Harrison Science Research Presents:

The 21st Annual

HARRISON HIGH SCHOOL SCIENCE AND TECHNOLOGY

{ SYMPOSIUM }

Monday, June 5, 2023
7:00 PM - 9:00 PM
HHS Student Union

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

Order of Events

6:30-7:00   **Science Research Orientation for 9th Grade**
                  (& other 1st Year Parents)

7:00-7:15   **Open House & Refreshments in the Student Union**
- Students & Parents are invited to informally visit posters.

7:15-8:00 Poster Presentation Session in the Student Union
- This session will include students from the Science Research and Technology Education programs. Parents and other attendees will be asked to interview Symposium participants. In addition to allowing students to present their work, this will help them prepare for future science fairs.

8:00-9:00   **Program Honoring the Work of Our Students**
- **Montage** - The Year in Photos
- **Opening remarks** - Dr. Joan O'Keeffe, Director of Science & Technology Education
- **Highlights of the HHS Program** - Allison Blunt
- **Guest Presenter** - Isabel O'Connell, HHS SR Alumnus & Clinical Research Coordinator at Massachusetts General Hospital
- **Project Presentation** - Magda Mani
- **Senior Reflections**
- **Closing Remarks & Group Photo**

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

Senior Research Bio Pages, Abstracts, and Mini-Posters

Junior Abstracts

Sophomore Abstracts

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 data-driven 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. 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.

Acknowledgments

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

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

Science Research III
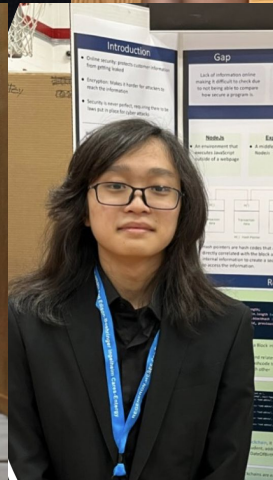
Ariella Blackman

Growing Plants in Ratios of MGS-1 and Biochar to Develop a Model In-Situ Resource Utilization System for O_2 Sustaining Life Support & Launch Cost Reduction for Mars

Location of Research: Home/HHS
Mentors: Dr. David Klaus, Univ of Colorado
Morgan Irons, Cornell University
WIll be Attending: MIT
Intended Major: Aerospace Engineering

Fairs & Awards:
STS 2023 - Top 40 Finalist
NYSSEF 2023 - 2nd Place Plant Sciences, NASA Earth Systems Award
WESEF 2023 - 2nd Place Plant Sciences,Women Geoscientists Award, Sustainable Development
Upstate/JSHS 2023 - 1st Place Plant Sciences
ASGSR Conference 2023 - 2nd Place
ISEF 2022 - 2nd Place Plant Sciences, 1st Place Air Force Award
NYSSEF 2022 - 1st Place Plant Sciences, Mu Alpha Theta Award
WESEF 2022 - 4th Place Plant Sciences, American Meteorological Society
Somers 2021 - 1st Place
HHS Symposium 2021, 2022, 2023

Martian agriculture may be the most cost-effective means to develop a sustainable human life support system on Mars by employing in-situ resource utilization to convert atmospheric CO_2 into O_2. A previous study in 2021 found that plants could successfully grow in ratios of MGS-1, one of the most accurate Martian regolith simulants available, and potting soil. However there were issues with water uptake that could be associated with the unstable aggregate structure of the growth substrates. This study determined whether Phaseolus acutifolius could grow in ratios of MGS-1 and biochar and if the addition of this biochar increased pore space and improved the structure of the substrates. Plants were grown in incremental substrate ratios, and bulk density and porosity testing was done on each of the substrates. While the beans initially did not germinate, they developed roots in all substrates after being treated for high salinity and pH. However, none of the plants sprouted above the ground, possibly due to nutrient deficiencies. Results suggested that the amount of biochar did not change the growth of the plants or substrate structure, as between ratios, the germination rates were the same and there was no significant difference between root length or bulk density (p>.05). Despite the limited change in the physical properties of the substrates, beans germinated in all substrates including biochar, despite not germinating in 75% or 100% MGS-1 in the 2021 study. This suggests that the major aspect of MGS-1 that inhibits plant growth may be salinity instead of the physical properties, as it explains the limited water uptake in both studies while explaining why the plants in the present study germinated despite having a high bulk density.

Growing Plants in Ratios of MGS-1 and Biochar to Develop a Model In-Situ Resource Utilization System for Oxygen Sustaining Life Support and Launch Cost Production for Mars

Introduction

In-Situ Resource Utilization (ISRU)
- Martian materials reduce launch mass
- Plants for O_2 in regolith - reduce cost

MGS-1: Regolith simulant

Previous Research - 2021:
- Potting soil/MGS-1; <u>goal</u> to optimize O_2 and launch cost
- Ideal: 50-75% MGS-1
- <u>Issues</u> from limited water uptake/<u>unstable aggregate structure</u>

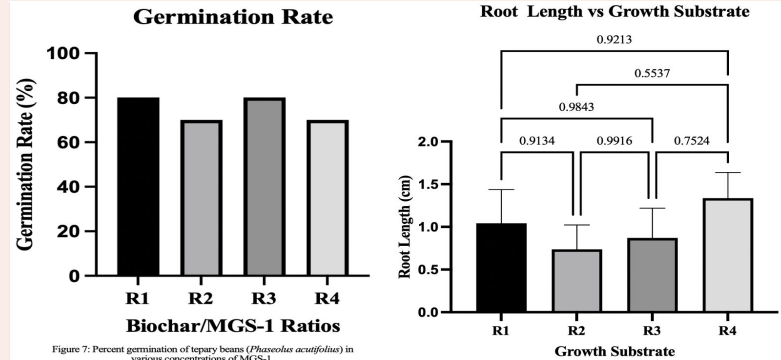**Replace soil with biochar; C to stabilize substrate**

Hypothesis

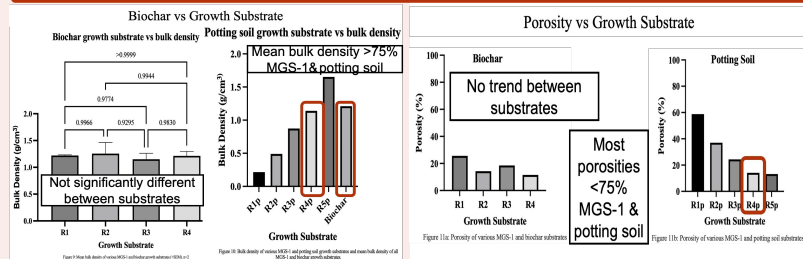**1.** *Phaseolus acutifolius* will grow & produce O_2 in MGS-1 and biochar.

2. Ideal includes more MGS-1 than 2021 study.

3. Biochar addresses unstable MGS-1 structure.

Results

Figure 7: Percent germination of tepary beans (*Phaseolus acutifolius*) in various concentrations of MGS-1.

Similar growth between substrates.

No significant difference in structure between substrates.

Methodology

Substrates	**Salinity**	**pH**
MGS-1 and biochar	High salinity limits water uptake	Decrease high pH
Treated for stability	Leach out salts with water	Add aluminum sulfate until pH = 7.5

Plant	**Bulk Density**	**Porosity**
Controlled environment 20 days; root length	Low bulk density = increased water motion	High porosity = increased water motion
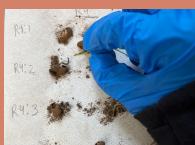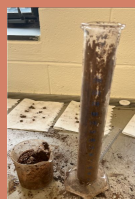
Conclusions

1. No differences in growth or structure

2. Germination rates improved post-salinity treatment

3. Salinity may cause issues, not unstable structure

4. May treat salinity & nutrient deficiency to address major issues

Adjust model

Potting soil
Density: 0.207 g/cm³
Volume: 75% (420 cm³)

Biochar
Density: 0.112 g/cm³
Volume: 5% (27 cm³)

Control cost = $4,545,000

Determine Cost

$$0.112 g/cm^3 = \frac{m}{(27 cm^3)(1000\ plants)}$$

$$m = 3.02\ kg$$

$$cost = 3.02\ kg\ (\$45,000)$$

$$cost = \$135,900\ per\ astronaut$$

$$cost\ savings = 4,545,000 - 135,900 = \$4,409,100$$

Plants can likely be LSS to improve accessibility of a human Mars mission.

Ava Cefaloni

The Effect of the Beats Per Minute of a Metronome on Heart Rate and How That Correlates to Pregame Stress

Location of Research:
Harrison High School

Mentor:
Christopher Grippo

WIll be Attending:
Dickinson College

Intended Major:
Biology / Pre-med

Fairs & Awards:
WESEF 2023 - 4th Place Behavior
JSHS 2023 - Local Speaker
HHS Symposium 2021, 2022, 2023

The stress of living up to high expectations, being perfect, and being number one can take a huge toll on student athletes. Stress is a common feeling for athletes that can be caused by a variety of different factors, and it can lead to serious mental health problems. The purpose of this study was to determine the direct effect of the beats per minute (BPM) of a metronome on pregame stress. The methods involved determining differences in heart rate and stress levels using the Perceived Stress Scale (PSS) before and after listening to a specified BPM on a metronome. Experimental groups listened to either 0 BPM, 30 BPM, 60 BPM, or 120 BPM (n=21). The results showed that as metronome BPM increased, average heart rate significantly increased ($p<.05$), which correlated to an increase in average reported stress levels, however this trend was not significant ($p>.05$). In other words, listening to a metronome at 30 BPM and 60 BPM caused a decrease in heart rate and reported stress levels, while 120 BPM increased heart rate and reported stress levels. This implies that listening to a metronome at a BPM of 60 or less can be a method used to decrease pregame stress.

The Effect of the Beats Per Minute of a Metronome on Heart Rate and How That Correlates to Pregame Stress
Ava Cefaloni

Introduction

30% of female student-athletes felt that difficulties were piling up so high that they often felt they could not overcome them (NCAA, 2019).

Sarah Shulze, Wisconsin

Ledin, 2022
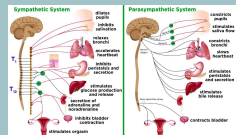
Hernandez, 2022

Katie Meyer, Stanford

Stress - a feeling of emotional or physical tension
Pregame stress - commonly felt before participating in a competitive sport (personal vs athletic)

Stress → Autonomic Nervous System (ANS) → Impacts changes in heart rate
Sympathetic → Increase
Parasympathetic → Decrease

Dave. "The Autonomic Nervous System: Sympathetic and Parasympathetic Divisions." YouTube, YouTube, 14 Mar 2019,

Heart Rate Synchronization: Music BPM can impact heart rate (BPM).

Purpose: Determine whether listening to lower beats per minute on a metronome reduces heart rate and results in decreased reported levels of pregame stress.
- **Hypothesis 1:** If the beats per minute is lower than average heart rate, then heart rate will decrease.
- **Hypothesis 2:** If the beats per minute is lower the average heart rate, then stress levels will decrease.

Methodology

Participants
- IRB approval received
- Parental and Participant Consent
- 21 total participants
- All female
- Varsity, JV, and Club
- 2 T&F, 17 soccer, 1 volleyball, 1 Field Hockey.

Variables
Independent: Metronome BPM
Dependent 1: Change in Heart Rate (BPM)
**Dependent 2:** Change in Stress Levels
Controlled:
- Gender = all female (as reported)
- Location = on bus to event
- Time = 1 hour before warming up
- Age = 14-18 year olds participating in team sports

Each group will listen to their assigned BPM for 5 minutes, headphones on half volume. 0, 30,60, 120 BPM

Post-listening heart rate and stress levels are recorded directly after listening to metronome..

Sit for 5 minutes and obtain resting heart rate. Pre-listening stress test (PSS) and records pre-listening HR.

Results & Analysis
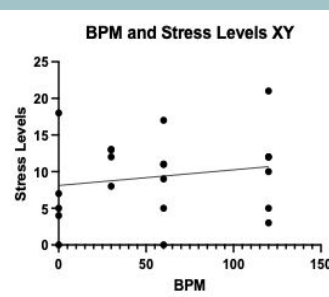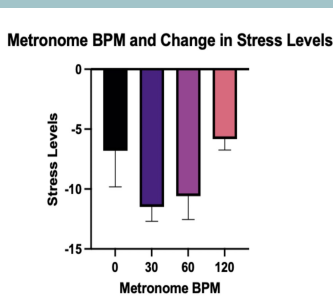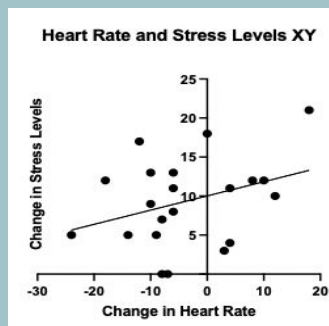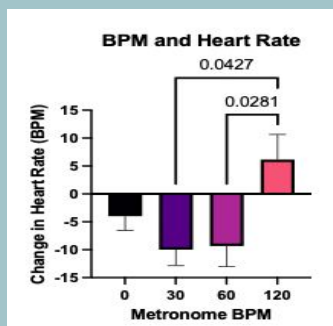
Lower BPM caused a significant decrease in heart rate and a trend towards decreased stress levels.

Conclusion & Future Research

Hypothesis 1 → SUPPORTED: Trend suggests that as metronome BPM decreased, average heart rate significantly decreased ($p < .05$).

Hypothesis 2 → NOT SUPPORTED: The decrease in heart rate correlated with a decrease in stress levels, but this trend was not significant.

- The trend demonstrated is important because it shows that a metronome may be an effective method in decreasing pregame stress levels. More research is needed to determine the effectiveness of this method due to a small sample size.

Future Research:
- Further research could help depict whether or not a metronome can **effectively** and **consistently** be used to decrease pregame stress levels.
- Determine the effect of metronome on **male athletes** and **different ethnic groups**

Lauren Davidson

The Effect of Copper (II) Sulfate Pentahydrate Concentration on Lifespan and Locomotor Ability of Transgenic Alzheimer's Model *Drosophila melanogaster*

Location of Research:
Harrison High School

Mentor:
Ms. Allison Blunt

WIll be Attending:
Lafayette College

Intended Major:
Biochemistry/Neuroscience

Fairs & Awards:
2023 Regeneron ISEF
WESEF 2023 - Top of Fair, 2nd Place Medicine & Health
Regeneron STS 2023 - Top 300 Scholar
JSHS 2023 - 1st Place Medicine & Health
Upstate JSHS 2023 - Regional Speaker
NYSSEF 2023 - Lightning Round Qualifier
WESEF 2021 - 4th Place Cell & Molecular Biology
**HHS Symposium** - 2021, 2022, 2023

Alzheimer's Disease (AD) is a progressive neurodegenerative disease believed to be caused by the abnormal breakdown of proteins creating toxic Aβ plaques. Copper is naturally occurring in the brain and is required for maintaining the health of neurons. Two conflicting theories on copper interaction with AD exist: 1. Aβ plaques absorb Cu^{2+} ions, creating a Cu^{2+} deficiency in neurons, decreasing neuronal function 2. Excess Cu^{2+} in the brain binds to Aβ, increasing aggregation, causing an increase in neurodegeneration. This study researched the effects of Cu^{2+} concentration on transgenic *Drosophila melanogaster* using a GAL4-UAS system expressing the human "Arctic" Aβ42 mutation to determine if supplementation could decrease AD-associated effects. A dose-response study was conducted by adding 0, 1, 10, 100, 500, and 1000 μM concentrations of $CuSO_4.5H_2O$ to Instant Drosophila Medium Blue. AD has progressive deterioration of movement coordination over time so a negative geotaxis assay was conducted on days 7, 8, and 9 of life to measure neurological function. Probability of survival was documented using Kaplan-Meier curves. Results showed that as Cu^{2+} concentration increased, locomotor ability of Arctic flies increased significantly ($p<.05$), while that of wildtype and Gal4 controls generally decreased. Arctic flies had normalization of lifespan with no significant difference in lifespan existing between 10 μM Arctic and 0 μM wildtype flies ($p>.05$). These results imply that Cu^{2+} supplementation had an ameliorative effect on neurological function and lifespan of transgenic *Drosophila melanogaster* suggesting that Cu^{2+} supplementation may have an improving effect in AD patients.

The Effect of Copper (II) Sulfate Pentahydrate Concentration on Lifespan and Locomotor Ability of Transgenic Alzheimer's Model *Drosophila melanogaster*

Introduction

Alzheimer's (AD) (NIH, 2022)
- Progressive, neurodegenerative
- 6 million U.S., 65+
- $28,000 per person/year healthcare cost (AD Association, 2022)
- No cure, few treatments
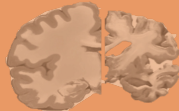
Drosophila melanogaster = valid model organism (Markstein, 2018)
Transgenic model = express human "Arctic" AD mutation that overexpresses Aβ in *Drosophila melanogaster* using GAL4-UAS model
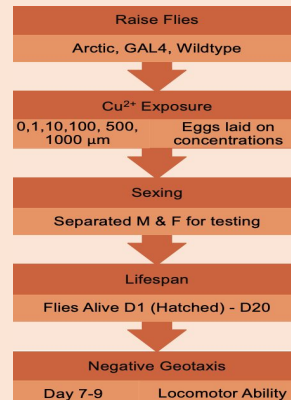
Copper = naturally occurring, maintains NMDA receptors responsible for cell-cell communication, cell survival, learning, & memory

Decreased Cu^{2+} in brain =
- Decreased learning and memory
- Decreased cell-cell communication

Methodology

Raise Flies
Arctic, GAL4, Wildtype

Cu^{2+} Exposure
0,1,10,100, 500, 1000 μm | Eggs laid on concentrations

Sexing
Separated M & F for testing

Lifespan
Flies Alive D1 (Hatched) - D20

Negative Geotaxis
Day 7-9 | Locomotor Ability

Negative Geotaxis:
Flies climb up to 8cm= locomotor ability = neurological function
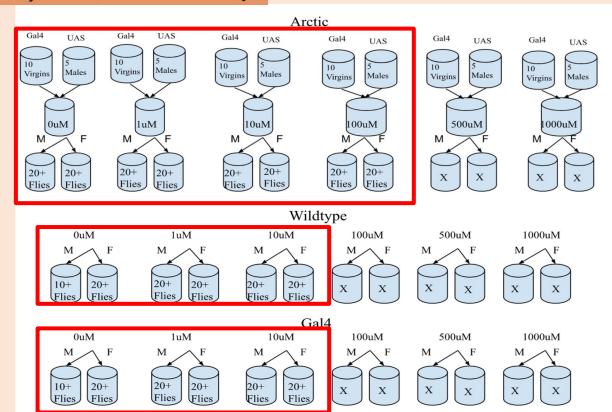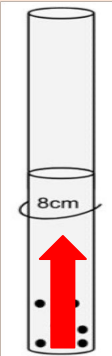
Results & Analysis

Negative Geotaxis
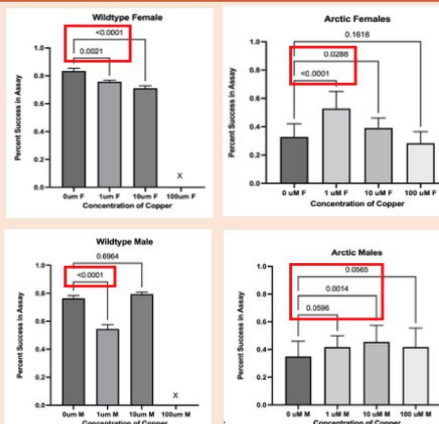
As [Cu^{2+}] increases, WT locomotor ability decreases significantly (p<.05). Arctic locomotor ability increases significantly (p<.05)

Lifespan (Kaplan-Meier Curves)
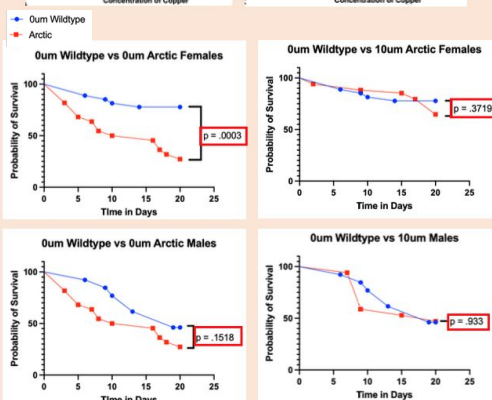
Normalization of Arctic (AD) lifespan as Cu^{2+} concentration increases; no significant difference with WT (p>.05)

Conclusion

Increased Cu^{2+} concentration leads to:

✓ Normalization of lifespan

✓ Significant increase in percent success in negative geotaxis (locomotor ability)

Copper Supplementation improves AD-associated effects in Transgenic AD-model *Drosophila melanogaster*

Limitations

Negative geotaxis: behavioral assay, not actual mechanism

Drosophila = avascular
Humans = vascular

Contamination after day 20 = not full lifespan

Doesn't distinguish central vs peripheral nervous system

Future Research

1. Find specific concentration most beneficial

2. Immunohistochemistry
Determine levels and aggregation of Cu^{2+} and Aβ in the brain

Zaynab Faisal

The Effect of Rising Water Temperatures on Righting Response Behavior of *Pagurus longicarpus:* A Study of the Effect of Climate Change on Organisms Living in the Intertidal Zone

Location of Research:
Harrison High School and Jones Beach

Mentor:
Dr. Jan Pechenik

Will be Attending:
University of Connecticut

Intended Major:
Environmental Science

Fairs & Awards:
WESEF 2022 - Teatown Young Environmentalist Award
NYSSEF 2022 Finalist
NYSSEF 2022 - Honorable Mention and Stockholm Junior Regional Water Prize Award
JSHS 2023 - 5th Place in Animal Sciences
WESEF 2023 - Special Award
NYSSEF 2023 Finalist
NYSSEF 2023 - Honorable Mention
Symposium 2021, 2022, 2023

Pagurus longicarpus, a common hermit crab incapable of regulating its body temperature inhabits the intertidal zone along the U.S. East Coast. The intertidal zone is a thriving ecosystem that undergoes a wide range of water temperatures. With increasing ocean temperatures due to climate change, it's important to examine how species that function over a wide range of temperatures are impacted. If higher temperatures alter hermit crab behavior, they likely affect marine organisms unused to temperature extremes. Experiments were conducted to determine the effect of rising water temperatures on righting response time, when hermit crabs in their shells are flipped over and have to right themselves (n=40). The hypothesis was that as temperature increases, the righting response time will decrease because ectothermic hermit crabs will draw energy from their environment to perform the behavior quicker. Natural conditions in the intertidal zone were found to be between 19-31°C during late summer and implemented as testing conditions. 33°C was added to display drastic temperature increases from climate change. Hypothesis was not supported; there was a significant increase in the time it took hermit crabs to perform righting responses at 33°C compared to 19°C ($p<.01$). Smaller massed hermit crabs performed significantly faster ($p<.01$) consuming more oxygen per gram indicating that the mechanism responsible was probably not metabolism, but possibly denaturing of enzymes; this trend exhibited only a small to moderate effect size ($r = .24$). Implications included that smaller massed hermit crabs could have the advantage to survive novel selection pressures.

