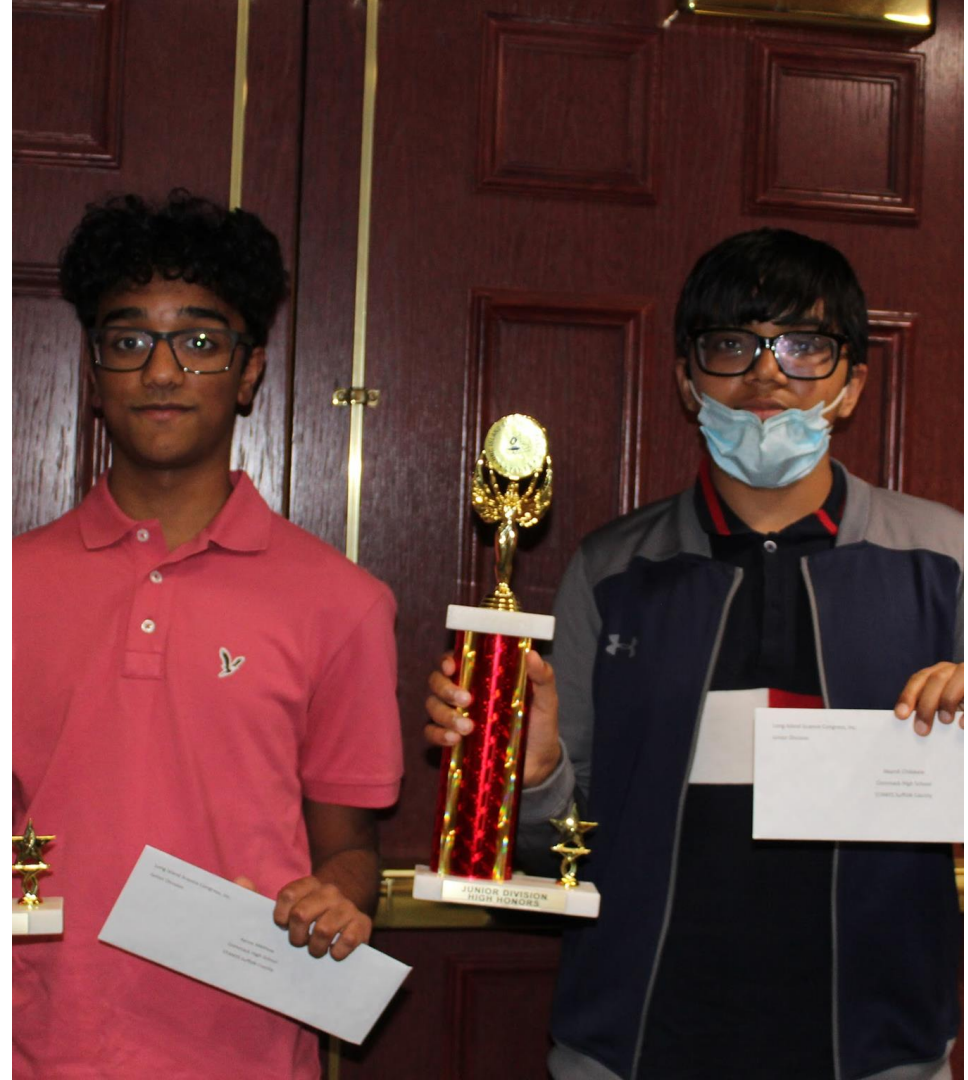


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Research Photos
