily life. Reclaiming wastewater will not only reduce and prevent pollution, but will also help decrease the diversion of water from sensitive ecosystems. Such wastewater can be reclaimed via decentralized and centralized systems. Centralized systems treat water in a central location and then distribute water via dedicated distribution networks, while decentralized systems convey, treat, and dispose of or reuse wastewater from small/low-density communities in remote areas. Conditions such as population and the economic wealth of an area influence which system works better. The issue lies in such centralized treatment facilities being very expensive and difficult to maintain for smaller communities, making decentralized systems the alternative. Decentralized systems stand out over centralized systems due to their low cost, minimal collection system, minimal solid handling and simple treatment technologies, ultimately making them ideal. However, most decentralized systems are not designed for the long term, except in the case of Mobile, Alabama. The effectiveness of integrating decentralized concepts into an urban centralized system, such as in the urban setting of Mobile, Alabama would not only maintain large populations in the long term but lower costs for such urban/suburban settings. In Mobile, the combination of the decentralized and centralized systems worked by targeting urban sewer interceptors subjected to overcapacity conditions during extreme weather, extracting and treating wastewater using several small decentralized treatment technologies, then using such wastewater for either irrigation or potable uses. Different models of decentralized systems treated over 40,000 gallons a day and used several different models of treatment technologies for irrigation applications (Bioclear, Delta BioPod, Bio Microbiotics FAST) and used a rotary screen to remove all solids from the wastewater. Cost, performance data and pollutant concentrations were evaluated and from this evaluation concluded that a combination of a centralized and decentralized system would be optimal in terms of maintaining large populations of urban and suburban settings in the long term, which decentralized systems were prior not designed for. Through analysis of previous data and through analysis of this ingenious system in Mobile, it was concluded that engineering such models based on the Alabama model could prove to be amazingly effective in terms of lowering costs and the need for maintenance in such other urban and suburban areas across the United States. Designing similar models and adapting them to the conditions of a specific area for the long term is a challenge scientists and engineers are tackling today. Future research will include analysis of such decentralized systems and will discuss and compare different theoretical models with the goal of engineering more of these systems for long term use in other such urban areas.

Elena McCann

The Effect of Ethanol on the Regeneration of *Lumbriculus variegatus* in Relation to Fetal Alcohol Syndrome

Fetal Alcohol Syndrome is a disorder that affects a child's mental and physical development caused by alcohol consumption from a mother during pregnancy. Oftentimes, scientists use model organisms to learn about the effects of alcohol on these model organisms and current FAS research. The model organism *Lumbriculus variegatus* is an ideal model organism because it regenerates tissue at a fast pace. Because of this, these worms can be used to show phenotypic changes that occur when the tissue is exposed to different concentrations of ethanol. In addition, gene expression analysis can be done to determine what genes are activated (or not) as the worms exposed to alcohol regenerate. Katherine Hernandez and Hailey Duncan, conducted a dose response study, using *Strongylocentrotus Purpuratus* (the Purple Sea Urchin) as a model organism to study the effects of ethanol on embryonic development. However, few known studies have explored regeneration in relation to FAS using *Lumbriculus variegatus*. There is uncertainty following which genes are affected in the process of regeneration of *Lumbriculus variegatus* when exposed to ethanol. This research aims to understand which genes are affected by different dosages of ethanol exposure and the associated phenotypic changes in the tissues of *Lumbriculus variegatus*.

Angelea Nicaaj

The Effect of Anchoring Bias on the Accuracy of Forensics Cases and DNA Evidence

Forensic science is seemingly impartial and not influenced by outside opinion, but that can rarely be the case because of cognitive bias. Cognitive bias is the systematic error in the processing and deciphering of information. For example, Lynch in 2003 stated that DNA evidence is viewed as an impartial science, but there are instances of the people analyzing the evidence affecting the objectivity of it. One type of cognitive bias is anchoring bias, which is a tendency to be heavily influenced by the first piece of information given. The purpose of this study is to determine if anchoring bias can affect the accuracy of DNA evidence used. The methodology involves using a stratified sample to determine if people's guesses when assessing evidence given are influenced by higher or lower anchors. For example, participants will be told that DNA evidence was collected in increasing increments of time and asked to guess when the suspect was at the crime scene. It is expected that higher anchors will affect the assumption of when the suspect was present.

Cassandra Rendlesham

The Epigenetic Effect of Anxiety on Gene Expression Over Multiple Generations

According to the Mayo Clinic, anxiety is an overwhelming and persistent worry about everyday situations. Anxiety can be inherited through epigenetic factors which change how your body reads a DNA sequence. This happens when the environment causes DNA markers to turn on or off genes which inhibit or overcompensate for a protein in the body. Gapp (2016) studied how anxiety and separation from the maternal rat affected her offspring. They showcased changes in DNA methylation of specifically the CpG 1, 3, 7, 8, and 9 genes. They found that CpG methylation decreased in both the mother and the offspring which meant that both the mother and the offspring were equally anxious even though the offspring did not have the same stressors in their lives. Gapp concluded that CpG 1, 3, 7, 8, and 9 were some of the genes that were affected when a mother has anxiety and that anxiety gets passed down to the offspring. However, there are few known studies researching the epigenetic effects of anxiety over multiple generations. The purpose of this study will be to identify patterns in affected genes over multiple generations. The methodology proposed will stress the parent generation of *Drosophila melanogaster* using intense light. A Genechip gene expression tester will be used to look at the patterns in genes over multiple generations. It is expected that similar anxiety causing genes will be expressed for multiple generations.