The Effect of Rising Water Temperatures on Righting Response Behavior of *Pagurus longicarpus*: A Study of the Effect of Climate Change on Organisms Living on the Intertidal Zone
Zaynab Faisal

Introduction

- By 2050, air temperature will increase by 2°C (Buis, 2019)
- Change in animal behavior is often the initial sign that they are being affected (Wong & Candolin, 2014)

Fig 1: Hermit crabs in the holding tank

Fig 2: The Intertidal Zone at Jones Beach

- A thriving ecosystem where ocean meets the land between low and high tide (Valére-Rivet et al., 2017)
- Hermit crabs = indicator species because they are known to function over a wide range of temperatures (Dunbar, 2003)
- Righting Response is a defense behavior performed when facing threats of predation (Zhang et al, 2017)

Purpose: To determine the effect of rising water temperatures on the righting response behavior of the hermit crab species, *Pagurus longicarpus*.

Methodology

Part 1: Righting Response Behavior
- Incubate Water
- Mass Hermit Crabs
- Observe Righting Response Behavior under different temperature conditions

Part 2: Determining Natural Conditions

Fig 6: HOBO Temp Logger
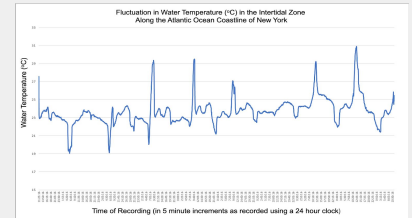
Fig 7: Results of Temperature Logger in Natural Conditions

Part 3: Determining Metabolic Rate

Used oxygen meter to determine oxygen levels.

Measured hermit crab's mass and aperture of their shell

Experimental Chamber: Measured metabolic rate determined by oxygen consumption

Results & Analysis
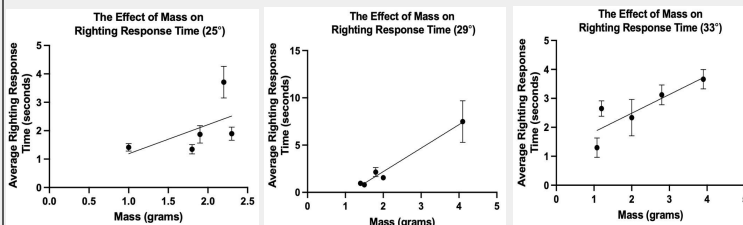
Fig 3: Smaller massed hermit crabs performed righting response significantly faster at 25ºC, 29ºC & 33ºC ($p<.01$)
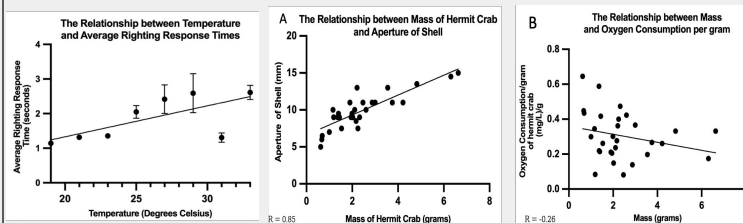
Fig 4: As temperature ↑, average righting response times ↑ significantly ($p<.01$)

Fig 5: Smaller hermit crabs have a higher metabolic rate ($p>.05$); could be age correlated

Conclusion & Future Research

Discussion:
- Hypothesis: Partially Supported:
- Righting Response Time increased significantly as temperature increased from 19°C to 33°C
- Smaller hermit crabs performed significantly faster & consumed more oxygen per gram

Future Research:
- Perform an immunohistochemistry, gene expression analysis, or examine the physiology
- Let hermit crabs acclimate in incubator overnight

Conclusion:
- Increase in average righting response time from 19° C to 33°C
- Metabolism is probably not the mechanism responsible
- Smaller massed hermit crabs could have an advantage to survive novel selection pressures
- Findings could apply to other aquatic organisms

Ella Farago

Using Virtual Reality as an Agent of Behavioral Change

Location of Research:
Harrison High School

WIll be Attending:
University of Delaware

Intended Major:
Psychology

Fairs & Awards:
WESEF 2023 - Participant
HHS Symposium - 2021, 2022, 2023

The purpose of this study was to explore the effectiveness of virtual reality as an intervention to promote behavioral change. Specifically, this study aims to evaluate whether virtual reality could be used to stimulate healthy hand-washing habits in a general adolescent population. A group of 13 high school students was randomly split into two groups. The experimental group watched a germ video in VR while the control group watched the video on the smartboard. After the video, participants were asked to wash their hands. The soap mass used was measured. In addition, both groups were surveyed before and after to assess their changed understanding of personal hygiene. Results found that there was no significant difference in the amount of soap used, but the survey questions showed a clear trend of recognizing the need to pay more attention to hygiene habits. This means that further research is warranted to determine if VR could be an effective tool for influencing high schoolers' attention to hygiene habits like washing their hands.

Using Virtual Reality an Intervention for Behavior Change

Introduction

Virtual Reality = immersion into an artificial environment where a user suspends belief and accepts it as a real environment

Virtual reality → **Promotes Behavior Change**
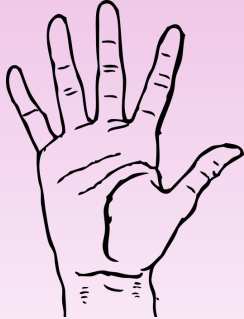
Covid 19 Pandemic→ Newfound universal consideration of spreading germs
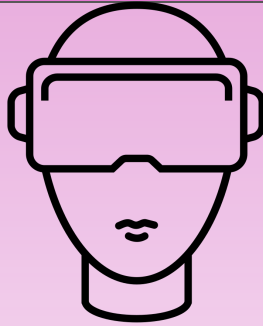
Proper hand hygiene =single most important method of preventing and controlling infection in healthcare facilities
- Use VR to practice proper hand washing in virtual world

"Hand Hygiene Training." Torkusa.com

Methodology

Hypothesis:
Once a high school student visualizes the spreading of germs in a virtual reality environment:
- They will immediately change their behavior to use more soap.
- They will report an increase in their desire to pay more attention to their personal hygiene.

Participant recruitment:
- IRB approval from local high school
- Opportunity Sampling from Science Research classes at local high school
- Parent and student consent obtained

Survey Construction
1. Asks about personal hygiene habits **before** viewing video
2. Asks about personal hygiene habits again after viewing video

Procedures
1. Researcher massed soap
2. Participant completed screening questions & consented to study
3. Participant answered personal hygiene questions
4. Participant watched video in VR or non-VR
5. Participant told to wash hands and then re-answer personal hygiene questions
6. Researcher re-massed soap

Results & Analysis

Figure 1: Average change in soap usage
Error bars = SEM
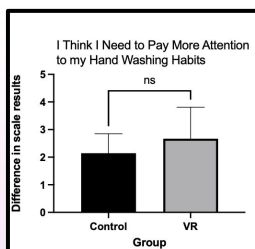
Figure 2: Average change in reported need to pay more attention to hand washing habits
Error bars = SEM
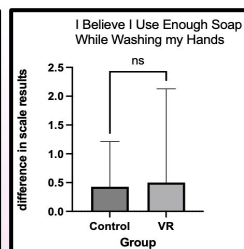
Figure 3: Average change in reported belief that enough soap is used while washing hands
Error bars = SEM
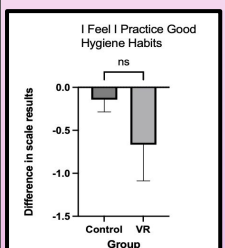
Figure 4: Average change in reported belief that good hygiene habits are practiced
Error bars = SEM
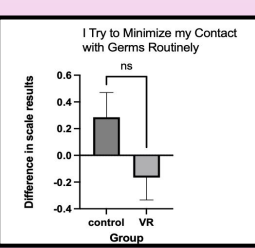
Figure 5: Average change in reported belief that an effort is made to minimize contract with germs.
Error bars = SEM
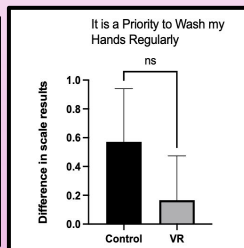
Figure 6: Average change in reported emphasis on need to wash hands regularly
Error bars = SEM

Conclusion & Future Research

Hypothesis that participants will immediately change behavior to use more soap when washing hands was not supported
- On average, the control group used more soap after watching the video than the VR group

Hypothesis that participants will report a desire to pay more attention to their personal hygiene was not supported
- On average, both the control group and the VR group reported that they felt less secure in their habits after watching the videos

Future research could include:
- Testing other human hygiene behavior changes
- Using Virtual Reality used for educational purposes to induce behavior changes in the classroom

Nikki Giandomenico

Rescuing Motor Delays in the Autism Model *Drosophila melanogaster* using Sodium Nitrate and Sodium Nitrite.
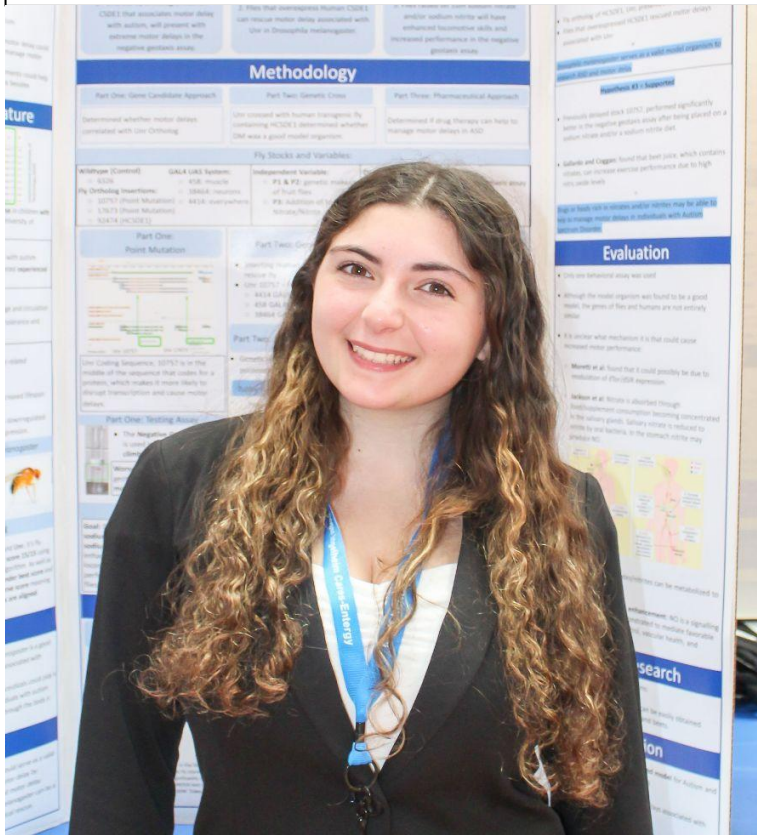
Location of Research:
Harrison High School

Mentor:
Dr. Cale Whitworth

WIII be Attending:
Ithaca College

Intended Major:
Psychology

Fairs & Awards:
TriCounty 2023 - 1st Place Biology
WESEF 2023 - 2nd Place Cellular and Molecular Biology, Future of Medicine Award
WESEF 2022- 4th Place Cellular & Molecular Biology
Westlake/Somers 2021 - 2nd Place Cell Biology
HHS Symposium - 2021, 2022, 2023

According to the US Centers for Disease Control (2020), for every fifty-four children diagnosed with Autism Spectrum Disorder (ASD), a developmental disorder, one in six of those children will also experience motor delays. The purpose of this experiment was to determine if *Drosophila melanogaster* could serve as a valid model organism to research ASD and motor delay by defining novel genes linked to both ASD and motor delay. Then use the connection between humans and the model organism to conduct research on ASD and motor delay. The gene CSDE1 was identified as a possible candidate for motor delays in autism patients and used in the study because the human gene and the fly ortholog Unr had the best forward and reverse scores in Flybase. The methodology entailed three parts: 1. A gene candidate approach to identify if the fly stocks had motor delays. 2. A genetic cross to rescue the motor delay identified in part 1 through overexpression of human CSDE1. 3. A pharmaceutical rescue to determine if motor delays can be enhanced with drugs. The negative geotaxis assay was used to assess whether motor delay was present in Drosophila. The results showed that the hypothesis was supported and the fly ortholog with the Unr mutation performed significantly worse ($p < .05$) than the wild type control meaning that *Drosophila melanogaster* could serve as a valid model for autism and motor delays. The pharmaceutical approach supported fruit flies on a food diet of sodium nitrate and sodium nitrite would perform significantly better in the negative geotaxis assay.

Rescuing Motor Delays in the Autism Model *Drosophila melanogaster* using Sodium Nitrate and Sodium Nitrite

Nikki Giandomenico

Introduction

According to CDC (2020):
- 1 in 54 children diagnosed w/Autism, 1 in 6 experience motor delays.

Gou et al. (2019):
- Human CSDE1 gene associated with autism
- Children with Human CSDE1 → 15 of 17 tested experienced motor delay

Jones (2014):
- After digestion: **nitrate → nitrite** for storage and circulation
- Sodium Nitrate/Nitrite **enhances** exercise tolerance and performance.

Purpose

1. Determine in *Drosophila melanogaster* can serve as a valid model organism for studying autism and motor delay
2. Attempt a pharmaceutical approach to manage motor delays.

Hypothesis

1. Transgenic fruit flies will present with motor delays.
2. Flies that overexpress HCSDE1 can rescue motor delays
3. Flies raised on sodium nitrate/sodium nitrite diets will have ↑ performance.

Methodology

Part One: Gene Candidate Approach

- Determined whether motor delays correlated with Unr Ortholog

Fly Stocks used:

Wildtype (Control)	GAL4 UAS System:
○ 6326	○ 458: muscle
Fly Ortholog Insertions:	○ 38464: neurons
○ 10757 (Point Mutation)	○ 4414: everywhere
○ 17673 (Point Mutation)	
○ 92474 (HCSDE1)	

Testing Assay:

The **Negative Geotaxis Assay** is used to test the fruit flies climbing abilities.
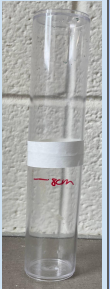
Variables:

Independent Variable:	Dependent Variable:
○ P1 & P2: genetic makeup of fruit flies	○ Performance in the negative geotaxis assay
	Control:
○ P3: Addition of Sodium Nitrate/Nitrite	○ 21 °C room
	○ 16 hours light/ 8 hours dark
	○ Carolina Biological Instant *Drosophila*

Part Two: Genetic Cross

-Inserting Human gene (HCSDE1) to rescue fly
-Unr 10757 + HCSDE1
X
1. 4414 GAL4 (all cells)
2. 458 GAL4 (neuronal)
3. 38464 GAL4 (Muscle)

Part Three: Pharmaceutical Rescue

Goal: Determine if **sodium nitrate** and **sodium nitrite** enhanced the locomotion and performance of the fruit flies.

Results & Analysis

Part One: Gene Candidate Approach
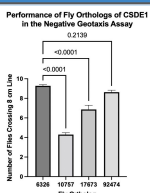
Figure 1. Performance of Fly Orthologs in the Negative Geotaxis Assay. Fly orthology 10757, the fly stock containing the Unr gene, performed significantly worse than the control and all other stocks.

Part Two: Genetic Cross
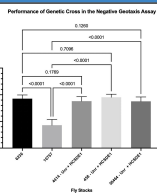
Figure 2. Performance of Genetic Cross stocks in the negative geotaxis assay. In the Genetic cross, When the same stock was crossed with the human gene, and GAL4 stocks, there was a significant increase in the performance of the flies.

Part Three: Pharmaceutical Approach
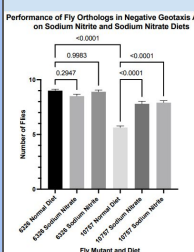
Figure 3. Performance of fly stocks in the negative geotaxis assay. In the gene candidate approach, fly Orthology 10757 with the Unr mutation performed significantly worse than the control. When stock 10757 was placed on a sodium nitrate and sodium nitrite, there was a significant increase in the performance.

Conclusion & Future Research

Hypothesis #1 & #2 = Supported
- Fly ortholog of HCSDE1, Unr, presented with motor delays
- Flies that overexpressed HCSDE1 rescued motor delays associated with Unr

=

Drosophila melanogaster serves as a valid model organism to research ASD and motor delay

Hypothesis #3 = Supported
- Previously delayed stock 10757, performed significantly better in the negative geotaxis assay after being placed on a sodium nitrate and/or a sodium nitrite diet.

=

Drugs or foods rich in nitrates and/or nitrites may be able to help to manage motor delays in individuals with Autism Spectrum Disorder.

Future Research:
- Clinical trials conducted on humans:
  ○ A high nitrate/nitrite rich diet can be easily obtained through green leafy vegetable and beets.

Haku Iijima

Utilising Blockchain Technology to Secure School Information

Location of Research:
Harrison High School

WIll be Attending:
Rochester Institute of Technology

Intended Major:
Cyber Security

Fairs & Awards:
WESEF 2023 - Participant
SOMERS 2022 - Participant
HHS Symposium - 2022, 2023

Cyber security is now a necessity in a society where mostly everything is stored online. There are many different data security systems people can use to encrypt and protect their data, but nothing can completely be safe online, for these laws were put into place to prevent this. One place that requires this is in schools, there are some laws put in specifically to protect information about students and their parents. Block chain technology is a type of web security that can be put in place to further secure online information. In this research a sample blockchain was made to store school information to test if it can be used in real life scenarios. Visual studio code was used in combination with programs used to encrypt files so that blockchains could be created and an accurate representation of a school security system could be programmed. The results of this research shows that blockchain technology is able to be used as a form of encryption for school data, this means that in combination with other security systems could potentially further strengthen the strength of school security systems.