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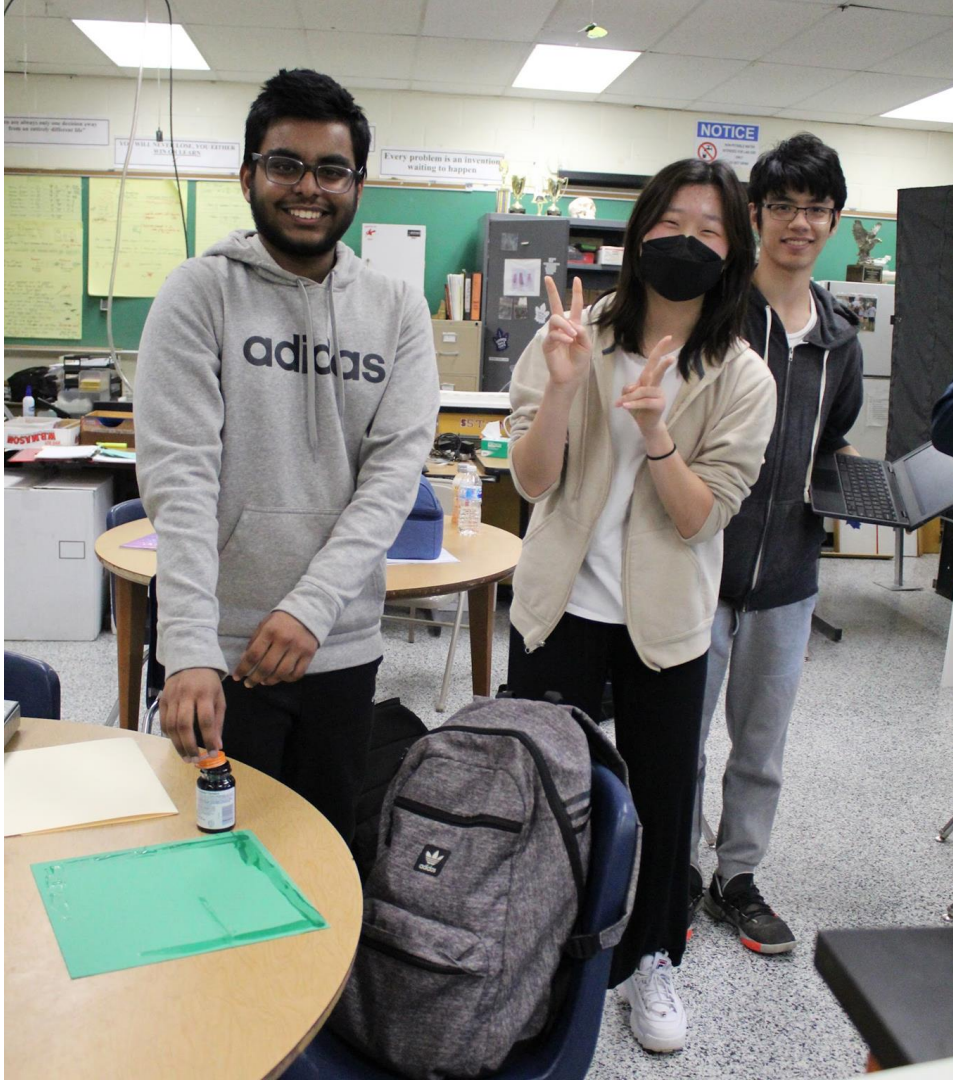






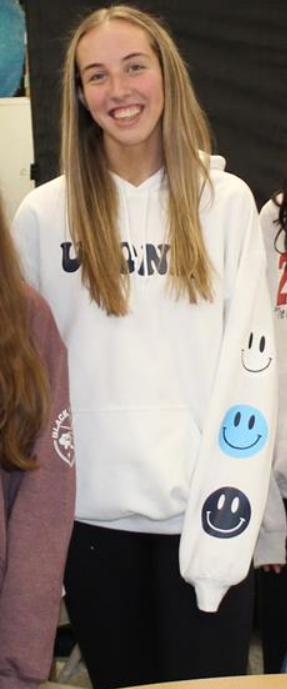
The best way
to predict