Peter Rinello

The Difference Between High Repetitions Lighter Weight and Low Repetitions Heavier Weight

Weight lifting has been shown to improve posture, increase metabolism and maintain weight loss. However, it is unclear whether weight lifting using heavier weights or more repetitions offers the greatest benefit. The purpose of this study is to determine whether a workout with high repetitions and lower weight, or low repetitions and heavier weight is more effective for building strength and for improving body fat percentage and body mass index (BMI). The methodology entails two groups: group 1 changes the weight but keeps the number of repetitions constant, group 2 changes the number of repetitions but keeps the weight constant. Strength and BMI will be measured before and after the experimental period (6 weeks). Then, both groups will switch and participate in the opposite exercise for the next 6 weeks so each group participates in both types of exercise. It is expected that the body fat percentage and BMI will decrease the most when workouts include more repetitions and lighter weights while strength will increase when there is fewer repetitions and heavier weight.

Leslie Rubio

The Psychological and Physiological Effects of Leukemia Survivorship Post Sickness

Surviving cancer is usually believed to be a positive experience however, some people continue to suffer after their last treatments. Some cancer survivors report experiencing memory loss or fixation, vision loss, mental disorders, learning and comprehension difficulties and motor skills. It is unclear how cancer and the resulting treatments affect the brain chemistry and the ability to perform everyday tasks of the patient. Aziz (2007) found that survivors of cancer experience difficulties in working memory and processing information. Furthermore, Erdman (2017) found a clear and direct correlation between survivors' performance on n-back performance tests and processing speed/ working memory setbacks. The purpose of this study is to quantify the psychological and physiological effects of surviving leukemia after having been treated with chemotherapy, especially in terms of mathematical processing, comprehension skills and mental health. The methodology includes a survey to examine survivors emotional and physiological response to cancer and a study of their performance on cognitive assessments. The neuropsychological measures tested will include tests of general cognitive abilities, motor speed, learning ability, and mental health. The requirements for participation in this study are that survivors are 18 or up, received chemotherapy, and have had no relapse of cancer for at least 1 full year since cancer survivorship. Internal Review Board approval will be sought and patient privacy will be maintained. Future research will test children of survivors to determine if the stress of cancer is inherited in the next generation.

Lauren Schnapp

The Effect of the New Western Diet on Jaw Development and the Quality of Sleep

Sleep Apnea occurs when there is a lack of oxygen to the brain because of blocked airways which cause sleep disturbances. According to the Mayo Clinic, obesity and excess weight can cause Sleep Apnea in adults. However, young children may also have Sleep Apnea and the causes are more unclear. The New Western Diet (NWD) is ubiquitous in westernized countries including the United States. The NWD consists of high fat and processed foods which tend to be softer to chew. It is possible that consuming the NWD alters the pallet structure of children and therefore contributes to Sleep Apnea. For example, people who eat softer food will have a weaker pallet and will have sleep disturbances compared to someone who eats harder foods. Khan (2020) explained that hunter-gatherers consumed harder foods like vegetables and nuts and did not use utensils. This type of diet has been shown to increase muscle use and mouth breathing which aids jaw development as seen in animal experiments. It is thought that a softer diet disrupts the signaling system that determines the proper orofacial structure. The purpose of this study is to determine if there is a link between the New Western Diet, pallet development and sleep patterns. The study will be conducted by surveying patients at a pediatric sleep clinic about their dietary consumption the day before their appointment as well as physically measuring participants' pallet width. Participants' sleep patterns will also be tracked. The expected results are that there will be a correlation between diet, pallet width and Obstructive Sleep Apnea.

Hayanna Silva

The Effect of Invasive Fish on the American Bullfrog Population in the Northeastern United States

Invasive species are nonnative to an area and have been known to push native animals and plants closer to their extinction. Koi fish ponds are popular in suburban New York. Koi fish are native only in Asia and Europe and therefore are invasive in the United States. Frog are an indicator species of the health of an ecosystem and Koi fish may be contributing to changes in frog population in these areas. The purpose of this study is to determine the effect of invasive species like Koi fish on the diversity of frogs and the population of the American Bullfrog. The methodology involves identifying frog calls to determine frog diversity, electrofishing to determine fish diversity and identifying the species of invertebrate populations (like dragonfly nymphs) in local ponds in the Northeastern United States suburbs. It is hypothesized that the non native Koi fish will lower the abundance of dragonfly nymphs, the reduction of native dragonfly nymphs will allow for an increase in survival of bullfrogs larvae which will cause an overpopulation of bullfrogs and a decrease in the diversity of other frog species.

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!

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Questions . . .

If you have any questions about the Research Program and/or the events of tonight, please feel free to contact either of us:

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