Utilising Blockchain Technology to Secure School Information

Introduction

Block chain is a type of security system which allows all users to have easy access to their information. Unlike other systems, each batch of information in a block chain is linked to the previously recorded date using a hash code. This can be used in school situations where there are many information to link to each other

```json
{
    "blockid": 1,
    "time": 1678811685792,
    "data": {
        "Student": "haku",
        "Gender": "male",
        "Address": "21234567890",
        "Grade": "12",
        "DateOfBirth": "2023-03-15",
        "Age": "21",
        "Email": "haku.iijima@gmail.com",
        "Phone": "1234567890"
    }
}
```

Private:
Requires invitation
Users will be validated based on rules set by the administrator
Limits participants

Public:
Transactions are decentralized (anyone is able to validate)
Encryption is used to ensure data security

Consortium:
Allows people preapproved to participate
Allows to be decentralized while still having a level of control over it

Methodology

NodeJs

An environment that executes JavaScript outside of a webpage

Express

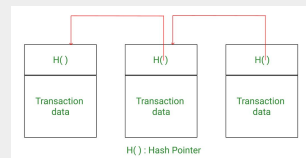A middleware for NodeJs

Nodemon

A tool that restarts the node application every time a change is made

Bcrypt

A library made for fast encryption, also can be used to run any hashing function

H( ) : Hash Pointer

Hash pointers are hash codes that are directly correlated with the block and its internal information

```
12  class Block{
13    constructor(blockid, previousHash, data){
14      this.blockid = blockid;
15      this.timestamp = Date.now();
16      this.blockhash = this.getBlockHash();
17      this.prevHash = previousHash;
18      this.data = data;
19    }
```

With this Block class, it is able to store information and utilise hashing

Results & Analysis

```
addBlock(data){
    let blockid = this.chain.length;
    let previousHash = this.chain.length !==0 ?
this.chain[this.chain.length-1].blockhash : '';
    let block = new Block(blockid, previousHash, data);

    this.chain.push(block);
}
```

This is the function to add a Block into the data chain

```
const schoolblockchain = new BlockChain();

schoolblockchain.addBlock({Student: "Haku", Address: "56 calvert st.",
StudentNumber:112328, DateOfBirth:"7/1/2005", MentalState:"normal", Email:"haku.iijima@gmail.com"});
schoolblockchain.addBlock({student: "Test student 1", address: "rand address",
Studentnumber:121233, DateOfBirth:"0/0/0000"});
schoolblockchain.addBlock({student: "Test student 2", address: "rand address",
Studentnumber:112328, DateOfBirth:"0/0/0000"});
schoolblockchain.addBlock({student: "Test student 3", Address: "rand address",
Studentnumber:134328, DateOfBirth:"0/0/0000"});
schoolblockchain.addBlock({student: "Test student 4", address: "rand address",
Studentnumber:156123, DateOfBirth:"0/0/0000"});
schoolblockchain.addBlock({student: "Test student 5", address: "rand address",
Studentnumber:198728, DateOfBirth:"0/0/0000"});
```

Created a new BlockChain() object named SchoolBlockchain to store all data

```
schoolblockchain.addBlock({Student: "Haku", Address: "56 calvert st.",
StudentNumber:112328, DateOfBirth:"7/1/2005", MentalState:"normal", Email:"haku.iijima@gmail.com"});
schoolblockchain.addBlock({student: "Test student 1", adress: "rand address",
Studentnumber:121233, DateOfBirth:"0/0/0000"});
schoolblockchain.addBlock({student: "Test student 2", address: "rand address",
Studentnumber:112328, DateOfBirth:"0/0/0000"});
schoolblockchain.addBlock({student: "Test student 3", Address: "rand address",
Studentnumber:134328, DateOfBirth:"0/0/0000"});
schoolblockchain.addBlock({student: "Test student 4", address: "rand address",
Studentnumber:156123, DateOfBirth:"0/0/0000"});
schoolblockchain.addBlock({student: "Test student 5", address: "rand address",
Studentnumber:198728, DateOfBirth:"0/0/0000"});
```

Added data to SchoolBlockchain

```
{
    "blockid": 0,
    "time": 1668028958463,
    "blockhash": "$2b$10$txHYscOwMdnnvV1/woQnW.2icRCUvBEqaHa1X5CqUXXHh17Fqmw.e",
    "prevHash": "",
    "data": {
        "Student": "Haku",
        "Adress": "56 calvert st.",
        "StudentNumber": 112328,
        "DateOfBirth": "7/1/2005",
        "Email": "haku.iijima@gmail.com"
    }
},
{
    "blockid": 1,
    "time": 1668028958572,
    "blockhash": "$2b$10$txHYscOwMdnnvV1/woQnW.2icRCUvBEqaHa1X5CqUXXHh17Fqmw.e",
    "prevHash": "$2b$10$nretDZoLvAUj5nYOs3ywHHeYtFX6Xz9u1nm.aQOx5RZ43WIUd66VZW",
    "data": {
        "Student": "Test student 1",
        "adress": "rand address",
        "Studentnumber": 121233,
        "DateOfBirth": "0/0/0000"
    }
}
```

An example of how block chains will be seen

Conclusion & Future Research

Enter your information into the school blockchain system

name	Please enter name	○ male
grade		○ female
		○ other
age	Please enter age	
date of birth	mm/dd/yyyy	

adress Please enter adress

phone number Please enter phone number (please do not enter dash or brackets)

email Please enter email

confirm email Please confirm email

submit Auto Fill

- A successful blockchain was created
- Created an system that will store all information for testing purposes in the future
- Hypothesis was supported but cannot be quantified since the system is secure but we do not know how secure
- Future research will be required to quantify how secure a system is to compare to other security systems and support that it is a safer system

Andre Joubert

How Human Encroachment on Wildlife Spaces in the KwaZulu-Natal Region on the Eastern Coast of South Africa Affect the Vulnerable Blue Duiker Population

Location of Research:
Harrison High School

Mentor:
Magda Goosen

WIll be Attending:
Stony Brook University

Intended Major:
Biochemistry (Pre-med)

Fairs & Awards:
WESEF 2023- Ricoh Sustainable Development Award
JSHS 2023 - Local Speaker
Tri-County 2022 - Participant
HHS Symposium -2021, 2022, 2023

As the South African population increases so does human development which is now encroaching on threatened areas. The Blue Duiker, a small antelope that provides the necessary upkeep of coastal forests, is identified as vulnerable in the coastal region of Kwazulu-Natal (KZN). By feeding on fruits, the Blue Duiker cleans the forest floor, helps to create pathways for other animals, and distributes seeds that lead to plant growth. The purpose of this study was to assess how changes in the forest area due to human development and the resulting decrease in the Blue Duiker population would affect the coastal forest in KZN. The methodology involved creating regressions by measuring the change in coastal forest area using the polygon and year tools on Google Earth Pro and extrapolating the Blue Duiker population from the measured area. Three scenarios were calculated for the regression of the forest area, 1. A constant decline in forest area, 2. A 2.5% increase in forest decline, 3. A 5% increase in the constant forest decline. Results showed that blue duikers would decrease with a slope of -4.049/year if the forest declined at a constant rate (r=-.887, and R^2=0.787). Implications included that human encroachment could cause severe disruptions in the ecosystems because of a noticeable change in the availability of energy for higher trophic levels, interruptions in environmental services provided by the Duiker such as seed dispersal, and decreases in the number of forest pathways.

How Human Encroachment on Wildlife Spaces in the KwaZulu-Natal Region on the Eastern Coast of South Africa Affects the Vulnerable Blue Duiker Population
Andre Joubert

Introduction

- COVID-19 lockdowns in South Africa → Higher inflation, unemployment and poverty
  - 55% of total population live on or below the poverty line (World Bank)
- To create more jobs and income for people, the government is expanding the mining and agriculture industries
  - These industries take up immense space and encroach on wildlife spaces

Blue Duiker

Important for:
- Seed Dispersal
- Pathway creation
- Primary consumer

Results & Analysis

Figure 4A: Regression of the coastal forest area over time (2005-2022)
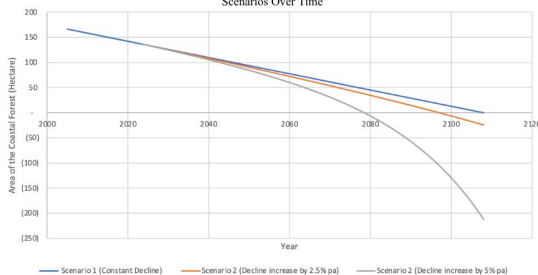
Figure 5: A model of accelerated coastal forest decline. Three scenarios show a constant rate of regression, a 2.5% increase in regression, & a 5% increase in regression.
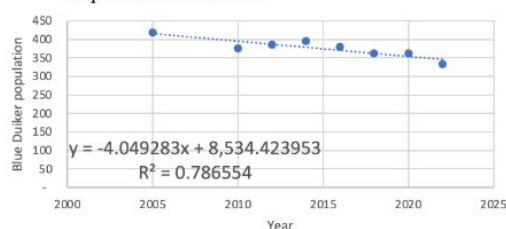
Figure 6A: A regression for the Duiker population predicted from the yearly area of the forest. The graph has an r=-.887, which shows that the data is a strong regression

Methodology

Using **Google Earth Pro** & **Excel** a model was built to show how human encroachment affected wildlife spaces and available land for Blue Duiker

Below =Image from 2022:
→ Orange outline = Measurement of the coastal forest area
→ Light Blue = the area that has been lost from 2014 → 2022

Assumptions:
1. The rate of human encroachment stays constant.
2. The forest continues to decrease in the area by the same amount over time.
3. Predators of Blue Duikers do not relocate to another area.

Discussion & Future Research

- **Hypothesis was supported because** the model reveals that as the area of the coastal forest decreased due to human encroachment the number of Blue Duiker pairs would also decline.

- Blue duiker is an important species because:

  - Lack of seed distribution may lead to competition within plant populations.
  - Less energy up the food chain as the Blue Duiker is a primary consumer that facilitates the transfer of energy through the food chain.
  - Less pathways pathways for smaller animals in the ecosystem
- Evaluate level of awareness of local community members about the importance of biodiversity
- Refine model so that it can be applied to other species and ecosystems

Conclusion

Hypothesis Supported:

- Measured decrease in forest area: As seen/measured on Google Earth Pro

- As the forest area decreased, less Blue Duikers could be sustained → Less food, migration & habitat space

Rachel Kindler

A Life Cycle Assessment of Plant-based Milks to Analyze their Environmental, Social, and Economic Impacts to Facilitate Consumer Food Choice

Mentor:
Dr. Julian Silverman

WIll be Attending:
Claremont McKenna College

Intended Major:
Public Health

Fairs & Awards:
WESEF 2023 - Teatown Young Environmentalist Award
Westlake 2020 - Participant
HHS Symposium - 2021, 2022, 2023

In 2019, plant-based milk made up 14% of the milk market and dairy milk growth remained flat (Plant-Based Food Association, 2020). As a result of the ongoing climate crisis, more consumers are considering the environmental impacts of their purchases, including the impacts of sourcing, manufacturing, and distributing a product. However, they also should consider nutritional value. Traditionally, life cycle assessments (LCA) are conducted by organizations to quantify the environmental impacts of their products. This study aimed to augment this method to inform consumers about the impacts of their dietary choices on environmental and human health. Specifically, it sought to determine which plant-based milk was optimal for consumption, comparing protein concentration, greenhouse gas emissions, and cost. The methodology involved creating process flow diagrams to compare the material and energy inputs and outputs throughout the production and packaging of seven kinds of milk (almond, coconut, cow, hemp, oat, pea, and soy), comparing the metrics of cost of production ($/L $_{milk}$) purchase price ($/L $_{milk}$), process mass intensity (PMI), energy used in production (Joules/L $_{milk}$), energy from transportation (Joules/L$_{milk}$), equivalents of carbon dioxide released (CO_2 eq), protein (g/L), and price per gram of protein ($/g $_{protein}$). Results revealed that pea milk required the least amount of energy in production (1.95E + 05 eq J), released the least amount of carbon dioxide (8.21E+03 CO_2 eq), had the lowest price per gram of protein ($0.11), and high protein concentration (8 grams/serving). However, its production generated the highest amounts of waste (PMI of 2.0). This LCA could help consumers make holistic decisions, and determine the strengths and weaknesses of LCAs as a model for quantifying sustainability.

A Life Cycle Assessment of Plant-Based Milks to Analyze their Environmental, Social, and Economic Impacts to Facilitate Consumer Food Choice
Rachel Kindler

Introduction

Plant-based market 35 billion 2021; 123.1 billion by 2030 (SMR, 2022)
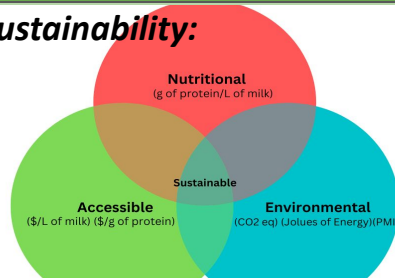
Sustainability:
Figure 1: Definition of sustainability

Nutrition:
- Question if plant-based milks are 'milks' (CNN, 2018)
- Milk: oil in water emulsion

Environmental Sustainability
- Sustainable agriculture (UC SAREP, 2021)

Accessibility
- $ Plant-based milk > $ Cow's milk
- Cow's milk subsidized since 1930 in US (Edwards, 2007)

The Intersection: Life Cycle Assessments *(LCA)*
- Inputs + outputs to quantify sustainability

Methodology

Choice of Milks
Almond, Coconut, Cow, Hemp, Oat, Pea, Soy

Process Flow Diagrams

Illustrate inputs and outputs in production processes

Figure 2: Process flow diagram for coconut milk

Choice of Metrics

Results & Analysis
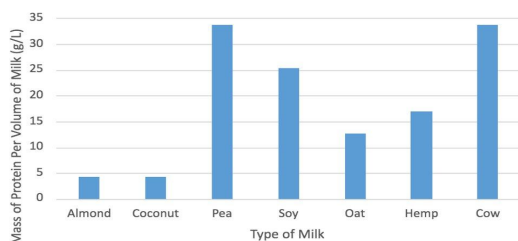
Figure 3: Most protein: Pea (8g)

Least Protein: Coconut (1g)
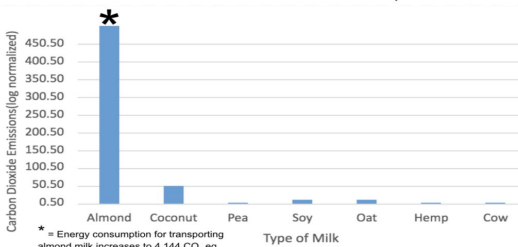
Figure 4: Most CO_2 emissions: Almond (3.73E +11)
Least CO_2 emissions: Cow (8.99E + 07)
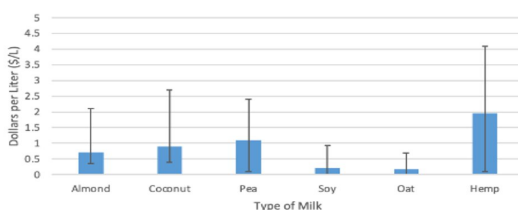
Figure 5: Most expensive: Hemp ($1.95/L)

Least expensive: Oat ($0.18/L)

Conclusion & Future Research

- Pea milk is the **'best'** milk
  - > protein concentration (8g)
  - Lowest J of energy in production (1.95E + 05J)
- Almond milk is the **'worst'** milk
  - < protein concentration (1g)
  - High J of energy in production (5.76E + 06 J)
  - Most CO_2 emitted in transportation (3.73E + 11)

Future Research

Evaluate other Metrics
- Water Use
- Calories

Accessibility of Information
- Create an LCA app for consumers

Elena McCann

How EtOH Effects the Regeneration, Lifespan and Genetic Expression of
Lumbriculus variegatus in Relation to Fetal Alcohol Syndrome Disorder (FASD)

Location of Research:
Harrison High School

Mentor:
Dr. Daniel Shain

WIll be Attending:
San Diego State University

Intended Major:
Cellular and Molecular Biology on a PreMed Track

Fairs & Awards:
WESEF 2023 - Excellence in Med Research Award
STS 2023 - Participant
JSHS 2023 - Regional Speaker
TriCounty 2022 - Participant
Somers 2021 - Participant
HHS Symposium - 2021,2022,2023

Fetal Alcohol Syndrome Disorder (FASD) is a set of preventable conditions that results from alcohol exposure during a mother's pregnancy. FASD can cause a range of irreversible physical, cognitive, behavioral and neurological abnormalities. The purpose of this study was to determine how increasing concentrations of ethanol (EtOH) affected the regeneration of *Lumbriculus variegatus* to identify patterns in gene expression which could provide clues as to the role alcohol may play on a genetic level in FASD. Also, given that adult regeneration could be seen as drastically different from embryonic development, the dysregulation of genes identified in the regenerative state due to alcohol could provide some indication that alcohol may affect neuroregeneration during stroke or traumatic injury recovery. This study consisted of two parts: a dose response pilot study (n=35) to document phenotypic differences in regeneration in the heads and tail ends of severed worms soaked in 0.00%, 0.01%, 0.10%, 0.50%, 1.00%, 5.00%, 10.00% of ETOH, and an exploratory analysis (n=50) using an RNA extraction to determine the genes that were differentially expressed in the heads and tail ends of the worms in concentrations ≤1% except 0.01%. The amount of regenerative growth in both the head and tail ends of the worms not subjected to ETOH were significantly greater than in all concentrations of alcohol after the 16-day experimental period (p<.01). Kaplan Meier curves showed exposure to ETOH concentrations >0.1% had significant decrements in longevity (p<.01). Gene expression results revealed significantly more alterations in downregulated genes with all concentrations of ETOH compared to the control. Many gene ID's were matched with hypothetical proteins that, once identified, can indicate the specific role alcohol could play on genetics in FASD. There is still an ongoing analysis to determine the specific genes and their phenotypic functions that are affected by the alcohol.

How EtOH Affects Regeneration, Life Span and the Genetic Expression of *Lumbriculus variegatus* in Relation to Fetal Alcohol Syndrome Disorder (FASD)

Introduction

- FASD affects 40,000 babies/year (Eberhart, 2016)
- FASD is caused by the consumption of alcohol by a pregnant mother
- FASD causes a spectrum of abnormalities that occur from alcohol consumption
- No cure

(The American College of Obstetricians and Gynecologists)

Shutterstock, 2022

Fetal Development

New cells stem from embryonic tissue

Tissue is created for new growth

Forms of development

New Tissue

Regeneration

New cells stem from old and damaged cells

Tissue is created to replace old and damaged cells

Regeneration is a recapitulation of Fetal Development

Methodology

Model Organism: *Lumbriculus variegatus*

35 worms (Total)
5 worms per group
Carolina Biological
Kept for 2 Weeks
Properly Disposed
Stored in 21 degrees Celsius incubator

Carolina Biological, 2021

Carolina Biological, 2021

Part 1: Pilot Study

10 mL poured into 5 separate chambers

Sever worms (initial cut)

Observational Period

Day 3
0.00% - 2

Part 2: Exploratory Analysis

RNA Sample Preparation

DNA Binding

RNA Binding

DNASE and RNA Wash Treatment

RNA Elution

Results & Analysis

Pilot Study: Kaplan Meier Curves
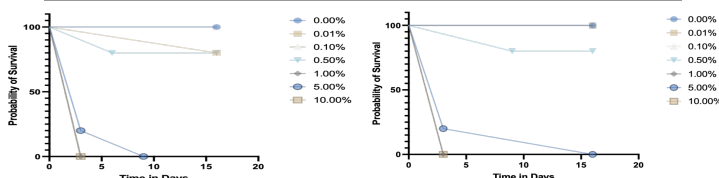
Survival probability ↓ as EtOH increases

Pilot Study: Scatter Plots
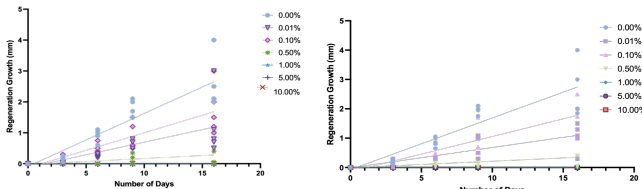
Slopes of experimental significantly different than the control

Exploratory Analysis: Volcano Plots
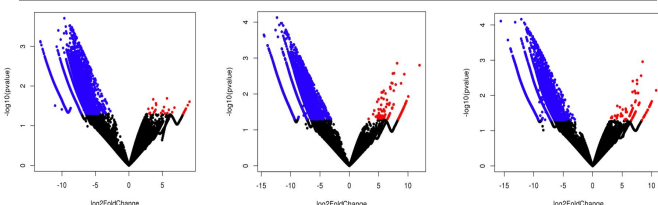
Significant Downregulated Genes>Significantly Upregulated Genes

Conclusion & Future Research

Conclusion

- As EtOH ↑ , regeneration, life span & genetic expression significantly affected ↓
- Many hypothetical genes identified → potential role in affecting developmental processes
- Could inform about identification of genes affected by alcohol consumption in developing fetuses → result in development of new treatments

Future Research

- Identify the function of hypothetical proteins
- Find linear sequence in significant hypothetical proteins → predict protein domains
- Predicting protein domains = identifying DNA sequences
- Role of key genes differentially expressed in FASD patients.
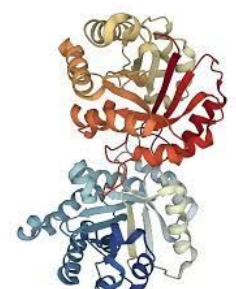
Protein Domains
Proteinstructures.com, 2022

Hayanna Silva

The Effect of Cholesterol Starvation on Tumor Development in Drosophila melanogaster

Location of Research:
Harrison High School

Mentor:
Cale Whitworth

Intended Major:
Nursing

Approximately every 3 minutes, one person in the US is diagnosed with blood cancer. Lymphoma is a blood cancer originating in lymphocytes or histiocytes, which attacks the body's immune system. Cholesterol is defined as any member of the group of specific chemical molecules known as lipids. Cholesterol can come from two distinct sources: Healthy cells can synthesize cholesterol or uptake it from lipoproteins to meet their metabolic needs. More recently, scientists have explored cholesterol starvation as a possible treatment for specific cancers with an appetite for cholesterol such as kidney and ovarian cancer. Cancer cells rely on cholesterol to satisfy their increased nutrient demands and to support their uncontrolled growth. The purpose of this experiment was to explore whether cholesterol starvation would affect the formation of cancerous overgrowths in the eyes of Drosophila melanogaster that contain the UAS-yki.S168A mutation. Eyes of Drosophila melanogaster are home to some of the most foundational discoveries in cancer biology and are thus a validated model for cancers. It was hypothesized that Drosophila melanogaster containing the UAS-yki.S168A mutation would show a decrease in the number or development of tumors when deprived of cholesterol. A metric was created that allowed for the grading of eye defect severity. Results showed that flies exposed to lower dosages of cholesterol had lower metric scores than those exposed to higher dosages, thus supporting the hypothesis. Since flies can survive without cholesterol, the selective removal of yeast from the diets allowed for the starvation of malignant cells, appearing to kill the cancerous cells while leaving healthy cells unharmed. Through the findings of this research on Drosophila melanogaster, it is evident that cholesterol starvation should be investigated as a potential treatment for cancers in humans as it may provide less harmful manners of decreasing and prohibiting tumor development.