the future
is to
create it."
Abraham Lincoln







NOTICE

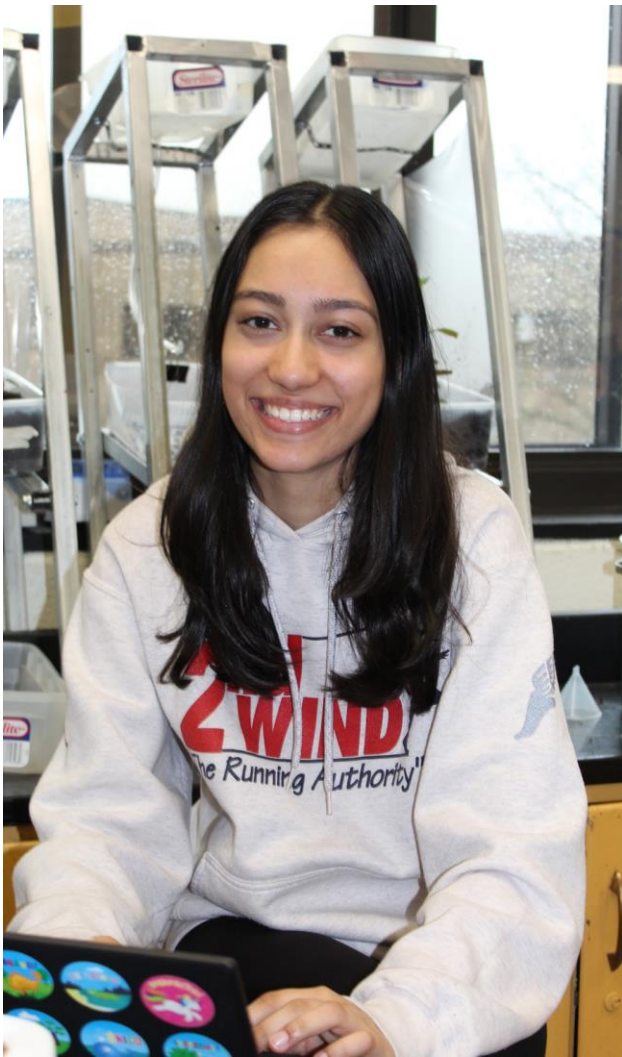


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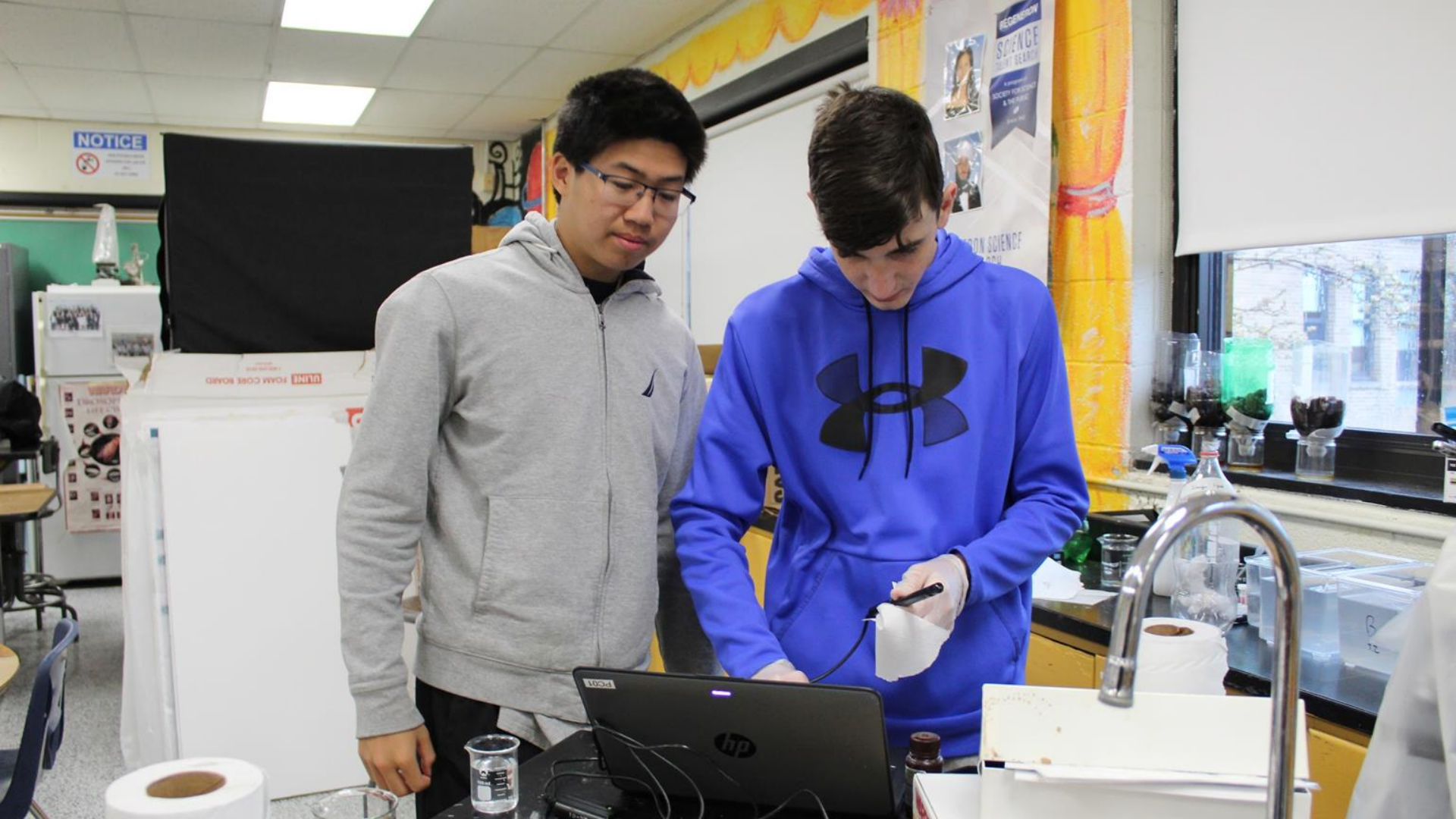






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