The Effect of Cholesterol Starvation on Tumor Development in *Drosophila melanogaster*

Introduction

Purpose: Explore whether cholesterol starvation will affect the formation of cancerous overgrowths in the eyes of Drosophila melanogaster that contain the UAS-yki.S168A mutation.

Lymphoma: Cancer that originates in lymphocytes or histiocytes

Hodgkin's Lymphoma
- presence of reed-sternberg cells
- swollen/painless lymph nodes
- standard treatment: ABVD Chemotherapy
- 85% curable

Non-Hodgkin's Lymphoma
- presence of cancerous lymphocytes
- Symptoms: swollen lymph nodes, fever, weight loss, and excessive tiredness
- Standard treatment: CHOP or CVP Chemotherapy
- 69% curable

Cholesterol: essential component of cell membranes that influences permeability & fluidity of the lipid bilayer
- In vertebrates, cholesterol is achieved primarily through de novo synthesis & dietary uptake
- malignant cells need cholesterol uptake to survive
- Lymphoma cells are dependent on lipoprotein mediated cholesterol uptake

Methodology

Raise Flies
Raise first generation of flies on designated cholesterol dosages

Genetic Cross
First gen offspring were sexed to create fly cross with desired phenotype (Cancerous overgrowths in eyes)

Raise Flies
Raise fly cross on designated cholesterol dosages
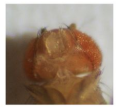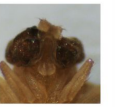
Measure Changes in Tumor Development
- Percent of eyes that have the "bulging and folded" phenotype
- Extent of the "bulging and folded" eye phenotype in a given eye

Statistical Analysis
- T test to determine significance
- Percentages of each metric score within a population of each dosage

Metric Scale Eye Phenotypes				
Metric Score Examples (0-3)				
	0 (wildtype)	1	2	3

Results & Analysis

Bar Graph Showing the Correlation Between Cholesterol Dosage and Mean Metric Score
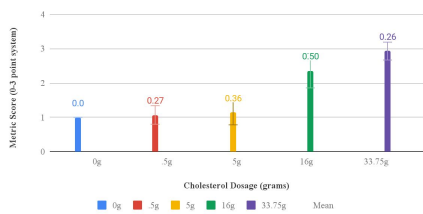
Linear Regression Showing the Correlation Between Cholesterol Dosage and Metric Score

Figure 1: Illustrates as cholesterol dosage increases, mean metric score increases

Figure 2: A strong positive linear correlation between cholesterol dosage and metric score was illustrated after receiving an R2 value of 0.892. The slope was deemed significantly non zero after receiving a slope p-value of <0.0001.

Table 1: Percentages of each metric scores within a population at each dosage. Drosophila melanogaster that contained lower doses of cholesterol in their diets had a higher percentage of flies with a metric score of 1.

	Cholesterol Dosage (grams)				
	0 g	.5 g	5 g	16.9 g	33.75 g
Percentage of Metric Score 1 (%)	100	92.9	85.7	0	0
Percentage of Metric Score 2 (%)	0	7.1	14.3	64.3	7.1
Percentage of Metric Score 3 (%)	0	0	0	35.7	92.9

Conclusion & Future Research

Conclusion

✓ Drosophila melanogaster containing the UAS-yki.S168A mutation when deprived of cholesterol will show a decrease of tumors and/or tumor development

✓ It is evident that there may be less harmful manners of decreasing and prohibiting tumor development.

✓ May aid in identifying less detrimental cancer treatments for Lymphoma/cancers with similar appetites for cholesterol.

Future Research

Conduct research on larger animals and mammals to analyze how the cholesterol starvation mechanisms work within their systems.

Lauren Schnapp

Strengthening the Idea of *Drosophila melanogaster* as a Model Organism for Narcolepsy

Location of Research:
Harrison High School

Mentor:
Allison Blunt

WIll be Attending:
University of Wisconsin-Madison

Intended Major:
Undecided

Fairs & Awards:
WESEF 2023 - 2nd Place Medicine and Health
JSHS Upstate 2023-1st Place Medicine and Health Poster Competition
JSHS 2023- 3rd Place Medicine and Health
Somers First Year Fair 2021- Participant
HHS Symposium - 2021, 2022, 2023

Narcolepsy, a chronic, debilitating disorder affects approximately 200,000 Americans. A key symptom is excessive daytime sleepiness causing decreased productivity. Narcolepsy Type 1 is caused by a deficiency of the neurotransmitter hypocretin/orexin which regulates sleep and arousal. Hypocretin deficiency results in the destruction of nerve cells which leads to cataplexy. Cataplexy presents as episodes of suddenly triggered muscle weakness. 75% of human disease-causing genes are believed to have a functional homolog in *Drosophila melanogaster* and they are low-cost, have a short lifespan, and rapid reproduction rate. Drosophila does not have hypocretin, but they have an analogous neuropeptide called pigment dispersing factor (*pdf*). Experiments were conducted to show that using mutant Drosophila with *pdf* deficiency (*pdf[01]*) could be valid to inform the study of Narcolepsy in humans. A sleep study examined whether *pdf[01]* flies exhibited interrupted sleep patterns during hours when they would typically be awake. The negative geotaxis assay was used to assess muscle weakness. The results showed that the *pdf[01]* flies slept significantly more 2 hours before dusk compared to other fly stocks (p<.05). The genetic cross with the normal *pdf* gene rescued the mutated stock that slept similarly to the controls. Additionally, the *pdf[01]* flies presented with significant motor delays in the negative geotaxis assay (p<.05). The normal *pdf* gene also rescued the performance of the mutated stock. Implications included that *pdf[01]* could have caused the abnormal behaviors making *Drosophila melanogaster* a valid organism for studying narcolepsy.

Strengthening the Idea of *Drosophila melanogaster* as a Model Organism for Narcolepsy

Introduction

Narcolepsy with Cataplexy (Type 1)
- Chronic, excessive daytime sleepiness
- Cataplexy

Narcolepsy Type 1 = Hypocretin Deficiency

Without Narcolepsy
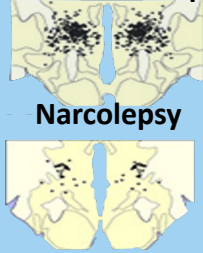
Narcolepsy

Sleep (Behaviorally Defined)

All animal species

- response to external world
- Reversible ↓ responsiveness
- Controlled by a circadian clock
- Requires homeostatic system
- Needs strong stimuli for arousal
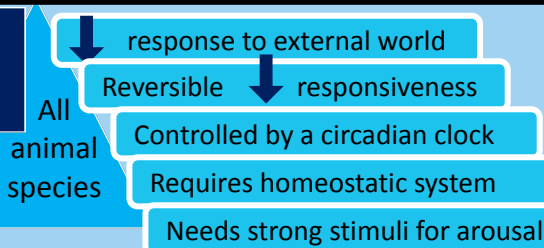
Hypocretin	Pigment Dispersing Factor (*pdf*)
Humans	*Drosophila melanogaster*
Neurotransmitter; regulates sleep & arousal, promotes wakefulness	Key transmitter in circadian clock
Human Narcolepsy (Type 1) = Hypocretin Deficiency	*Pdf* analogous to hypocretin
No exact ortholog in flies	(Sehgal & Mignot 2011)

Methodology

Testing *pdf* deficient flies

Pdf[01] deficient	Wildtype	Timeless GAL-4

Rescuing *pdf* deficient flies

Genetically Engineered by BDSC)	Homozygous UAS-*pdf* (normal)
•Tim-GAL4 •*Pdf[01]* Balancer chromosome for stubble – phenotype used to identify genotype for study	

Assay 1: Sleep

Trikinetics *Drosophila Activity Monitoring* (DAM) System →sleep study on flies.

(Schnapp, 2022)

Assay 2: Negative Geotaxis

Negative geotaxis assay to assess muscle weakness

(Schnapp, 2022)

Results & Analysis

Average Dawn

0.6609
0.5243
0.9914

Average Dusk

0.5965
0.9310
0.0004

Negative Geotaxis Assay

0.2155
0.0003
<0.0001
0.0113
<0.0001
<0.0001

- Unexpectedly no trend between control and *pdf*[01] in average, bouts and total sleep dawn (p> 0.05)
- Expected significant difference between control and *pdf*[01]flies in average, bouts and total sleep for dusk (p<0.05)
- Significant difference between control and *pdf*[01] (p<0.05), and insignificant difference between control and rescue (p> 0.05) in negative geotaxis assay

Conclusion & Future Research

Hypothesis = Partially Supported

- Dusk: P*df[01]* slept significantly more → interrupted sleep at night ✅
- Negative geotaxis = the *pdf[01]* flies exhibited muscle weakness ✅
- Genetic rescue successful → *pdf* mutation could be responsible for behaviors ✅
- Dawn ≠ significant ❌

Behavior =
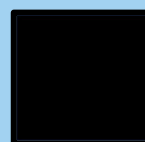
Future Research

Immunohistochemistry
- Detect the actual mechanism by which *pdf* is affecting the behaviors of the flies

- *D. Melanogaster* = possibly valid model for human Narcolepsy Type 1
- *D. Melanogaster* can potentially be used to test drugs and other treatments in the future

Science Research II
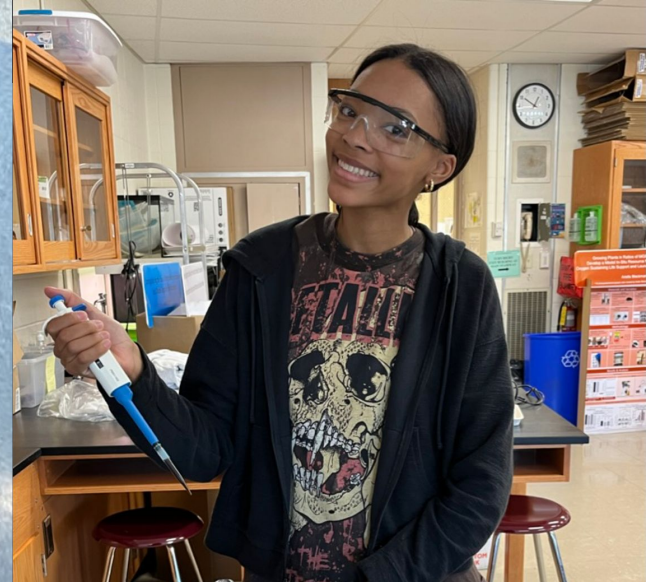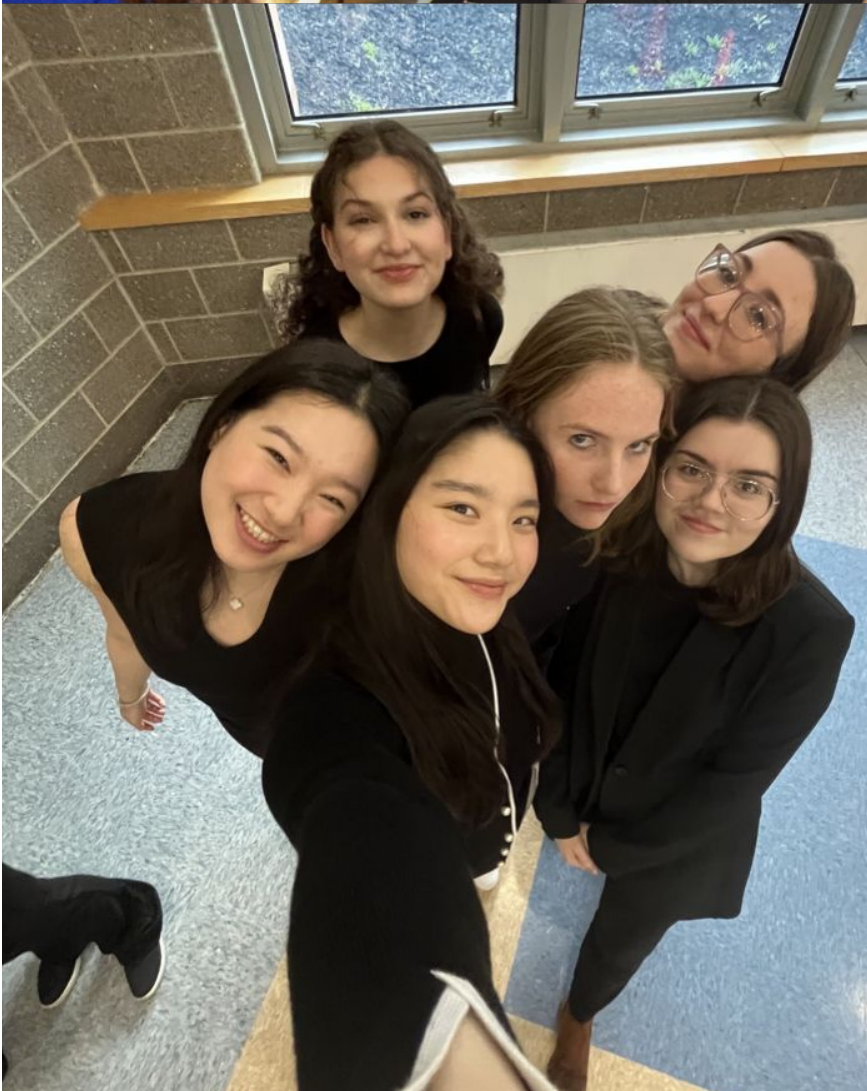
Galle Blaustein

An Analysis of Uveal Melanoma Cell Line Migration and Invasion in Response to MET Pathway Modulation

Mentor:
John DaSilva, Regeneron Pharmaceuticals

Uveal melanoma (UM) is the most common primary intraocular malignant tumor in adults, representing ~3%–5% of recorded melanoma cases in the USA. Prognosis of metastatic UM is poor with median survival of less than 12 months and no systemic treatment improving survival (Carvajal RD ,2017). Metastatic cancer is a cancer that has spread from the part of the body where it started (the primary site) to other parts of the body. Mesenchymal-epithelial transition factor (MET) overexpression through its ligand HGF is associated with higher risk of metastasis (that occurs) predominantly to the liver (Gardner et al., 2014). Mesenchymal-epithelial transition factor (MET) protein remains on cell surfaces and acts as a receptor for hepatocyte growth factor (HGF). The MET tyrosine kinases receptors are activated by ligand binding to HGF. Inhibition of MET signaling may decrease the metastatic potential of UM. The purpose of this study was to determine whether MET pathway inhibition decreases migration/invasion of uveal melanoma cell lines (OMM1.3, MP41). The procedure was broken into two parts. The first part consisted of a wound healing assay to determine the extent of HGF-induced migration of primary (MP41) or metastatic (OMM1.3) UM cells. The second part consisted of a Boyden chamber to determine the extent of HGF-induced invasion of primary (MP41) or metastatic (OMM1.3) UM cells. Modulation of UM cell migration/invasion was assessed following inhibition of MET signaling with the tyrosine kinase inhibitor; Capmatinib using microscopy. The results show an established correlation between treatment with the MET inhibitor, Capmatinib, and the inhibition of Uveal Melanoma stimulated with the MET ligand HGF (P<0.05). Future research is needed to make clear the long-term efficacy of Capmatinib in treating Uveal Melanoma.

Adelaide Boyle

To Determine the Factors Affecting the Intrinsic Motivation of a Worker's Impact on the Level of Care for Shelter Animals

Mentor:
Paula Krenkel, NY Pet Rescue

Intrinsic motivation is the doing of an activity for its inherent satisfaction rather than for external rewards. The Harrison Pet Rescue is a volunteer-based organization dedicated to saving dogs and cats and finding them safe and nurturing homes. The New Rochelle Humane Society of Westchester uses paid employment to find reasonable adopters for their animals. The purpose of this study will be to determine what factors including personality type affect the intrinsic motivation of a worker or volunteer. An adapted version of the Intrinsic Motivation Inventory (IMI) will be used to determine how intrinsically motivated workers and volunteers care for rescued pets and find loving homes. In addition, workers and volunteers will complete the "Big Five Personality Test" to measure their degree of openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. Finally, multiple observers will rate the environment of the shelter, and the cleanliness of the kennels to assess the quality of work done by the volunteers vs paid employees. Future research will examine whether there are patterns in intrinsic motivation among volunteers working in other sectors.

Julia Carrea

Using Eye-Tracking Technology to Detect Emotion

Mentor:
Lou D'Alessandro, Harrison High School

Parkinson's Disease (PD) is a neurodegenerative disease where speech and communication problems are common. Due to lack of facial expression, it is challenging for PD patients to express emotion. Eye-tracking technology tracks movements of the eyes through the use of infrared light and may have the ability to enable PD patients to express emotions, especially empathy. The purpose of this study was twofold: 1. to utilize an online eye-tracking software to determine relationships between eye fixations, gaze point, and empathy levels when exposed to tears, freckles, and pimples. 2. to construct an eye-tracking device prototype that could enable PD patients and others to express emotion in real time. Participants were divided into 4 groups of approximately 10 and the Toronto Empathy Questionnaire was administered before and after they were exposed to faces with tears, freckles or pimples. Results showed that the tears group had a significantly smaller average area of fixations, meaning that fixations were focused in a smaller portion of the faces rather than being scattered throughout ($p < .01$). The difference in the average dwell time and time of first view was not found to be significant ($p > .05$) although the tears group had the shortest time of first view. Although there was not a significant difference in the empathy level of participants before and after eye-tracking, the change in empathy level was greatest in the tears condition ($p > .05$). PD patients may find eye-tracking technology to be a beneficial tool in improving the quality of communication as it has been constructed in a wearable/portable device, potentially allowing for the expression of empathy/emotion in real time.

Mia Castillo

Determining the Most Efficient Shape of a 3D Printed Solar Evaporator Structure to Maximize Clean Water Production

Mentor:
Michael Schweitzer, Harrison High School

Earth's surface is roughly 70% water; only 1.6% is obtainable and drinkable. Water scarcity is currently a considerable problem for many developing countries. Processes of cleaning water are typically large, expensive, and environmentally harmful. Through solar energy and 3D printing, clean water can be made accessible. However, the water evaporation rate could be faster to produce a meaningful amount of water for human consumption. Wu (2020) used biomimetic cones to increase the surface area from which the water evaporates. This study will determine if the biomimetic cone is the best shape to increase the surface area from which water evaporates and, thus, the evaporation rate. The 3D shapes were designed using the OnShape program, printed from Form3+ 3D printer using standard resin. The 3D shapes which will be printed are a cone, pyramid, tetrahedron, and cube. A tetrahedron is hypothesized to be the most efficient shape due to its high surface area and pointed tip. A pilot study was conducted to determine whether one large shape (surface area of 98.76cm^2) or four smaller shapes (surface area of 91.84cm^2) would increase evaporation rate. Two 300mL plastic containers that were built to replicate Wu's (2020) solar evaporator, were filled with 100mL of 32ppm artificial seawater. In 1 container, the large 3D-printed cone was placed in the seawater, and the other had the four smaller cones. Each small container was placed in its own larger 2130 mL airtight plastic container. The containers were set 52 cm below a 250 Watt heat lamp with a reflector (90-degree angle). After approximately 20 hours, the evaporation rate in the container with the four smaller cones far exceeded the container with the larger cones. Therefore, four smaller shapes with similar surface areas will be 3D printed for each of the other shapes and tested.