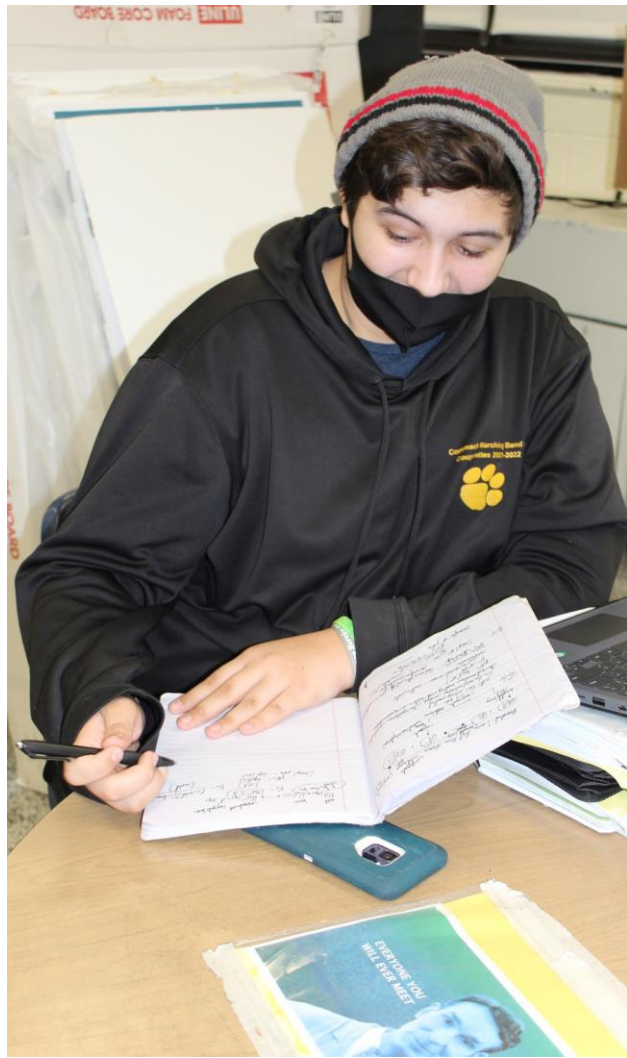
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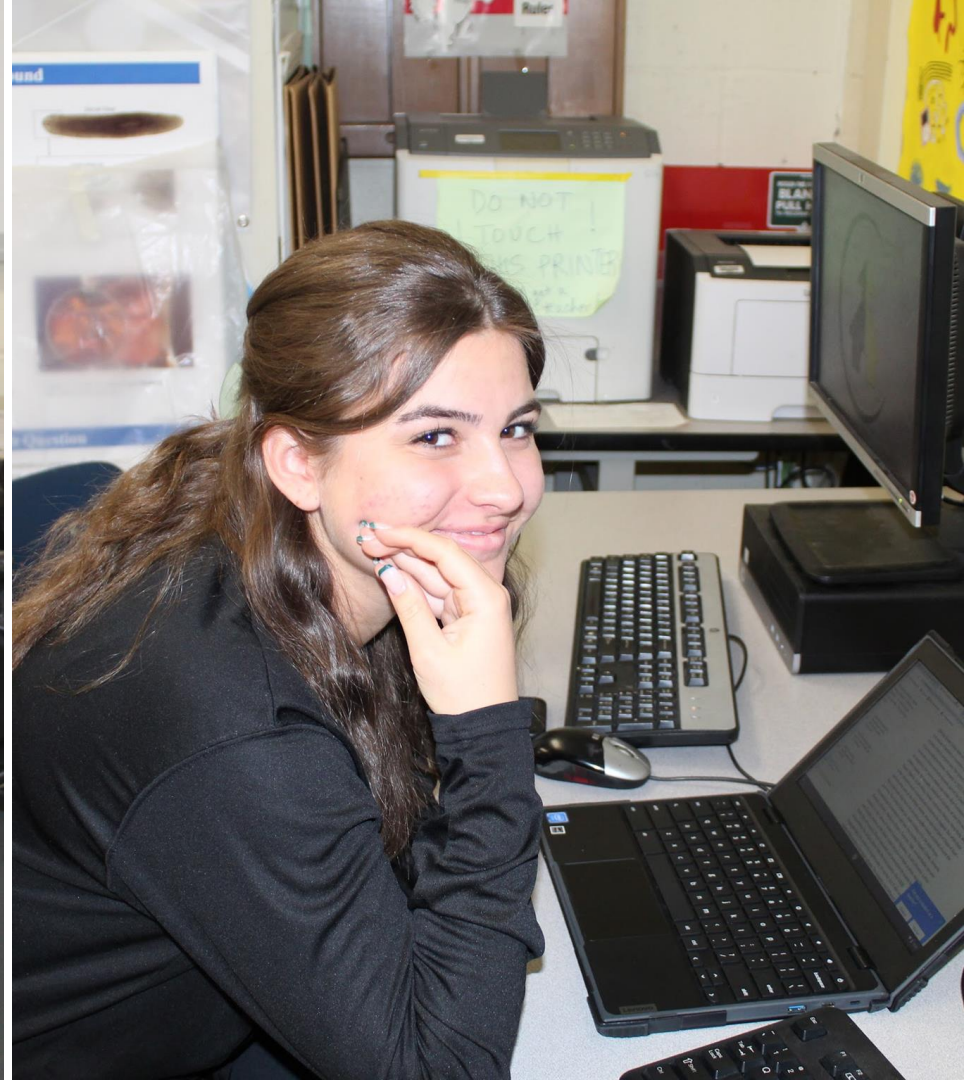
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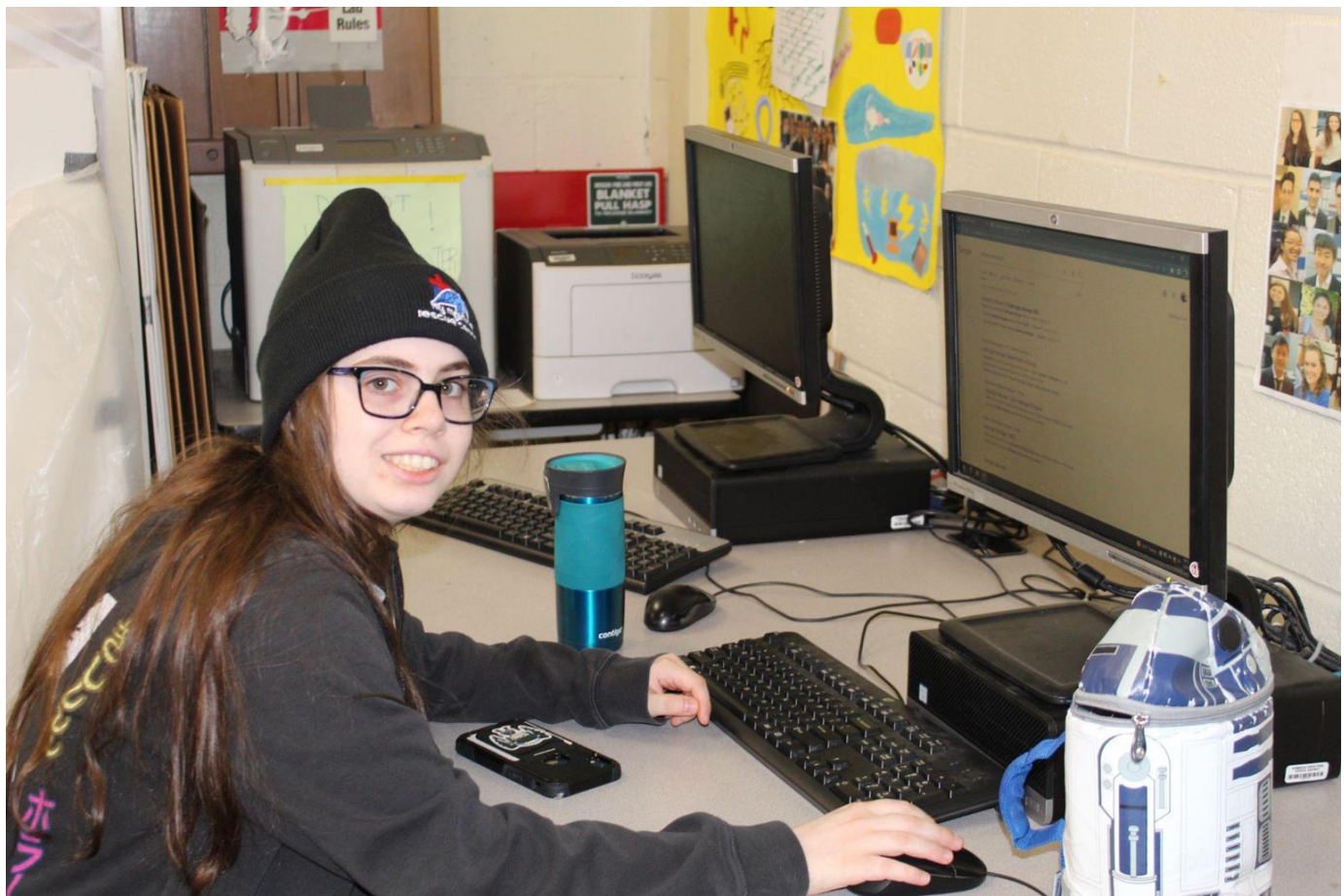
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