Mason Danzig

Determining the Most Effective Medium of Telling a Story That Results in Empathic Change

Mentor:
Allison Blunt, Harrison High School

Holocaust education has been shown to increase empathy and one's willingness to be an upstander and stand up for what's morally correct in difficult situations. The Florida Department of Education Commissioner's Task Force on Holocaust Education found that students exposed to Holocaust education demonstrated higher critical thinking skills and a greater sense of social responsibility as well as being more open-minded to different viewpoints including race and sexual orientation. Learning about the Holocaust through the stories told to audiences directly by Survivors has been supported as the most effective method of imparting holocaust education, but the number of Holocaust survivors is dwindling steadily. Therefore, the purpose of this study was to discover the best way to keep a story alive for future generations that results in the greatest empathic change for the audience. The hypothesis was that watching a video of holocaust survivor speaking will leave the audience with the greatest gain in dispositional empathy over other methods because the audience will be able to connect with the survivor personally even if they are no longer alive. The methodology entailed dividing 288 high school students into 4 groups: one that heard the survivor speak, one that heard a relative of the survivor speak while the survivor was present, one that heard the relative of the survivor speak without the presence of the survivor, and one that watched a video of the survivor speaking. Each group completed the Interpersonal Reactivity Scale scale both before and after the presentation that measured empathic change. Attentiveness was also measured after the presentation. Statistics are currently being tabulated.

Alexia De La Jara Cabrero

The Extent to which TikTok Reinforces Stereotypical Perspectives in Teenage Users

Mentor:
Allison Blunt, Harrison High School

Stereotyping refers to a prevalent, yet rigid and oversimplified perception of a specific category of person or object. Often these stereotypes are part of one's perspective about a certain group. Perspective can be affected by our environment and particularly by social media for the teenage audience. Many social media platforms lack filters, meaning that users could be exposed to stereotypical content that could affect the perspective of the viewer. Tik Tok is the most downloaded IOS app among adolescents. Its algorithm is designed to learn an individual's preferences and recommend content that will interest the user.The purpose of this study was to determine how TikTok reinforces stereotypical perspectives in teenage users. The hypothesis was that by exposing users to the content that they want to see, TikTok is reinforcing singular perspectives and stereotyping of other groups. The methodology consisted of a survey that was administered to high school students, ages 12 - 18, that examined if the content that the individual wants to see correlates with the content that appears on their "ForYouPage". This was done to determine whether they were exposed to new perspectives. In addition, the survey examined the diversity of individuals that were portrayed when each participant searched for #crime, #lawyer, #doctor. This was done to see if specific stereotypes about a certain group were reinforced. Results are currently being tabulated.

Isabella Estroff-Liberti

The Effect of Socioeconomic Status on the Rate of Domestic Violence

Mentor:
Robin Schlaff

Domestic violence is aggressive behavior towards a spouse or partner to assert control and dominance. Socioeconomic status (SES) is related to or concerned with the interaction of social and economic factors that determine one's stance in society. According to the Domestic violence hotline, 25% of girls experience an incidence of domestic violence before the age of 18 and 20% of all women are abused at some point in their marriage. The purpose of this study was to determine if a correlation existed between SES and domestic violence rates within a suburban town in Westchester, New York. It was hypothesized that the higher the SES and the greater the desire to protect one's reputation would result in more incidences of domestic violence. In addition, more wealth may correlate with one partner having more power in a relationship making it difficult for a victim to leave the relationship. The methodology involved collecting police FOIL reports with incidences of domestic violence per police beat for the suburban New York town in the years 2000-2022. Each beat was divided into 4 sections and a random generator was used to pick out four streets from each section. For every street the price of four different houses was found using Zillow. The average house price per beat was used to estimate the wealth of that given area, so that the beats could be ranked from highest SES to lowest. The hypothesis was not supported as the data clearly showed areas of lower SES and had significantly increased reports of Domestic Violence ($p < .05$). A potential reason for this could be that the poorer the person is, the more likely they may be to turn to the police in times of distress, whereas wealthier people may enlist the help of lawyers and other professionals. Further research will involve testing to see how aware women and men are in different situations in relationships that are abusive.

Benjamin Gold

Using the R Phyloseq Package to Find a Potential Connection Between Diet, The Human Microbiome, and Parkinson's Disease

Mentor:
Joe Boktor, CalTech

The microbiome is a system of bacteria and other microorganisms within the human body, primarily the digestive system, that plays a major role in digestion. When digesting food, certain species of bacteria within the microbiome, such as *Bacteroides fragilis*, can release toxins that are hypothesized to further the progression of neurodegenerative diseases such as Parkinson's disease. Frequent consumption of certain foods, such as red meat or dairy, may increase the production of these toxins. Therefore, a diet higher in these types of food may lead to specific microbes being more prevalent within PD patients, which could provide insight into how these microbes connect to the progression of PD. The purpose of this study will be to use bioinformatics, or the use of specialized computer software for analyzing biological data. In particular, the programming language R will be used to look at the microbiotal compositions of various Parkinson's patients, compared with a control group, in order to see which microbes have an increased prevalence in group of PD patients with higher consumption levels of animal products, compared to both those who consume less animal products and the control group. It is expected that PD patients who consume more red meat may have lower overall diversity within their microbiomes, as well as higher amounts of *B. fragilis*. If a correlation between consumption of certain foods and/or microbes with PD were to be discovered, it could potentially provide insight into how one can prevent PD from developing or worsening.

Blayse Jennings

Comparing the Effectiveness of *Hypericum perforatum,* a Natural Alternative, to Lithium Chloride for Treating Depression

Mentor:
Dr. Cale Whitworth, Bloomington Drosophila Stock Center

Depression is a common and serious medical illness that currently affects over 280 million people in the world. Depression can cause feelings of emptiness or desolation, and many can experience a loss of interest in activities that were once enjoyable. Serotonin is a hormone that carries messages between nerve cells in the brain and throughout your body. Depression has been linked to low serotonin levels. Lithium Chloride and *Hypericum perforatum*, or St.John's Wort, are two drugs that work as serotonin reuptake inhibitors. St.John's Wort is a natural alternative whose usage dates back to Ancient Greeks and has been known to treat depression, insomnia and other ailments. The purpose of the study is to figure out a natural approach to combating depression. With a more natural approach of *Hypericum perforatum*, there will be less unfortunate side effects than with a more chemical approach through Lithium Chloride. The hypothesis of my study is that *Hypericum perforatum* will be equally effective at relieving symptoms of depression in *Drosophila melanogaster* because it is a unique herb thought to be a serotonin reuptake inhibitor. The methods will involve using a shake table to induce depressive-like symptoms in wildtype *Drosophila melanogaster* and comparing their recovery rate when fed St. John's Wort or Lithium Chloride. It is expected that there will be no difference in the performance of the flies on the two types of medications meaning that more research should be done surrounding the treatment of depression in humans using St. John's Wort, a natural alternative.

Emma Jonisch

Determining Whether the Use of Antidepressants Reduce the Risk of Psoriasis Patients with MDD of Developing Psoriatic Arthritis

Mentor:
TBD

Psoriatic arthritis is a form of joint disease that affects some people who have the skin condition psoriasis. 7.5 million Americans have psoriasis and 30% of these people develop psoriatic arthritis. Depression is a mental health disorder characterized by persistently depressed mood or loss of interest in activities, causing significant impairment in daily life. The purpose of this study will be to investigate whether taking antidepressants reduce the risk of Psoriasis patients with Depression from developing Psoriatic Arthritis. It will be hypothesized that Psoriasis patients with Depression taking antidepressants will be less likely to develop Psoriatic Arthritis than Psoriasis patients not taking antidepressants. The methodology will entail first accessing deidentified patient data through the THIN database. Then, the next step will be to look at the number of Psoriasis patients with Depression to see which take anti- depressants and which don't. After that, an analysis will be performed using the Cox Proportional Hazards Model to determine whether those taking antidepressants are at a decreased risk of developing Psoriatic Arthritis. It is expected that of those with Psoriasis and Depression, patients taking antidepressants will have a decreased risk of developing Psoriatic Arthritis. Further research will investigate whether antidepressants can be used as treatment to minimize the symptoms of Psoriatic Arthritis.

Lucia Lammers

Using Local Waste Materials to Create Vibrant Dyes with Large Color Ranges

Mentor:
Dr. Julian Silverman, FIT

For many years, synthetic dyes have been utilized to color textiles produced in the fashion industry. These synthetic dyes are very toxic to the environment and harmful to humans. In order to decrease the demand for synthetic dyes, natural dyes made from plants, invertebrates, and minerals can be used as a sustainable substitute, and are better for the environment. To maintain sustainability with natural dyes, it is important to only use the necessary materials without harming future resources, while maintaining a social, economic, and environmental balance. More specifically, sustainability can be achieved by collecting waste materials and transforming them into functional colorants for textiles. Waste materials like agricultural waste, food waste among others are very abundant, and through research have proven to be effective dyes for clothing. Scientists have taken steps forward in using these waste materials to create colorants, by converting food waste into natural powder pigments with new systems like KAIKU, and sourcing agricultural waste like grape and apple pomace for the creation of dyes. Many experiments lack the use of local waste materials to create both a natural dye and sustainable mordant. The application of metallic mordants to fabric can create richer colors and larger color ranges, but they also leave behind metal contaminants that pollute the environment. Therefore, it is important to research effective waste materials common to Westchester County that can create sustainable dyes and mordants.

Magda Mani

The Extent to which *Fucus vesiculosus* Adapts to Changing Conditions in the Long Island Sound

Mentor:
Dr. Catherine Matassa,
University of Connecticut

Eutrophication is the process where there is an increase of nutrients found in the water column which depletes oxygen and causes hypoxia. An increase of sewage waste and runoff containing fertilizer from lawns in the Long Island Sound has created a nutrient gradient, where the Western Long Island Sound has a much greater nutrient concentration due to a larger and more dense population compared to the Eastern Long Island Sound. The purpose of the study was to determine if *Fucus vesiculosus,* a seaweed found in both the West and East Long Island Sound adapted to nutrient conditions in their reciprocal environments. A reciprocal transplant study was conducted where 48 samples of *F. vesiculosus* were extracted from the Long Island Sound in total, 24 samples originating from the West, and 24 samples originating from the East. Before replantation, the samples were weighed, scanned and labeled. In the Western site, 12 samples of each Western and Eastern *F.vesiculosus* were labeled using cable ties and planted using marine epoxy to ensure the seaweed could freely move in the water. This process was repeated for replantation in the Eastern site. 10 out of the 48 samples were found during recollection after 1 month. Results showed that although the percent change in both surface area and mass decreased for the samples in both of the plantation sites, the Eastern samples replanted in the Western site performed better than the Western samples planted alongside them, although the differences were not significant ($p>.05$) meaning the species possibly could be evolving differently. The implications were that as *F.vesiculosus* adapts to changing conditions, it could disrupt food web relationships in its ecosystem.

Margaret Martinez

Determining the Extent to Which Magnesium Influences the Fecundity of Female Drosophila melanogaster: A Dose Response Study

Mentor:
Allison Blunt,
Harrison High School

Infertility affects 1 in 5 women and is the inability to get pregnant after one year of unprotected sex. Impaired fecundity refers to women who have difficulty getting pregnant or carrying a pregnancy to term and affects 1 in 4 women. Many fertility treatments can be expensive so it's important to investigate alternate options. According to the Harvard School of Public Health, magnesium is crucial for many bodily processes including regulating muscle and nerve function and making protein, bone and DNA. Magnesium is found naturally in a variety of foods including legumes, nuts, seeds, whole grains, leafy vegetables, milk and yogurt. Magnesium supplements are widely available to purchase. Bloom (2010) found that many infertile women were magnesium deficient, most likely due to eating a western diet where the majority of food is processed and stripped of its nutrient benefits. However, it is unclear what the role is that magnesium plays in fertility. Drosophila melanogaster is a good animal model for fertility and fecundity research because they are relatively inexpensive, have short reproduction cycles and lifespans, and because eggs are externally laid making them easy to count. In addition, they share 75 percent of their genes with humans. Therefore, the purpose of this study will be to determine whether magnesium affects the fertility and fecundity of female Drosophila melanogaster. It will be hypothesized that the greater the dosage of magnesium, the more eggs the female Drosophila will lay, and the more larva, pupa and offspring will be produced. The methods involve conducting a dose response study using 0mM, 20mM, 40mM, 60mM, 80mM concentrations of Magnesium. It is expected if Drosophila melanogaster were fed 80mM of Magnesium, the fecundity would be greater compared to lower concentrations of magnesium.

Caitlin May

Finding the Correlation Between Personality and Music Preference

Mentor:
Dr. Melville Francis,
Harrison High School

Individual online content consumption provides large-scale data that can advance social scientists' understanding of human behavior. For example, Anderson et al. (2020) conducted an observational study using Spotify which showed significant correlations between the music genres that people prefer to listen to based on listening histories, and the personality traits of users. This could inform whether people select musical environments that reflect their psychological needs. They found that preference plus habit had greater predictive value for personality. However, these studies did not isolate which component correlated with the personality traits. The purpose of this study was to determine if there was a correlation between an individual's personality as determined by a personality test using the Big Five Inventory and the tempo of the music of the top 10 songs participants listed from their Spotify Wrapped/Apple Music Replay in 2021. Tempo was defined as the pace at which a song is played, measured in beats-per-minute. The methods involved creating regression models to determine if there was a correlation between the personality traits of openness, conscientiousness, extraversion, agreeableness, and neuroticism, and the tempos of the top ten songs identified on the Spotify Wrapped and Apple Music Replay for 2021. The average tempos of the songs were found by using the website SongBPM.com. Results indicated that there were no significant associations between any of the personality traits and tempo ($p > 0.05$). Future research entails testing other components of music, such as lyrics and instrumentals, to determine their relationship with personality traits.

Katherine McCann

Determining the Effect of Broccoli Sprout Extract on The Upregulation of Mutant KRT 17 in Zebrafish Embryos

Pachyonychia congenita is a dominant autosomal disease that is caused by mutations in keratin genes including KRT 17. Zieman (2019), proposed a form of broccoli sprout extract which contains the active ingredient,sulforaphane, could possibly help cure lesions on the skin that are there because of Pachyonychia Congenita. The broccoli sprout extract is used with the activation of the Nrf2 pathways, the principal protective response to oxidative and electrophilic stresses. Zebrafish embryos are a reliable model to study the genes associated with Pachyonychia Congenita because they share 70 percent of genes with humans and 84 percent of genes known to be associated with human disease. The purpose of this study will be to use different concentrations of broccoli sprout extract to activate the Nrf2 pathway to determine if the genetic expression of KRT17 would be upregulated in zebrafish embryos. The hypothesis is that a high concentration of broccoli sprout extract could trigger the same responsiveness in the Nrf2 pathway in fish that would help alleviate the lesions or expression the the KRT17 gene. The methodology will involve soaking the zebrafish embryos in broccoli sprout extract to determine whether the expression of KRT17 is upregulated. Quick RNA kits and a RT PCR, a technique used for the detection and quantitation of mRNA, will be used to determine whether the gene was upregulated. Determining whether sulforaphane would upregulate KRT17 could potentially help develop treatments for patients with Pachyonychia Congenita in the future.

Mentor:
Dr. Howard Sirotkin, Stony Brook University

Stella O'Connell

The Effect of Interleukin-22 on the Proliferation of Murine ATG16L1 T316A Intestinal Organoids

Crohn's disease is a currently incurable chronic disease that impacts the epithelial lining of the gastrointestinal tract through spotty inflammation throughout the gut, often studied through the model organism of intestinal epithelial organoids. This inflammation of the gut is often caused by the overexpression of cytokines, proteins created by immune cells that are vital for signaling, due to uncontrolled immune response. A cytokine, interleukin-22 (IL-22) is important in epithelial regeneration and wound healing, yet also can be pro-inflammatory (Arshad, T., et al., 2020). Autophagy, a necessary process that recycles unneeded cellular materials, can regulate immune response and deter inflammation. ATG16L1 (autophagy 16 like 1) is a gene that regulates the process of autophagy, but can contain an allele, T316A in mice, T300A in humans, that can dysregulate this autophagic process (Willemsen, J., et al., 2021). This study aimed to view the relationship between dysregulated autophagy (via T316A) and interleukin-22 by using intestinal organoids to model epithelial regeneration. The hypothesis for this study was that IL-22 would have an exacerbated effect on the proliferation of T316A organoids due to the dysregulated autophagy present, however, this was not supported by the data. It was seen that there was no statistical difference between the growth rates of WT and T316A organoids, as viewed through the readouts of total average area, darkness, and eccentricity. These results bring light to the nuances of autophagy, and may imply that autophagy in any capacity is enough to regulate epithelial regeneration when exposed to outside growth factors.

Mentor:
Dr. Stephanie Lau, Regeneron Pharmaceuticals

Stella Perini

Utilizing *Drosophila melanogaster* to Evaluate the Impact of the Abeta42 with the "Arctic" mutation on Recovery Time within Chronic Traumatic Encephalopathy

Chronic Traumatic Encephalopathy (CTE) is a neurological disease formulated from repeated head injuries. This disease is most common in contact sport athletes, more specifically football, and boxing. This disease develops due to a buildup of tau proteins around blood vessels in the brain and leads to delayed symptoms including signs of dementia, depression, erratic behavior of aggression, and personality changes. Research has shown that CTE patients often contain an Alzeimers and Dementia linked gene. Those that do, may have a higher severity of CTE symptoms and struggle through this disease at an earlier age. *Drosophila melanogaster* is a good model organism for studying Alzeimers because the GAL4-UAS system can be used to express the human Abeta42 with the "Arctic" mutation. In addition, 2017 Minkaun Sun and Liam L. Chen designed a gas-propelled ballistic impactor that will be controlled by regulating the flow rate of CO_2 at a constant gas pressure system that can systematically hit the Drosophila on the head at a constant speed to conduct a dose response study. The purpose of the study will be to understand how the Abeta42 with the "Arctic" mutation most often found in Alzeimers patients, affects the recovery time of Drosophila that suffers through repeated head trauma. *Drosophila melanogaster* that possess the Abeta42 with the "Arctic" mutation will have a longer recovery time after experiencing multiple head injuries than without the gene. The gas- propelled ballistic impactor will apply a mTBI (Mild Traumatic Brain Injury) protocol of five consecutive strikes at the 5.0 L/min flow rate, with 24h recovery periods between each strike to both sets of flies. To investigate the impact of mTBI on locomotor function a negative geotaxis assay will be used to assess recovery time and will be administered both before the head blows and one day afterwards. In addition, a Kaplan Meier curve will assess the estimated survival function.

Mentor:
Allison Blunt, Harrison HIgh School

Samuel Potkin

The Effect of Different Nanofluids on the Working Temperature of Computer Processors

Liquid cooling systems function by pumping a liquid next to a computer processor, transferring the heat out of the system. Recent studies have supported the idea that nanofluids, liquids with nanoparticles suspended in them, allow for a greater thermal conductivity. This is due to the particles suspended in the liquid being only nanometers in size, with smaller particles having more surface area while maintaining the same volume, thereby increasing the energy transfer rate. As computer chips become smaller and smaller, their need for cooling systems grows substantially as the smaller parts tend to generate more heat. The purpose of this study will be to find the point at which increasing the concentration of nanoparticles, Fe_3O_4, produces insignificant returns. This will be done to find the proper concentration of nanofluids to increase thermal conductivity significantly while maintaining relatively low costs.It will be hypothesized that as the concentration of nanoparticles increases, the thermal conductivity of the nanofluid will increase up until a threshold, where the data will show diminishing returns or even a decrease in conductivity. To test this hypothesis, different mixtures of water and black iron oxide will be prepared for use in a liquid cooling system. After connecting the system to a heat source, each mixture will be used and the results will be recorded over time to determine which mixture was able to keep the heat source at as low of a temperature as possible. It is expected that the mixtures with a higher concentration of nanoparticles will be more thermally conductive compared to the less concentrated mixtures. However, it is also expected that at some point the mixtures will become too viscous or be unable to hold any more nanoparticles, meaning that after a point the efficiency of the cooling system will decrease.

Mentor:
Randy Gunnell, Harrison HIgh School

Filippa Rasmussen

Effect of Tactile Sense on Food Enjoyment

Food enjoyment is the pleasure found in the food and eating experience as a whole. Consumers often choose foods that are more enjoyable than healthy. To change the food choice consumers make to become healthier, it is important to look at how environmental and cognitive factors impact food enjoyment. The sensory aspect of touch is largely influential in food enjoyment as touching food can elicit an emotional response. The purpose of this study was to understand the relationship between the sensory attribute of touch in connection to food enjoyment. Thirty teachers and staff of the local high school over the age of 18 participated. The participants ate fruit and cheese served on a platter, first with their hands, and then with a fork, and they also rated on a scale 1-10 how much they agreed with statements about preferences and causes of food enjoyment. Results showed that over 50% of participants preferred eating with a fork more than eating with their hands. There was a significant relationship between preferring a fork and reporting food was gross or too sticky/greasy/messy to touch with hands, decreasing enjoyment when eating ($p<.05$). This implies that the sense of touch may actually have detracted from the food enjoyment experience. However, because of opportunity sampling, the results may not be generalizable to the broader population. Future research should employ fMRI technology to explore whether the results hold true with participants from a broader range of cultures and ethnicities, including some that encourage eating with hands.

Mentor:
Allison Blunt, Harrison High School

Alissa Remeza

Testing Deep Neural Networks for Neutrino Identification Ability

The Standard Model of Particle Physics (SM) describes physicists' best understanding of the fundamental makeup of the universe, yet neutrinos, part of the SM, exhibit unaccounted oscillations. Understanding anomalous neutrino properties answers key questions posed about the universe, including evolution of the universe since the Big Bang, observed matter-antimatter imbalance, supernovae, and unification of forces. The Deep Underground Neutrino Experiment (DUNE) is a next-generation international experiment seeking to answer these questions. DUNE neutrino detection relies on liquid argon time projection chambers (LArTPCs) that produce detailed images of neutrino events. These events are classified by a trained Convolutional Visual Network (CVN), an image-processing neural network. This study improved DUNE analysis efforts by identifying erroneous or biasing factors influencing CVN predictions. Disproportionate effects on CVN accuracy from any custom modification was recorded for 800 event simulations and divided by event topology. Results found significantly worsened performance (5.5 sigma, $p << 0.01$) with one of the three input images ("collection plane") to the CVN obstructed as well as significantly increased network errors for high energy, inelastic, and deep inelastic scattering (DIS) interactions (4.9 sigma, $p << 0.01$) for electron and muon neutrino events. These results suggest a bias in CVN training. Principally, there was an overreliance on the collection plane compared to the other input images. Moreover, there was evidence of poor training for highly inelastic events. This work enables more accurate training to provide comprehensive results for future neutrino research.

Mentors:
Dr. Mary Bishai &
Dr. Bannanje Nitish Nayak, Brookhaven Labs

Kyra Repa

Determining whether Lack of Enjoyment Mediates the Relationship between a Perceived Parental Pressure and Athlete Burnout

Mentor:
TBD

Parents play a major role in their child's sports participation. They usually contribute to children's initial sport involvement and provide concrete and emotional support throughout children's sport careers. However, sometimes this support can be perceived as pressure. This may cause athletes to lack enjoyment in the sport and can even lead to athlete burnout. Enjoyment in sport can be defined as an athletes' positive emotional response to playing their sport that generates feelings, such as fun, pleasure, liking, and love. Athlete burnout can be defined as a condition in which an athlete's increased training causes fatigue and declining performance in their sport which may also lead to mood changes, decreased motivation, frequent injuries, and infections. The purpose of this study is to determine if parents pressuring their children can lead to athlete burnout due to causing their child to lack enjoyment in their sport. It can be hypothesized that athletes who perceive high levels of parental pressure will also record low levels of enjoyment in sport and high levels of athlete burnout. This study will determine if the lack of enjoyment in sports will act as a mediator between the effect of perceived parental pressure on athlete burnout. The method of collecting this data will be through a survey, where athletes will rate their perceived parental pressure on a pressure scale, and then fill out an enjoyment in sport questionnaire, and an athlete burnout questionnaire. The expected result is that athletes showing higher levels of perceived pressure from parents, will also lack enjoyment in their sport and experience athlete burnout. Future research regarding this experiment could be determining how much pressure parents perceive they put on their children, to see if it is the same amount of pressure the athletes perceive from their parents.

Makayla Sullivan-Pizarro

Identifying Whether Factors that Affect Happiness Differ Among High School Students in an Income Diverse High School Setting

Mentor:
TBD

Happiness is a positive state of mind as well as a feeling of contentment that is usually associated with feelings of pleasure, joy, and satisfaction. It's a subjective experience that can also be influenced by factors such as relationships, health, career, and personal values. It's often characterized by positive emotions like love, peace, and gratitude, and is considered a common goal individuals set. Past research has shown that happiness can help improve a person's well-being, increase their productivity, and promote their physical health. Though research has been done on what makes people happy and unhappy, and how happy people may be, there is not much that reveals how to influence a person's happiness. It's commonly assumed that happiness is rooted in a person's mental and physical well-being. In addition, Twenge & Cooper (2022) found that associations between income and happiness were linear in adults over 30, however, it is unclear if this same trend holds true for adolescents.Therefore, the purpose of this study will be to identify whether factors that affect happiness differ among high school students that report different levels of family affluence in an income diverse high school setting. The hypothesis will be that the higher the reported family affluence, the higher students will score on the Subjective Happiness scale. In addition, it is expected that students that report higher GPAs, more involvement in sports and clubs, a diet high in fruits and vegetables, and a daily physical activity routine will report higher levels of happiness. .

Mako Suzuki

The Extent to Which Blue Light Filters Mitigate Computer Vision Syndrome Caused by Differential Computer Interactions

Mentor:
Dr. Christopher Tyler

Eye strain is a common condition that occurs when the eyes get tired from intense use, such as staring at computer screens and other digital devices. Blue light is a color on the visible spectrum with high energy and short wavelength that is said to cause eye strain. Blue light glasses were marketed to reduce eye strain by blocking blue light. The study aimed to investigate whether blue light glasses mitigate eye strain caused by differential computer interactions by testing blinking rate. Students were randomly assigned to complete multiple activities at different brightness levels while wearing blue light glasses or a placebo. The study found wearing blue light glasses caused a significantly greater blinking rate for reading a passage at all brightness levels and watching a video at higher brightness levels ($p<.05$). For writing a transcription, there were slightly higher means of blinking rate while wearing blue light glasses although it was not significant. While wearing a placebo, the blinking rate slightly decreased as brightness levels increased. While wearing blue light glasses, the blinking rate increased as brightness levels increased. The results indicate that blue light glasses could mitigate eye strain under certain conditions: reading or watching a video at higher brightness levels. Also, that blue light may be a cause for eye strain.

Danielle Topper

Evaluating Gene Linkages through Pathway Analysis within Alzheimer's Disease

Mentor:
Dr. Silvia Smith,
UNC Pembroke

This study evaluated the role of the lysosomal pathway in Alzheimer's disease (AD). Investigations of AD are important in the scientific world because the disease is highly common and is even fatal. To evaluate the lysosomal degradation pathway's implications in AD, this study utilized in-silico analysis. A set of molecules was identified through extensive literature searches of peer-reviewed articles to form a molecules of interest list. These categories included molecules pertaining to AD, the lysosome, or both AD and the lysosome. The software QIAGEN IPA(R) was used to generate results for this study once the molecules of interest were inputted into the database. Key findings from the analysis support the role of the cathepsin enzymes as key players in the lysosomal pathway and AD. Trends seen in the produced results support the relation among cathepsin B, cathepsin S, cathepsin L, and cathepsin D and other molecules in the data set. Findings were statistically supported by statistical tests performed by QIAGEN IPA(R) and their respective p-values. In conclusion, results support that the initial set of molecules are mostly connected and implicated within the lysosomal pathway. This is important in the general study of Alzheimer's disease because it points to the lysosome as a key player in the disease.

Alec Udell

Creating Biodegradable Fishing Lures: Determining the Hydrolytic Degradability of Biodegradable Plastics Under Natural Aquatic Conditions

Over 13 billion hooks and 16 million km of fishing line are lost every year in our oceans. One solution to this is creating biodegradable fishing products. Biodegradable means a material that can be broken down by its environment into natural products like biomass. Several fishing lures claim biodegradability, but it is unclear if these companies actually create products that can degrade in oceanic environments. Therefore, the purpose of this study is to analyze different samples of fishing lures (including Berkley Gulp *Alive*! Swimming Mullet & Z-man Diezel *MinnowZ)* and other products that claim biodegradability, and test their degradability in different marine conditions. The hypothesis will be that the commercially available fishing products will not degrade significantly in these environments, as they are made up of non-biodegradable materials such as oil-based polymers. The methodology will entail four different treatments for these samples. One of each product will be placed in seawater with specific modifications. The treatments include: varying pH levels, varying temperatures, varying salinity and varying UV exposures. The masses of these product samples will be measured each week to see how much they are degrading over time. It is expected that the fishing products selected will not degrade as much as the plastic straws because of their composite chemical makeup. The product sample of the biodegradable plastic straws will degrade much more than the fishing lures, as the plastic used to make these straws is 100% PHB, a biodegradable plastic.

Mentor:
Dr. Ashlee Jahnke,
Texas A&M

Alexandra Wong

Pathogenesis of CAG Repeat Disorders: Modeled in Fibroblasts from DRPLA and HD Patients

Neurodegenerative diseases (ND) are diseases characterized by the irreversible loss of susceptible neurons of the brain and spinal cord. Dentatorubural-Pallidoluysian Atrophy (DRPLA) is a rare autosomal dominant neurodegenerative disease caused by the expansion of trinucleotide CAG repeats encoding poly-glutamine (PolyQ) tracts in the Atrophin1 gene. Research has reported the involvement of mitochondrial dysregulation and oxidative stress in child- and adult- onset of neurological diseases like Huntington's Disease (HD). As new therapies are being developed, it is worthwhile to understand if the abnormalities of mitochondrial bioenergetics characterized by reactive oxygen species (ROS) overproduction seen in HD are also seen in DRPLA. To investigate oxidative stress and mitochondrial alterations, we provided different insights into ROS parameters to link with mitochondrial dysfunction. Our studies show a significant increase in the mitochondrial morphological changes (considering mitochondrial length) in diseased samples in DRPLA and HD lines compared to control lines. Increased levels of both mitochondrial superoxide and cytosolic ROS have been noticed in both HD and DRPLA fibroblast lines. We further confirmed the significantly elevated levels of ROS using a nonfluorescent Nitroblue Tetrazolium (NBT) in diseased PolyQ samples. Thus, we propose that patient-derived fibroblasts can be established as a model system in identifying novel biomarkers of PolyQ that recapitulate in neuronal cells including alterations in mitochondria and oxidative stress.

Mentor:
Dr. Rajiv Dixit, Weill Cornell

Ines Xhayet

Using the Hot Plate Assay to Evaluate the Nociception in *Drosophila melanogaster*

Mentor:
TBD

Chronic pain can be defined as pain that carries on for longer than 12 weeks despite medication or treatment. According to the CDC, an estimated 20.4 % of U.S. adults had chronic pain at some point in their life. There is limited research on chronic pain, and a definite treatment for the permanent removal of chronic pain with little to no side effects is unknown. Since *Drosophila melanogaster* have high homology with human disease genes, reproduce rapidly and are very cost efficient, they are good models for numerous studies. However, what makes them great models for nociception is that they are similar to vertebrates in morphology and function, and their unique nerve endings allow them to quickly perceive tissue damage. The purpose of this study is to isolate genes, most closely associated with the chronic pain pathway in order to identify possible targets for future drugs. It will be hypothesized that genes in the dorsal root ganglia, hence the endocytic pathway, will relate to pain sensitivity. The methodology will involve heat-stimulating mutant *Drosophila melanogaster* using a water bath kept at >40°C to determine their response. It is expected that the flies with genes mutated along the endocytic pathway will not respond, indicating that the gene may play a role in the pain response. This study could help isolate potential targets/pathways that represent good targets for drug treatments.

Science Research I
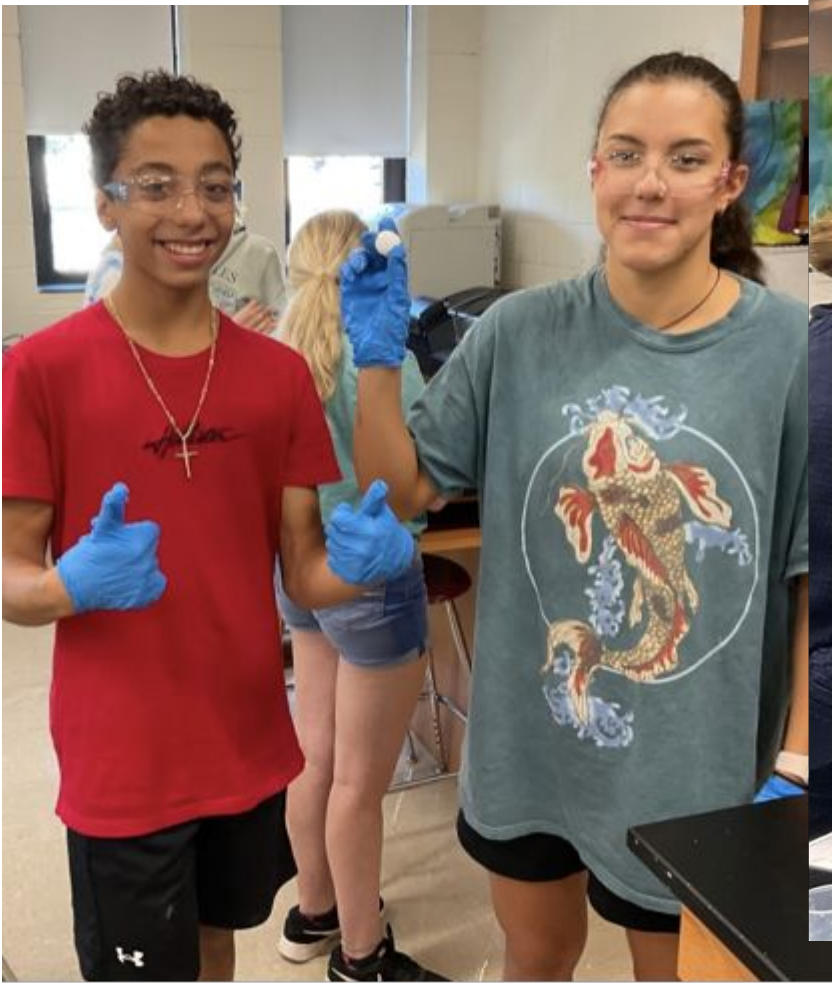
Amelia Amaral

How Dietary Practices and Exercise Impact Mental Well-being in Adolescent Males and Females

According to the CDC (2021), approximately 42% of high school students feel persistently sad or hopeless and 29% experience poor mental health. Begdache (2020) discussed that there is a need to personalize mental health care. Bao & Swaab (2011) found that a low quality diet can contribute to mental distress, especially in adolescents where the brain is still developing. In addition, exercise supports processes that improve cognitive functions and mental wellbeing. Therefore, the purpose of this study will be to identify how diet and exercise work together and individually to impact the mental well being of adolescent males and females. This experiment will speak to the influence of exercise and dietary practices of adolescents differently in terms of gender. The hypothesis is that adolescent females will be more mentally impacted by exercise and dietary practices when compared to adolescent males. The methodology involves surveying an adolescent population using an adapted version of the Food Mood Questionnaire (FMQ) created by Begdache (2020). It is expected that diet and exercise will more greatly impact adolescent females based on the trends identified by Begdache in older populations.

Remi Badner

Determining Whether The Amount of Time Spent On Social Media Affects The Reported Frequency of Cognitive Distortions

Cognitive distortions are internal mental health filters or biases that increase our misery, fuel and our anxiety, and make us feel bad about ourselves. Social media are online platforms which enable people to communicate through the use of words, videos, or photos. Surveys show that around 90% of teenagers between the ages thirteen and seventeen have used social media. Teenagers spend more than 5 hours each day on different social media platforms or playing video games. Although scientists have studied the effects of social media on the general mental health of teenagers, few known studies have explored the extent to which different social media platforms impact the frequency of cognitive distortions, specifically. The purpose of this study will be to determine whether the amount of time spent on social media affects the reported frequency of cognitive distortions. It is hypothesized that the amount of time a High School student spends on social media increases, the frequency of cognitive distortions will also increase.

Julianna Blackman

Correlating Neurocognitive Outcomes With Grading of Cisplatin-Induced Hearing Loss

Ototoxicity is defined as damage to the ear caused by a medication, and can have lasting impacts on the patient's quality of life. According to Freyer et al. (2022), approximately 50% of childhood cancer survivors treated with a chemotherapy drug known as cisplatin faced a clinically significant form of sensorineural hearing loss, but it can be up to 70-90% in certain patient subsets. As a result, researchers have focused on finding otoprotectants for cisplatin-induced hearing loss (CIHL), meaning medications that would prevent the ototoxic effects from occurring. Freyer (2016) and Brock (2018) each conducted studies that found sodium thiosulfate as an effective protectant against CIHL. The Food and Drug Administration approved this medication to reduce the risk of hearing loss in certain cisplatin-treated patients on September 20, 2022. However, sodium thiosulfate does not completely eliminate the risk of ototoxicity, and has only been approved in pediatric patients with localized, non-metastatic solid tumors. Therefore, many patients continue to suffer from CIHL. The purpose of this study is to find a correlation between the grading, or severity, of hearing loss in patients treated with cisplatin and their neurocognitive abilities. It is hypothesized that higher measures of hearing loss in patients will lead to increased risk of neurocognitive deficits. The study will be conducted using data analysis of the medical charts of childhood cancer survivors to find potential correlations. Future research can look at how the severity of hearing loss impacts other factors such as mental health or socialization skills.

Sophia Bondikov

The Effect of Cyanidin-3-Glucosyl-Rutinoside on Improving Athletic Performance by Decreasing GFP Expression in Drosophila melanogaster

Tart cherry juice has various health benefits due to its high content of antioxidants, anti-inflammatory properties, vitamins, and minerals. This juice has been linked to improving athletic performance by speeding up muscle recovery as well as decreasing the amount of oxidative stress found in muscle cells. The main substance found in tart cherry juice that is linked to the majority of benefits is an anthocyanin called cyanidin-3-glucosyl-rutinoside. This study will determine if there is a correlation between improved performance and decreased inflammation due to cyanidin-3-glucosyl-rutinoside supplementation in *Drosophila melanogaster.* The hypothesis will be that the supplementation of cyanidin-3-glucosyl-rutinoside will improve performance which will be linked to decreased inflammation. There will be two parts to this study, the first testing the impact of cyanidin-3-glucosyl-rutinoside on performance, and the second determining the green fluorescent protein (GFP) expression/inflammation in *Drosophila melanogaster.* There will be six groups of *Drosophila*, a control fed 0μM of cyanidin-3-glucosyl-rutinoside, and the other 5 will be fed diets with concentrations of 1μM, 10μM, 100μM, 500μM, and 1000μM. After feeding, a negative geotaxis assay will be used to test the performance of each group. To determine the amount of inflammation post-performance, the groups of *Drosophila* will be examined under the NIGHTSEA Stereo Microscope Fluorescence Adapter. This will show the amount of GFP expressed in the flies, thus showing how much inflammation there is. It is expected that the *Drosophila* fed the diet higher in cyanidin-3-glucosyl-rutinoside will perform better in the negative geotaxis assay and will not express high GFP levels. Further research will involve testing other substances found in tart cherries to see if they work hand in hand with cyanidin-3-glucosyl-rutinoside for optimal results.

Andi Camardella

Determining Whether the Ability to Tell a Plausible Lie Requires Divergent Thinking or Convergent Thinking

Many individuals deceive or lie in order to gain something when telling the truth is less advantageous. Many times telling harmless white lies doesn't bring consequences and at times can be beneficial. The development of deception has been related to cognitive maturation. Children with lower general intelligence may deceive more frequently than others because they focus on the short-term benefits of dishonesty and might not realize the long-term consequences of their behavior. However, Bate *et al.* (2014) found that people with psychopathic or antisocial behaviors with high levels of general intelligence are able to lie on tests to mask their personality and symptoms. High emotional intelligence and divergent thinking, which is the process of creating multiple creative ideas or solutions to a problem that you are trying to solve, have been linked to the ability to tell plausible lies, however, Sarzyńska et al proposed that general intelligence and executive functions might be just as important as emotional intelligence when lying. It is unclear as to whether divergent thinking or convergent thinking, which is reaching one well-defined solution to a problem using logic as opposed to creativity, is what leads to the ability to tell a lie. Therefore, the purpose of this study is to determine if the ability to tell a plausible lie requires divergent thinking or convergent thinking.