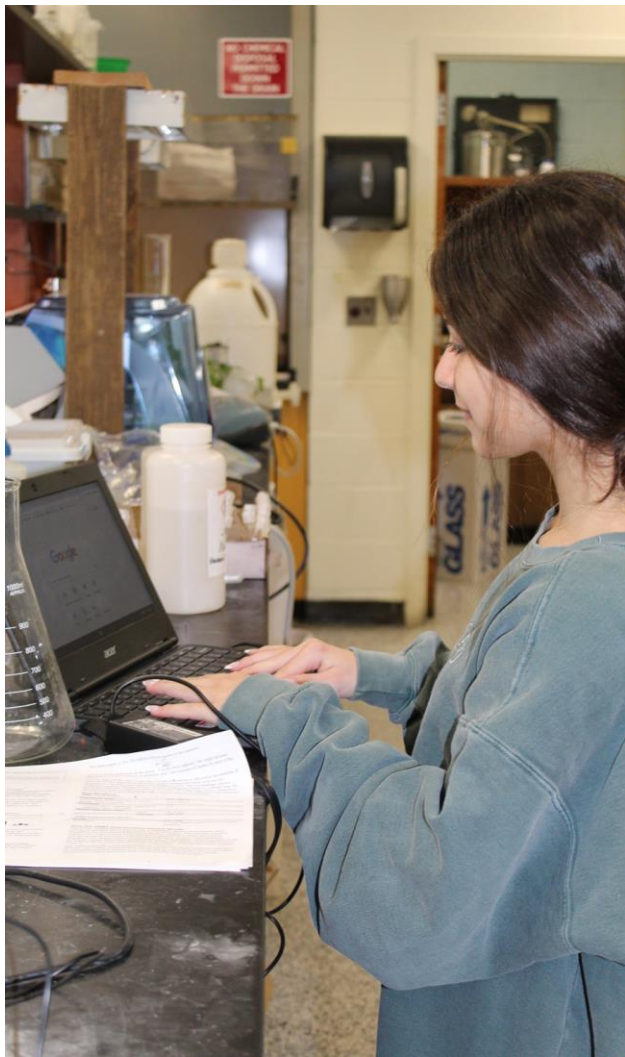






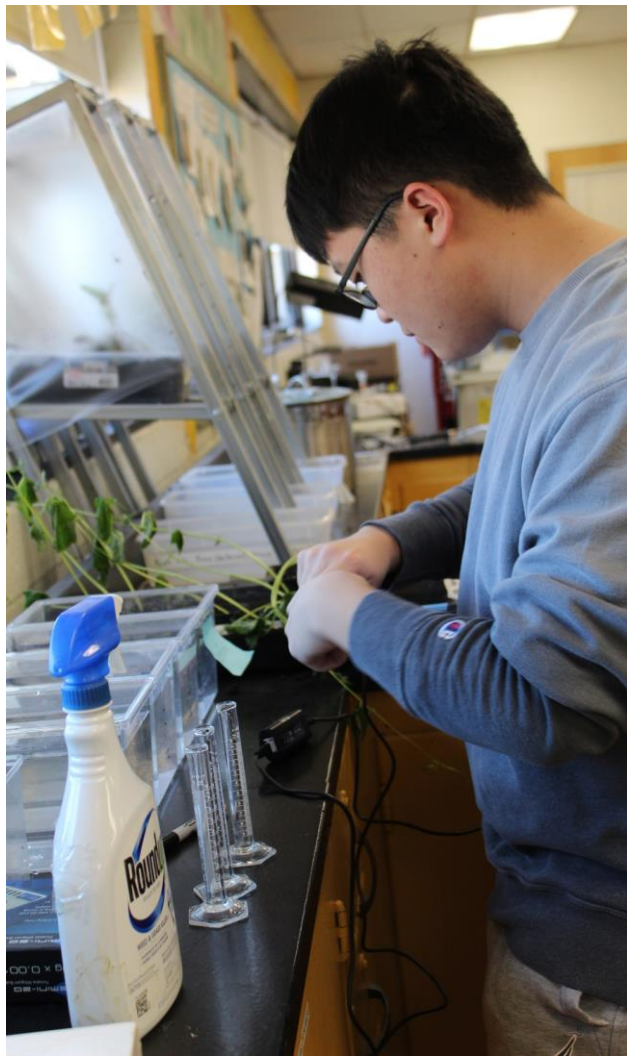


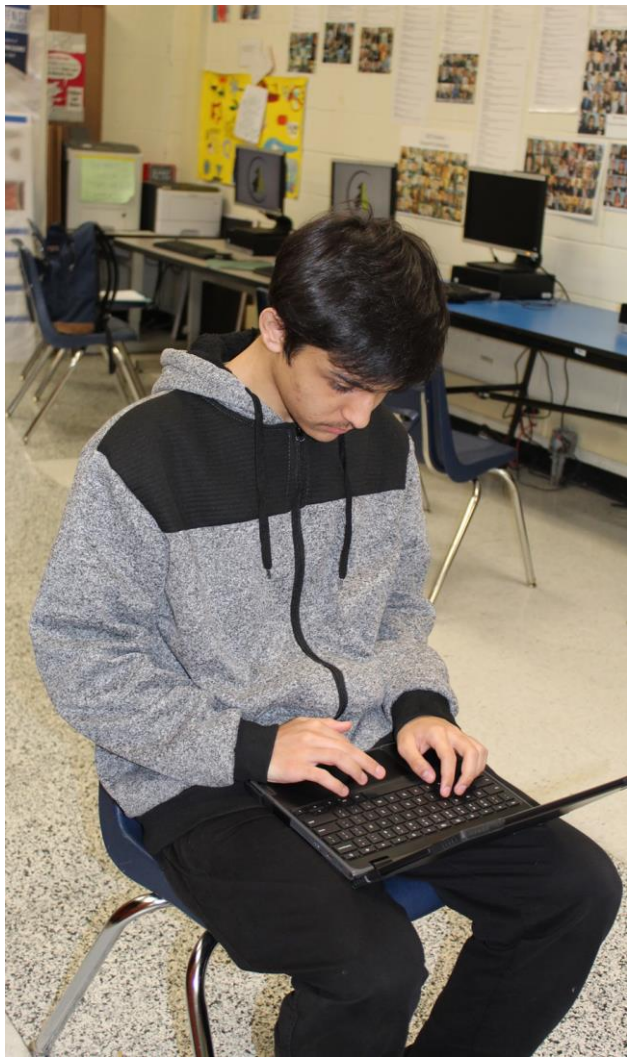