Frederick Carver

The Effect of Blending Different Aliphatic Alcohols into Hydrogen Fuel on the Overall Efficiency of an Internal Combustion Engine

Hydrogen fuel is an alternative fuel to conventional gasoline, produced by the reformation of natural gas, and electrolysis. Hydrogen fuel is clean burning, producing only H_2O as a product, which would mean use of this fuel on a large scale would greatly decrease overall global carbon emissions and its impacts.. One problem with Hydrogen fuel however, is that it is unclear whether Hydrogen fuel would be more or less expensive than gasoline. If Hydrogen fuel was to be more expensive than gasoline it would likely result in a lack of use across the country, which would defeat the purpose of using Hydrogen fuel as a clean burning alternative. It would be difficult to decrease the cost per gallon of Hydrogen fuel, but one of the ways to get around this would be to make Hydrogen a more efficient fuel overall. It has been found that Alcohol fuels have a high energy density which increases the power output of an engine. By adding different Alcohols into Hydrogen fuel, the cost per gallon may be higher than gasoline but a car may potentially get more miles per gallon and cause a decrease in how often one would have to fill up a car's tank and pay for fuel due to the increase in efficiency of the fuel.

John Colacioppo

Assessing Potential Environmental Factors
Contributing to the Onset of Coats Disease

Coats Disease is a rare retinal disease that causes exudation in the retina that may result in retinal detachment and loss of vision. Currently, there is no known cause or cure for this disease however studies have looked into possible genetic factors for it. Some studies theorized that there is a connection to the NDP (Norrie Disease Protein) gene however there has not been evidence to support it. Other studies have researched similar diseases such as ROP (Retinopathy Of Prematurity) and have uncovered possible environmental causes such as number of days of intubation, postnatal low weight gain, development of sepsis, gestational age, birth weight, Respiratory Distress Syndrome, excess of oxygen and Apnea episodes. The purpose of this study is to determine if there is an environmental factor such as those related to ROP that contribute to the occurrence of Coats disease. The hypothesis is that an environmental cause related to number of days of intubation, postnatal low weight gain, & development of sepsis will be identified as a possible link between Coats patients. The methodology entails surveying Coats Disease patients and health controls identified by the Jack McGovern Coats' Disease Foundation for their environmental exposures to determine if there are commonalities among patients compared to the healthy controls.

Mark Colacioppo

How the Time of Bloom of the Barberry Bush in Upstate NY
Affects Migratory Patterns of Birds

Migration is the pattern of behaviors in which animals travel from one place to another, usually to find more desirable weather conditions, food sources, or for reproductive needs. Climate change is theorized to be changing bird migration patterns and has been associated with population declines in over 48% of bird species around the world. The barberry bush *(Berberis vulgaris)* is an invasive species but has become a prime food source for American Robins and Finches. Because of warmer average temperatures and decreasing number of rainy days, the barberry bush may bloom earlier each year. The purpose of this study will be to see how the timing of bloom of the barberry bush impacts the arrival time of American Robins and Finches. It will be hypothesized that the earlier the barberry bushes bloom, the sooner the birds will arrive in Upstate New York. The methodology will entail using camera traps to assess the time of bloom of the barberry bush over the past 10 years. Cornell Ornithology's Ebird, an app where birders share their sightings will be used to determine the arrival time of American Robins and Finches during the same time period. It is expected that the sooner the bloom of the barberry bush, the earlier the birds will arrive which could have vast implications. When the birds eat the seeds encased in barberries of this invasive plant, their poop will effectively spread the seeds throughout the surrounding area. When these seeds germinate and grow into mature plants, they will potentially take up space and nutrients needed by native species, choking them out and decreasing biodiversity in the area.

Alexia Cozzali

Determining whether Perceived Stress Mediates the Relationship
between a Perfectionistic Coaches Climate and Athlete Burnout

According to the NIE, athlete burnout is a psychological syndrome that consists of emotional and physical exhaustion, a reduced sense of accomplishment, and sports devaluation. A personality factor that has been linked to athlete burnout is perfectionism. Perfectionism is a personality trait in which a person has excessively high standards and overly critical evaluations.Olsson et al. (2019) found that a coach's performance perfectionism had a direct relationship with athlete burnout, meaning that as a coach's perfectionism increased, athlete burnout also increased. Although this relationship has been supported, it is unclear what exactly is causing the burnout in athletes. The purpose of this study will be to find out if perceived stress is the underlying cause of burnout in athletes that have coaches with a high level of performance perfectionism. In other words, this seeks to determine whether stress mediates the relationship between a perfectionistic coaches climate and athlete burnout. The hypothesis will be that stress will show a positive correlation to causing an athlete with a highly perfectionistic coach to burnout. The methodology will entail surveying 100 male and female high school athletes who engage in both team and individual using the CPP-S (The Coach's Perfectionistic Performance Scale), The Perceived Stress Scale (PSS) and The Athletes Burnout Questionnaire (ABQ).

Isabel Cross

To Determine Whether The AMPD1 Gene Affects
Athletic Performance in *Drosophila melanogaster*

According to NLM (2023), 30-80% of athletic performance differences between individuals are due to genetic factors. AMPD1 is a gene in humans that produces a digestive molecule called IMP that is responsible for providing quick energy for muscles. Ginevicience (2014) studied the relation AMPD1 has with athletic performance and concluded, the AMPD1 gene is beneficial in short-term explosive movements. In addition, Kocakulak (2021) found that genes associated with athletic performance may be expressed differently in males and females due to the differences in hormonal responses and energy metabolism during exercise. *Drosophila melanogaster* or the common fruit fly can be a valid model organism for studying the genetics of athleticism because the Drosophila genome is approximately 60% homologous to that of humans, are low-cost, have a short lifespan, and have a rapid reproduction rate. In addition, short-term performance can easily be tested using the Negative Geotaxis Assay and long-term endurance can be tested using a power tower, a device constructed that can be used to determine how flies respond to sustained physical exertion. Therefore, the purpose of this study is to test the effect of the AMPdeam gene, the fly ortholog of AMPD1, on the physical performance of female and male *Drosophila melanogaster*. The methodology will entail testing both female and male mutant flies for AMPdeam in the Negative Geotaxis and power tower assays. Then a genetic rescue will be attempted by crossing the mutated AMPdeam fly with a fly that is normal for AMPdeam to determine whether AMPdeam was responsible for the compromised behavior. It is expected that the AMPdeam mutant Drosophila melanogaster will perform worse on both Negative Geotaxis and the power tower assays; however, the rescue fly will match the performance of the wildtype in the negative geotaxis assay but not the power tower. This will determine whether the AMPdeam is responsible for short-term explosive movements, but not sustained physical exertion.

Caua Dos Santos Barofaldi da Silva

Determining Whether Dark Roast Coffee has a Neuroprotective Effect
on Alzheimer's Model *Drosophila melanogaster*

Alzheimer's disease is a neurodegenerative disorder that destroys memory and affects mental cognition, especially in elders. Approximately 5.8 million Americans were diagnosed with Alzheimer's disease in 2020. Currently, Alzheimer's disease has no cure and few treatments. Mancini (2018) quantified the aggregation inhibition effects of coffee extracts and found that dark roast coffee elicited neuroprotective effects, however few known studies have tested these neuroprotective effects in animal models. The purpose of this study will be to determine the effect darker roast coffees both with and without caffeine, have on the performance of Alzheimer Model *Drosophila melanogaster*. It is hypothesized that in the dark roasted coffee phenylindanes will act as an agent that prevents the aggregation of amyloidogenic proteins, eliciting neuroprotective effects against Alzheimer's disease in the model flies. The methodology entails using transgenic flies created using the GAL4-UAS system and expressing the human "Arctic" Aβ42 which have already been supported as a valid Alzheimer model. A dose response study will be conducted using light, medium and dark roast caffeinated and decaffeinated coffee. Lifespan will be measured by counting the number of flies alive over time and locomotor performance, an indicator of neurological functioning, will be assessed using the negative geotaxis assay. It is expected that the darker the roast of coffee, the better the Alzheimer Model flies will perform demonstrating the neuroprotective effect of dark roast coffee. Future research would be intended to isolate phenylindanes individually to determine whether it is responsible for any observed neuroprotective effects.

Drew Dougherty

Examining the Extent to which Adolescents Turn to Online Sources Rather
than Mental Health Professionals and Other Adults in Their Lives

Because of the popularity of smartphones and the widespread access to the Internet, many teens turn to their devices to get support for mental health issues. Whether allowing teens to talk to friends online, meet new people, search for information, or to get advice, the smartphone makes it easy for teens to be misled. It has become a comfort factor for many since, unlike an adult figure, it is always there for them, providing seemingly meaningful connections to their friends, the social media world, and to advice. But, it is unclear whether teens are too trusting of the advice and comfort they get online and are turning to online sources rather than trusting mental health professionals and other adults in their lives. This study focuses on determining the extent to which teens turn to social media for support after experiencing trauma, including the type of support they seek and whether they turn to social media before seeking help from adults. The hypothesis is teens will report relying less on adults and have increased dependence on online platforms for mental health advice and support.

Dean Edwards

Evaluating the Risk of Significant Head Injury in High School Contact Sports

CTE, chronic traumatic encephalopathy, is a degenerative brain disease that is caused by brain trauma. There is currently no cure or way to diagnose CTE until a brain examination can be done after death. CTE is mostly studied in higher level athletes like professional or college level players, but fewer studies have focused on high school athletes. A potential reason is that E is unknown if high school athletes are at risk. The purpose of this study will be to evaluate the risk of significant head injury in high school sport, and to document in which sports athletes are more prone to head injuries. It will be hypothesized that male athletes who play football and hockey will be at the greatest risk for a head injury. The methodology involves surveying a minimum of 10 male students per sport who play football, hockey, soccer, lacrosse, and wrestling. The survey will consist of questions including what sport they play, if they have ever gone into concussion protocol, and if they have ever had a head injury that resulted in physical, cognitive, emotional, or sleep problems related to concussions. It will also ask them to give a range of how many times they are hit in the head per game and to give an average rating of the impact of those hits on a scale of 1-10. It is expected that the sports with the most contact will have the highest risk of getting a head injury which could be a risk factor for CTE through repetitive brain trauma. Further research will include studying whether there is a difference between the risk of head injury between boys and girls.

Farrah Frandson

Determining whether Universal Beauty Exists in Viewing Fine Artworks by Evaluating both Aesthetic Appraisal and Features that Garner Attention-Attraction

Art can be a unifying force that can convey social meaning through symbolism. Humanity values art not only for its cultural charge, but also for its beauty and representation of the prosperity of our society. Classical philosophies debate whether beauty is objective or subjective. Objective beauty can be defined as universal qualities of beauty that are rooted in the human brain's desire for proportion and symbolism that often lead to widespread appeal across cultural boundaries. Subjective beauty can be defined as relative qualities perceived as beautiful based on one's cultural background and prior experiences. Darda and Cross (2022) found that despite cultural differences, Eastern and Western participants viewed representational paintings as more beautiful than abstract paintings because of their inherent objective beauty lying in naturalistic symbolism. However, few studies have explored whether people perceive objectively beautiful art as more pleasing than subjectively beautiful art, while also discovering what features within these artworks universally garner immediate attention-attraction and positive aesthetic appraisal. The purpose of this study is to discover the exact features and characteristics within artworks that garner attention-attraction and positive aesthetical appraisal across individuals (with the use of EEGs) to identify if universal beauty exists in art. It is hypothesized that the higher the level of objective beauty within an artwork, the higher its perceived beauty. The study will first require norming to ensure that the series of artworks are comparable. Subjects of different cultural backgrounds will take the questionnaire where they will rate the series of normed artworks on various qualities relating to levels of objective beauty. The same diverse group of subjects will then view the artwork on their computer while using eye-tracking technology to identify which aspects of the artwork they are attracted to and appreciate. This study will reveal whether humanity has a universal view of art as a result of objective beauty. If so, art can be considered an instrument of unification across humanity.

Taylor Hackett

Analyzing the Relationship between the Inhibition of Memory and Post Traumatic Stress Disorder

Post Traumatic Stress Disorder (PTSD) is oftentimes the result of neurological changes in the limbic system and prefrontal cortex of the brain, caused by experiencing a traumatic event. Nearly 20% of the United States population will experience a traumatic event in their lifetime leading to the development of PTSD. Eye Movement Desensitization and Reprocessing (EMDR) stimulates the brain bilaterally and associates a traumatic memory with the prefrontal cortex, or the executive functioning part of the brain, by using a light moving back and forth. The purpose of this study is to examine whether EMDR is an effective method of desensitizing patients with PTSD to their episodic trauma. This method will enable patients to better process traumatic memories to lessen the trauma's emotional significance. A licensed social worker will administer the DSM 5 Scale to PTSD patients to establish a baseline measure. Half the patients will be treated using EMDR where the social worker will stimulate the brain by drawing the emotions out of the patient whilst simultaneously keeping eye contact with the light. The other half will serve as a control group and will receive the same therapy but without the eye movement desensitization. Then, the PTSD DSM 5 Scale will be readministered and the variance in scores will be analyzed.

Sara Hanna

Determining how the Proximity of a Smartphone Affects Adolescents' Sleep Procrastination Habits

Sleep is vital for every aspect of our daily functioning -including our social interactions, mood, and other aspects of our health including growth and repair of tissues. Procrastination is the act of deliberately delaying sleep in order to avoid upcoming events such as a stressful assignment, and procrastination is usually fueled by events happening in the next day or next couple of days There are two main types of sleep procrastination adolescents usually partake in, either in bed or out of bed procrastination. In bed procrastination is the tendency for a person to procrastinate while in bed and whereas, out of bed procrastination happens outside of bed. Smartphones are known to be addictive since adolescents can spend hours at a time on their phones and often prioritize leisure time on their phone over healthier and more productive activities. The purpose of this study is to determine whether the proximity or nearness of a smartphone to an adolescent while in bed results in sleep procrastination. The hypothesis is, the closer the proximity of a phone to an adolescent while in-bed at bedtime, the more they will engage in sleep procrastination and the more their quality of sleep will decrease as a result of the phones' location. The methodology will involve asking adolescents to keep sleep journals where they record the time they get into bed at night, the time they wake up in the morning, and a rating of their quality of sleep over a 9 day period. In addition, participants will be required to wear an apple watch on sleep mode to track the time they fell asleep and the amount of REM sleep they experienced. Every 3 nights during the 9 day period, participants will be asked to move their phone to one of three locations: next to their bed so that the phone is in arm's length, across their room so that they would need to get out of bed to interact with it, and in another room so that they can't see or hear it. It is expected that teens will experience more time between getting into bed and falling asleep when the phone is within arm's reach of the bed. In addition, it is expected that teens will report less REM sleep on those nights.

Ryo Ide

Effectiveness of the YOLOv8 Image Detector for Using Smoke to Predict Wildfires at Night

In the US, wildfires are intensifying both in frequency and destructiveness. While deaths from wildfires are relatively low, the magnitude and quantity of infrastructural damage are beyond tremendous. Furthermore, tens of thousands of residents must evacuate in the event of a wildfire. The five-year average of fighting wildfires costs 2.35 Billion USD (NIFC, 2021). Thus, scientists aim to prevent wildfires at their initial development stages. Prediction is difficult due to technical challenges and the need for more data. Many image detectors use convolutional neural networks to learn and predict various objects in images. One current image detector is the YOLO algorithm. This model is very accurate for being so fast. YOLO can be fed training images (for example, wildfire smoke images) and adjusted using pre-annotated images (an "answer key") such that it can predict objects in an image with great accuracy. This study will determine the effectiveness and limitations of the YOLOv8 (the newest version of YOLO) image detector in detecting emerging wildfire smoke at night. The hypothesis is that the YOLOv8 image detector accurately predicts wildfire with smoke during the day but diminishing returns at night. The methodology will involve the YOLOv8 algorithm, which will be trained with wildfires at different times of the day. After training, YOLOv8 will be fed raw and real-time imagery of emerging wildfire smoke. YOLOv8 will provide images at different times of the day. It will then be measured on accuracy based on data showing where the wildfire was. It is expected that YOLOv8 will greatly surpass prior models in terms of accuracy in predicting wildfires *during the day.* At night, however, YOLOv8 may or may not exhibit only minor increases in prediction accuracy during the night. YOLOv8 will also struggle to locate very large and small objects.

Shun Ide

Vulnerability of Personality Traits in Inducing Illusion of Control

Gambling is a commonly enjoyed mode of entertainment that involves betting on a (mostly) random, chance-based event. There are many biases with respect to the behavior of gamblers, one of which is the illusion of control. The illusion of control is a cognitive bias that outlines the tendency for people to overestimate their ability to predict chance-based events. Among gamblers, there has been evidence to suggest that people with certain personality traits are more likely to perceive delusional outcomes in such situations. Many studies connect delusional traits to either gambling or illusion of control, but not both. The purpose of this study will be to assess the relationship between personality traits and the generation of illusion. These superstitious inclinations encourage impulsive or risky investments, which can quickly have a negative effect on the player. This often leads to other harms such as financial loss and hardship. There is evidence to suggest that emotions of negative effect (anxiety, worry, jealousy, etc. - collectively known as negative emotionality) can produce detrimental delusions in gambling. The methodology will entail assessing whether or not problem gamblers in a sample are more likely to have a higher level of negative emotionality. A group of people will be tested to play a sample gambling game (e.g. slots), and will take a Gambler's Belief Questionnaire to assess their gambling-related cognitive distortions. It is expected that gamblers with high negative emotionality will have a higher vulnerability for illusion.

Maya Levine

Determining How the Carbon Footprint and Ecological Behavior of Students Differ Depending on the Size of the Home in which They Live

There is evidence that people who move to tiny homes are more environmentally aware and their behaviors tend to contribute to environmental conservation or preservation rather than overconsumption. The tiny house movement is defined as an architectural and social movement that advocates for downsizing living spaces. However, it is unclear if a tendency towards being environmentally aware is limited to people who live in tiny homes or if individuals who live in smaller homes also share this tendency. These behaviors can be measured using the Ecological Behavior Scale. In addition, a carbon footprint is a measure of the total amount of greenhouse gasses generated by an individual's behaviors which can be measured using a footprint calculator. The purpose of the study will be to determine how carbon footprint and ecological behavior of students differs depending on the size of the home in which they live. It will be hypothesized that those who live in smaller homes typically will practice more ecological aware behaviors. The methodology involves recruiting adolescents from a local community in suburban New York and surveying them about their Eating Habits, Transportation, Recycling Habits, and Purchasing Habits. The survey will collect demographic information including the square footage of their family home and will require them to calculate their ecological footprint using an online calculator and complete the Ecological Behavior Questionnaire.

Elias MacMillan

Plants May Reveal Where a Corpse is Buried: How the Stages of Decomposition of Pork Affect the Growth Rate of Papaver Somniferum

Many murder mysteries go cold, meaning that the case has been opened and unsolved for at least 3 years. This can happen for a multitude of reasons: a lack of evidence, strained resources, and ineffective investigation. Another reason could be that the body was too well hidden underground, and the body parts were dismembered and buried in the earth. Forensic botany uses plants as evidence to reconstruct a crime. Cholewaa *et al.* (2022) found that decomposed pig limbs increased growth, number of flowers, number of leaves, and the width of the leaves of *Begonia semperflores*. However, few known studies have looked at how bodies in different stages of decomposition affect the growth rate of plants. Therefore, the purpose of this study will be to determine the relationship between decomposed pork at various stages and the growth rate of poppies. Pork was chosen because it is the closest meat that is similar to humans. It will be hypothesized that the pork in the Fermentation stage (approximately 20-30 post death)will increase the growth rate of poppies the fastest because the nutrients in the pork will be absorbed into the soil faster, therefore reaching the plant's roots faster. The methodology involves burying pork at the different stages of decomposition 20 cm beneath germinated poppy plants of the same age. After 90 days, the height, number of flowers and the number and width of the leaves on each plant will be recorded.

Martina Marcinkevicius

Correlation Between Mental Health and Oral Hygiene: Implications for Future Pathology

Oral hygiene can be defined as the practice of keeping one's oral cavity clean and free of disease. People of low socioeconomic status may prioritize spending money on household bills and therefore may neglect their dental health because it is an added expense. In addition, Greats (2022) found that in a high income country adolescents were less likely to brush their teeth if they reported higher levels of stress and more physiological health complaints. However, it is unclear if this trend holds true in a more economically diverse country like the United States. Therefore the purpose of this study will be to determine whether an individual's affluence and mental wellbeing correlate with an individual's oral hygiene. It is hypothesized that students with a low family affluence are more likely to report poor mental wellbeing and to brush their teeth less often.The methodology involves surveying high school students with measures that includes: The Family Affluence Scale, The Warwick–Edinburgh Mental Wellbeing Scale, and an original Oral Hygiene Survey. It is expected that adolescents that report higher family affluence and a more stable mental well being will report consistent high levels of oral hygiene. These correlations are important to understand because they may have implications for development of future pathologies.

Adriana Marraccini

The Relationship between the Diversity of the Skin Microbiome and the Development of Atopic Dermatitis in High School Athletes

Atopic Dermatitis (AD) is a skin disease that causes dry, itchy, and inflamed skin. In athletes, atopic dermatitis can be exacerbated in the places where skin touches equipment but it is unclear why. Kim & Kim (2019) found that microbial communities that live on the tissue surface and the appendages, such as the sweat glands and hair follicles, differ in composition. The more diverse the microflora the less likely an individual was to develop AD, while the less diverse in the microbiome of the skin, the more likely AD would develop. The purpose of this study will be to determine whether there is a change in bacteria in the skin microbiome at the locations where sporting equipment touches the skin that could potentially result in the development of AD. The hypothesis will be that less diversity in the skin microbiome will lead to the growth of AD. The methodology will entail taking swabs of high school student-athletes from before and after they practice in places where sporting equipment touches the skin. In addition, the material of the equipment will be noted. Bray Curtis models will be constructed to examine the diversity of the skin microflora. It is expected that less diversity in the skin microbiome will be correlated with students who report that they often develop skin rashes in places where equipment touches the skin.

Heidi Monke

Determining the Extent to Which Lutein Has a Neuroprotective Effect on Alzheimer's Model *Drosophila melanogaster*: A Dose Response Study

According to the Alzheimer's Association, Alzheimer's Disease (AD) affects over 6.7 million Americans over the age of 65. The prognosis of AD is low with little success rate in treatment. Lutein is a carotenoid that is a naturally potent antioxidant and has been associated with neuroprotective effects, yet has only been studied within observational studies. The imbalance between the production of reactive oxygen species and antioxidant mechanisms causes a form of metabolic stress referred to as oxidative stress. Free radicals which are unstable atoms damage the mitochondria causing the production of toxic amyloid beta in AD. Consuming antioxidants like lutein through supplementation, can reduce damage caused by ROS and mitigate oxidative DNA damage, lessening AD-associated effects. This study will explore the effects of lutein on the validated AD model transgenic *Drosophila melanogaster* using a GAL4-UAS system expressing the human "Arctic" Aβ42 mutation to determine if lutein decreases AD-associated effects. A dose-response study will be conducted to determine if lutein improves neurological function in the AD model flies. It will be hypothesized that as the concentration of lutein increases, the Arctic flies will experience longer lifespans and improved neurological function as measured through a negative geotaxis assay.

Elizabeth Nicaj

The Effect of Hallucinogenic Episodes on the Amount of White Matter in Schizophrenic Patients' Brains

Schizophrenia is a chronic and severe brain disorder that interferes with a person's ability to think clearly, manage emotions, make decisions, and relate to others. White matter in the brain is a part of the brain that contains nerve fibers that help connect neurons in the brain and helps with problem-solving, focus, and it plays an important role in mood, walking, and balance. Schizophrenic patients often have a small reduction of white matter in their brains, leading to psychosis and symptoms similar to psychosis such as hallucinations and episodes of hallucinations. Hallucinations are the false perception of objects or events involving one of your five senses. The purpose of this study will be to determine how the number of hallucinations a patient experiences impacts the deterioration of white matter in their brain. Patients with schizophrenia often experience vivid hallucinations that can most commonly be auditory, and visual hallucinations of denatured people, unidentifiable objects, religious figures, animals, parts of bodies, and or other things. With that comes reactions of fear, pleasure, and or indifference. The hypothesis will be that schizophrenic patients who experience more visual episodes will have less white matter than those who experience fewer visual episodes. The methodology will entail using the Schizconnect database to quantify how white matter in the brains of schizophrenic patients will change over time, and whether it correlates with the number of hallucination episodes (total, visual, auditory). It is expected that with more visual hallucinations, white matter deterioration in schizophrenia patients' brains will increase.

Mariana Orozco Lopez

How A Parent's Intuition Influences
Their Child's Access to Mental Health Services

Millions of adolescents struggle with mental health. One of the most effective ways to handle mental health problems is by seeking help, however, for some students it is harder to access mental health services than others. For many teenagers, their high school offers mental health centers so they can seek the help they need. But, even though they have access to it, their parents' intuition, or their ideas or their beliefs, can impact adolescents' decisions whether they are able to get the help they need or not. A study conducted by the Ethical Guidelines of the German Association of Psychologists (DGPs) and the American Psychological Association (APA), researched how decisions about whether or not parents allowed their children or themselves to get the COVID 19 vaccines were made based on their intuition or feelings. Mostly these feelings are influenced by political, religious, or educational ideology. Similarly, the purpose of this study will be to show how a student's access to mental health is influenced by the parent's intuition about mental health.

Yaseen Osman

Comparing AI and Human Denoising Capabilities
to Improve Artificial Sound Systems to Treat Auditory Deficits

According to the WHO, by 2050 almost 2.5 billion people will have a degree of hearing loss, and right now over 1 billion young adults are at risk of permanent hearing loss. However, there is a technology to assist people who have severe hearing, the 'Cochlear Implant'. It works by bypassing the damaged part of the ear and sending nerve signals straight to the brain. Nonetheless, the quality of Cochlear implants are not the same as normal hearing. Individuals still report muffled hearing and trouble identifying certain noises. Deep Neural Networks (DNNs), at type of Artificial Intelligence (A.I.) model may be used to solve this problem. The issue with Cochlear Implants is that the electrodes implanted in the ear that process the sound can only be tuned to a specific frequency range and there are at most 22 of them. The human ear has thousands of hair cells that are also tuned to a frequency range but because there are thousands of them processing sound. DNNs can solve this problem by listening to the incoming noise, identifying what the frequency range of the noise is, then tuning the electrodes in the ear to favor this range of frequencies. Few known studies have studied the capabilities of DNNs tuning the frequency bands of electrodes in cochlear implants based off the noise environment in real time. To test if DNNs are capable of achieving this a simple cochlear implant will be created and a DNN model will be deployed to test if it can change the frequency ranges of the electrodes in real time depending on the incoming noise. It is hypothesized that the DNN model will do well but will struggle when in an area with a lot of sound texture.

William Pflieger

Growing *Brassica rapa* in Ratios of MGS-1 & Alfalfa Meal to Develop a Model In-situ Resource Utilization System to Create a Self-sustaining Food Source & Reduce Launch Cost for Mars

One of the major challenges faced in human missions to Mars is providing livable amounts of food for astronauts. Due to the low nutrient content of Martian regolith, it is currently not feasible to propagate crops on Mars. Kasiviswanathan (2022) used alfalfa to enrich nutrient deficient soil made from Natural basalt-type volcanic rocks. Alfalfa was chosen because it has been supported as an efficient biofertilizer. In addition, alfalfa is incredibly lightweight, with a density of only 128 to 224 kg/m3. It could be brought to Mars in its seed form and planted in the regolith. And, once grown, the alfalfa increases the concentration of organic nitrogen in the soil, which allows for nitrogen based crops such as turnips. to thrive further. No known studies have attempted to use alfalfa as a biofertilizer in Martian Growth Simulant (MGS-1), the most accurate martian soil simulant to date.Therefore, the purpose of this study will be to conduct a dose response study where varying amounts of alfalfa will be added to MGS1, in order to grow turnips (*Brassica rapa)*. It will be hypothesized that a threshold will exist where the ratio of alfalfa to MGS1 will be sufficient to support the germination and growth of turnip seeds.

Reese Potash

Determining Whether Academic Performance is a Mediator Between Adverse Childhood Experiences (ACEs) and Juvenile Delinquency

High school dropouts are three and one-half times more likely than high school graduates to be arrested, and eight times as likely to juvenile delinquents. Juvenile delinquency is when an individual under the age of 16 commits an action that would be deemed a "crime" if they were an adult, and is in need of treatment or confinement. Adverse childhood experiences (ACEs), such as childhood trauma or sexual abuse, have been found to have a substantial impact on the rate of juvenile offending. Fox et al (2014) found that 90% of juvenile offenders in the U.S. experience some sort of traumatic event in childhood. The purpose of this study will be to determine if academic performance will mediate the relationship between adverse childhood experiences and juvenile offending, meaning that it will explain the relationship between the independent variable (ACEs) and the dependent variable (offending). The methodology involves analyzing data collected by the Inter-university Consortium for Political and Social Research site. Further research will identify other mediators for ACEs and juvenile delinquency, and their effect on modern society, as well as explore how academic learning can be tailored to benefit students who struggle with ACEs.

Samantha Ramirez

To Detect and Quantify the Expression of Urocortin3 During Incidents of Infant-directed Aggression in Males and Females

There are several factors that influence parents' behavior toward their children. Some parents neglect or attack young animals from their same species in stressful environments. Additionally, parents may leave their children when facing stressful situations, such as food shortages. Stress plays a major role in determining how males and females interact with their infants. In 2021, Autry *et al.* found that the gene Urocortin3 is known to be expressed exclusively during infant-directed aggression in males and females. This study aims to detect and quantify the expression of this gene in a population of neurons known to express Urocortin3, which is known to regulate adult-infant behaviors. The neurons that expressed this gene are in the hypothalamic perifornical area. Through qPCR, genes, such as Urocortin, can be expressed and magnified. DNA must first be extracted, and then an RNA strand is separated; qPCR will then begin to quantify the gene with the mice and determine when it's most prominent. If male or female parent mice are put into a high-stress or alarming environment, they will respond in harsh manners, specifically towards their children and Urocortin3 will be expressed in abundance.

Massimo Reali

Using Drug Delivery Systems for Colon Cancer to Evaluate the Effectiveness of PLGA-PEG based Nanoparticles Loaded with Oxaliplatin on the Cytotoxicity of HCT-116 Cell Lines

Colorectal cancers start as a growth on the inner lining of the colon or rectum and according to the American Cancer society, affect approximately 1.1 million people annually. Nanocarriers are small agents that can contribute to efficient and effective drug delivery since they are used to deliver medicine without damaging healthy tissue surrounding the tumor. Pegylated-PLGA based nanoparticles are nanocarriers made up of the polymer, polylactide-co-glycolide, which encapsulates both hydrophilic and hydrophobic drugs. When delivered intravenously and decorated with folic acid, therapeutic effects are enhanced in platinum based drugs. The drug chosen to be loaded is oxaliplatin, a platinum based hydrophobic drug that has high selectivity and cytotoxicity of cancer cells. The purpose of this experiment is to construct Pegylated PLGA based nanoparticles with decorated folic acid to make intravenous delivery more efficient and minimize side effects with loaded oxaliplatin in HCT116 cell lines. The highest concentrated nanocarrier will be the most specified, allowing for the selectivity of nanoparticles at the targeted area with also the highest cytotoxicity rate at tumor cells limiting tumor growth. The methodology involves constructing the nanoparticle by creating a PLGA-PEG nanoparticle and placing the oxaliplatin in an aqueous solvent through double-emulsion methods to load the carrier. Folic acid is then decorated on the surface of the carrier to limit side effects and slow tumor growth. An MTT Assay will then be conducted to measure the cytotoxic effects of a therapeutic agent. It is expected that the more concentrated the PLGA-PEG based nanocarrier is, the higher cytotoxic and selective the target area of the tumor will be. This will be further evaluated through a competition assay to measure the binding between a ligand and a protein.

Siobhan Rice

Factors that Contribute to the Decline of Eelgrass Beds in the Long Island Sound

Climate change, which exacerbates water pollution and shifts temperature in various North American water systems, has contributed to the decline of eelgrass beds. These beds provide clean water, shelters and hiding places for various aquatic species, take in excess carbon to reduce the effect of climate change, and weaken wave energy to protect coastlines. Previous studies have looked into the effects of the changing climate on eelgrass beds, and have discovered their sensitivity to various differences in their environments, including water temperature and CO_2 concentration. The purpose of this study will be to investigate, at a local level, what factors in the water are causing the decline of eelgrass beds and how the removal of these factors can allow beds to naturally recover. The hypothesis will be that nitrates and nitrites in local waters will cause the most harm to eelgrass beds. The methodology will entail the collection of water samples from areas with a high density of eelgrass beds. The condition of the eelgrass beds in areas of collection will be noted; the water will be tested for certain contaminants like mercury, lead, nitrates, and nitrates, and pH, temperature, and salinity. In the laboratory, eelgrass will be planted in different terrariums, with each one containing artificial seawater with a high concentration of a contaminant. Other eelgrass plants will be grown in a terrarium with clean, non-contaminated water, Eelgrass samples will be compared to determine their responses and survivability rates. Then, plants will be moved to a tank without the contaminant to determine the recovery rate of the sample. Based on previous studies nitrates and nitrites will damage eelgrass samples most severely.

Callum Robertson

Determining if Sexism Affects the Difference in Societal Views and Treatment of Transgender Women Versus Transgender Men

Roughly 5% of young adults in America say their gender is different from the one they were assigned at birth. Despite being a small portion of the United States population, a record 423 bills have been passed in 2023 alone that target LGBTQ rights regarding healthcare, education, and the freedom to express themselves. Additionally, more than two-thirds of the healthcare-related bills regarding LGBTQ rights have been to prevent trans youth from receiving gender-affirming care. In recent years, laws like these are becoming more frequent . A misconception the public has is that transwomen could just be predatory men trying to get into women's bathrooms. The purpose of the study is to determine whether people's opinions of transgender individuals differ between transgender men and transgender women, and if so, assess the part that sexism or misogyny plays in these opinions. The hypothesis will be that overall there will be a more negative reaction to transwomen rather than transmen from cis-gendered individuals. High school-aged students from suburban New York will be surveyed about topics surrounding transmen and transwomen including hormone therapy, surgeries, and unisex bathrooms. It is expected that cisgender opinions of transgender women will be more negative than transgender men because of deep-rooted misogyny in both men and women.

Patrick Rodier

Use of Wind Energy to Power Direct Air Electrolysis

According to the Environmental and Energy Study Institute, 80% of energy comes from fossil fuels. Fossil fuels, generally coal, oil and gas, have emissions called greenhouse gasses which trap heat in the atmosphere, causing global warming. Hydrogen may represent an ideal form of alternative energy because it emits only water vapor and warm air when burned and therefore is considered zero emissions. While not abundant in its elemental form, it is also found in water and water vapor. Current hydrogen fuel technologies rely on a water source. However, for places with little access to water, it may be possible to obtain water from the air. Direct Air Electrolysis (DAE) absorbs water from the air and outputs pure hydrogen. Current DAE models are powered by solar energy. However, water scarcity exists in areas with little sunlight during certain times of the year. A viable alternative to solar power is wind energy. The purpose of this study will be to construct a DAE that can effectively run using wind powered energy. The hypothesis will be that wind power will be a viable non-solar renewable energy to power DAE. The methodology will entail constructing a DAE, putting it in a temperature and humidity controlled environment with simulated wind, and running it for 48 hours and collecting the hydrogen. It is expected that wind power will be able to produce high purity hydrogen at a similar rate to solar power.

Teddie Stevens

Using Satellite Image Data to Investigate Trends Between the Formation of the Bloom and the Conditions of the Water

In the Long Island Sound, algae rapidly accumulates in water bodies to form algal blooms, which can naturally produce toxins that harm the surrounding marine life and local residents. This event is prompted by an overabundance of nutrients in the water, as well as favorable conditions such as warmer water temperatures. Due to global warming, the expected number of algal blooms are predicted to increase, and expand to other areas that do not commonly foster the formation of algal blooms. For monitoring these blooms, forecasting by satellite and water sampling have emerged as common methods of overseeing the progression of the blooms and identifying influential water conditions. Satellites track algal blooms by their pigment, chlorophyll-a, which is a predominant type of chlorophyll that allows plants to photosynthesize. The satellite operates by detecting ratios of light at numerous wavelengths of the infrared and visible spectrum, which is used in algorithms to calculate chlorophyll concentrations. The purpose of this study will be to determine if there is a correlation between specific water conditions and algal bloom growth while using satellite image data and water sampling. Previous studies have not utilized the Long Island Sound under these circumstances. It is hypothesized that the higher the temperatures of the water, the longer the duration of the bloom will last. The methodology involves obtaining data from monitoring stations near the Long Island Sound, and satellite imagery to observe the continuation of the algal bloom given the circumstances of the water body. Specifically, satellite imagery for the study was derived from NOAA CoastWatch East Coast Node, and data was compiled from Interstate Environmental Commission. This data will be contrasted with an area lacking algal blooms to analyze key influences.

Jordyn Summer

Determining What Senses Are More Responsible For Producing Anxious Behaviors

Social anxiety (SAD or social phobia) is a mental health condition where social interactions cause irrational anxiety (fear increases and it is out of control). According to the Anxiety and Depression Association of America, 31.9% of teenagers struggle with anxiety disorders and 6.8 million adults have anxiety. There are many symptoms of anxiety such as fear of being watched and eye contact avoidance. Therefore, it makes sense that seeing others could be a mechanism responsible for triggering anxiety. Additionally, Mohammad (2016) found that *Drosophila melanogaster* was a valid model for anxiety because within an enclosed arena, flies tend to stay near to the walls during spontaneous locomotion which is a type of behavior connected to anxiety which allows for the study of neuronal and molecular bases of anxiety. The purpose of this experiment is to determine whether vision is a mechanism for producing anxious behaviors in *Drosophila melanogaster.* It is hypothesized that if the fly genome is mutated for vision so that the fly can't see, then the flies will exhibit less anxious behaviors meaning that there will be increased travel away from the walls. The methods involve using a Wall Following Assay to test overcrowded flies mutated for vision so that they cannot see to determine if they are more or less anxious than sighted control flies. Future research will be to test other senses including hearing, taste and smell.

Valeria Torres Reyes

The Relationship between Parenting Style and Academic Achievement in Adolescents

There are four main types of parenting; permissive, neglectful, authoritative, and authoritarian. Each parenting style focuses on two dimensions of parenting, responsiveness and demandingness. According to Hayeck (2022), the microenvironment such as the school and home environment are considered to have the strongest influence on a child's development. Moreover, different parenting styles may promote different attitudes toward the school environment; impacting the aim of getting higher grades. The purpose of this study will be to determine whether a relationship exists between parenting style and the academic performance of the child. It will be hypothesized that an authoritative parenting style will result in the best academic performance because it focuses on high responsiveness and demandingness. The methodology entails collecting demographic information as well as surveying parents using an adapted version of the Parenting Style Questionnaire based on Robinson, C., Mandleco, B., Olsen, S.F., & Hart, C. H. In addition, the survey will ask the parent to provide their child's approximate grade point average and level of academic rigor as determined by the number of AP/IB classes in which the child is engaged. It is expected that authoritative parenting will have the best outcome on the academic performance of the child. This is because this form of parenting promotes high academic rigor as well as enforcing boundaries and taking their child's needs in mind.

Parker Yates

The Effect of Investor Age on Behavioral Biases

When making investment decisions, investors are influenced by biases that can hinder their decisions. Implicit biases can be emotional or cognitive biases such as gender bias or ethnicity bias, and they unconsciously influence an investor's decision-making process. Demographic factors of an investor serve a role in defining their implicit biases. Specifically, age is an important factor that affects implicit biases and the success of investment decisions. The purpose of this study is to explore the correlation between investor age and their implicit biases by examining their funding intentions for entrepreneurs with different demographics. The implicit biases studied will be gender bias, age bias, and racial and ethnicity bias. It is hypothesized that there will be a significant relationship between investor age and their implicit biases with older investors more likely to fund entrepreneurial ventures from caucasian, male and older entrepreneurs. The methodology involves developing Linkedin profiles for entrepreneurs. Slides will be created with two Linkedin profiles side by side, with differences being the demographics of the entrepreneur such as age, gender, nationality and ethnicity. The profiles will be evaluated through a norming process, in which all characteristics will be equal, besides from the intended differences in demographics. Participants of different age groups will function as informal investors, and will view the Linkedin profile slides. Participants will be asked to review each profile and will answer questions regarding their funding intentions. In addition, data will be collected using eye tracking technology to determine which aspects of the Linkedin profiles participants view most frequently or for the longest duration. It is expected that older investors will have greater fixation time on the demographic characteristics of entrepreneurial profiles, meaning that the decision making process of older investors will be more influenced by their implicit biases. Further, older investors will display less explicit biases than younger investors, but will have greater implicit preference for certain entrepreneurs based on common stereotypes.

Congratulations to all our students!
It's been an unforgettable year!

HARRISON HIGH SCHOOL SCIENCE AND TECHNOLOGY SYMPOSIUM

Special Thanks:

The students and faculty of the Harrison Science Research Program thank you for coming to this year's Science Symposium.

We hope you enjoyed the night as much as we enjoyed sharing our work with you!

Questions . . .

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