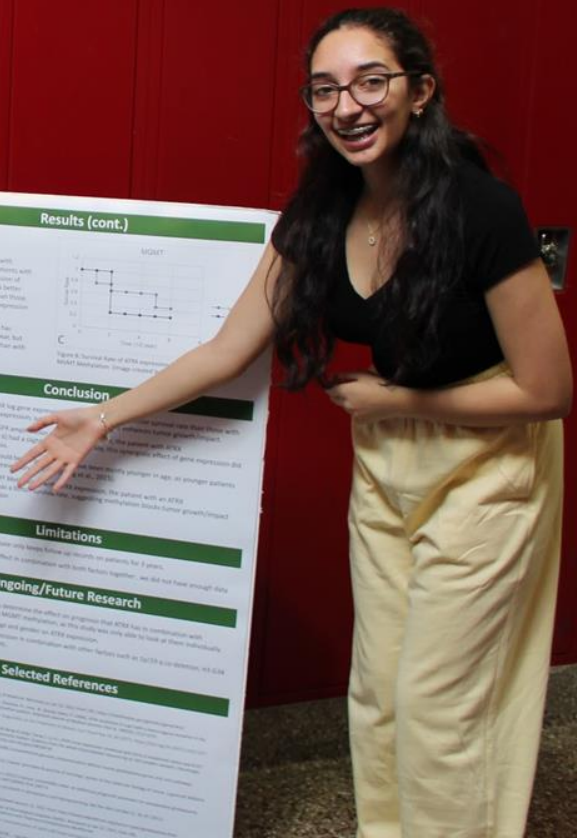
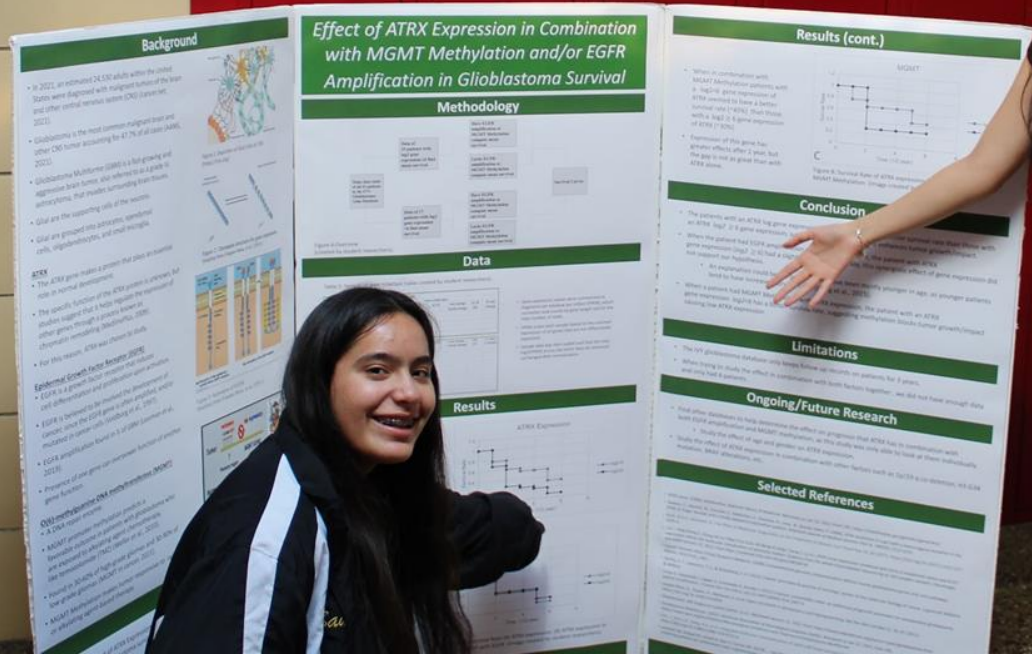


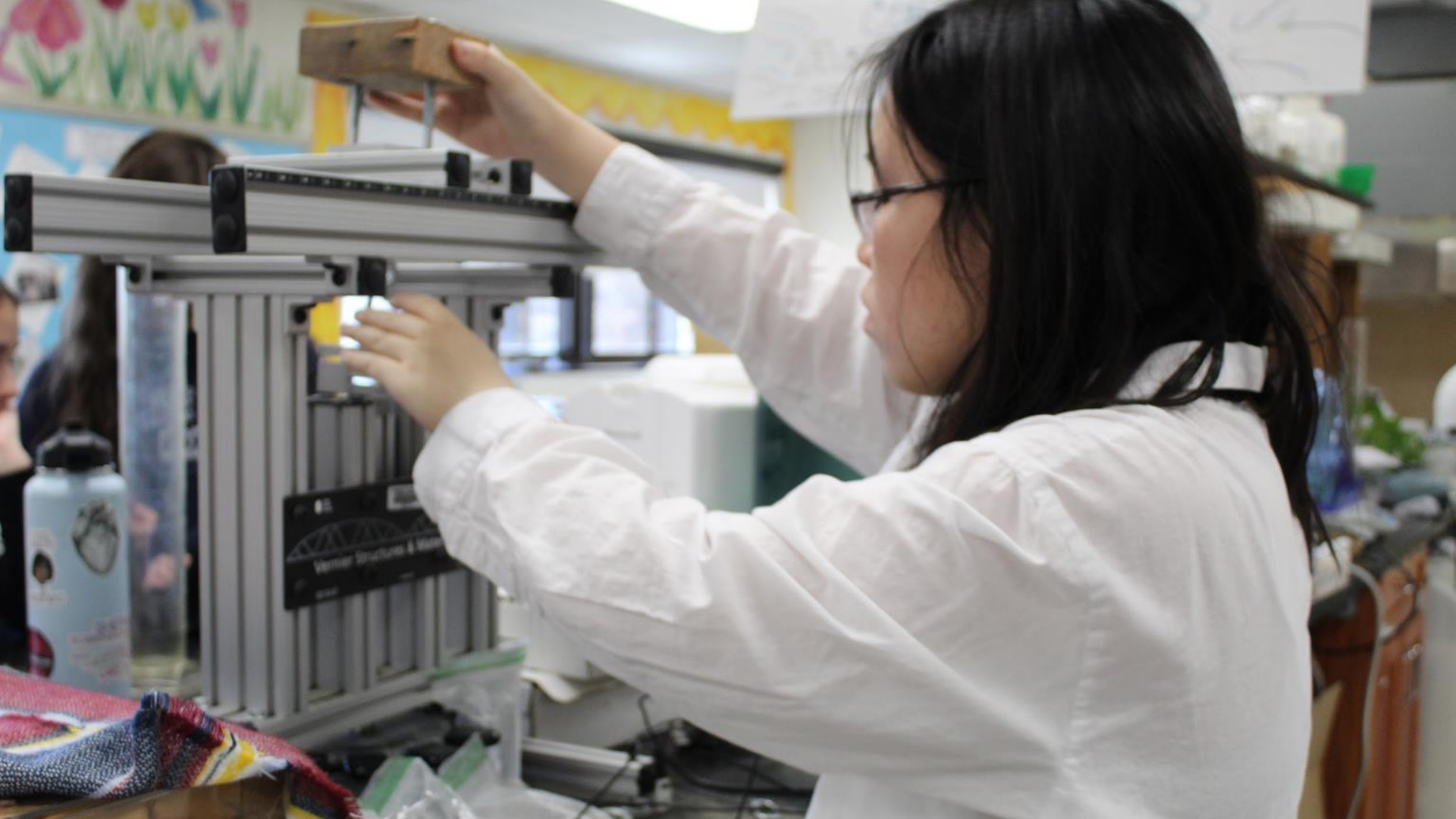
















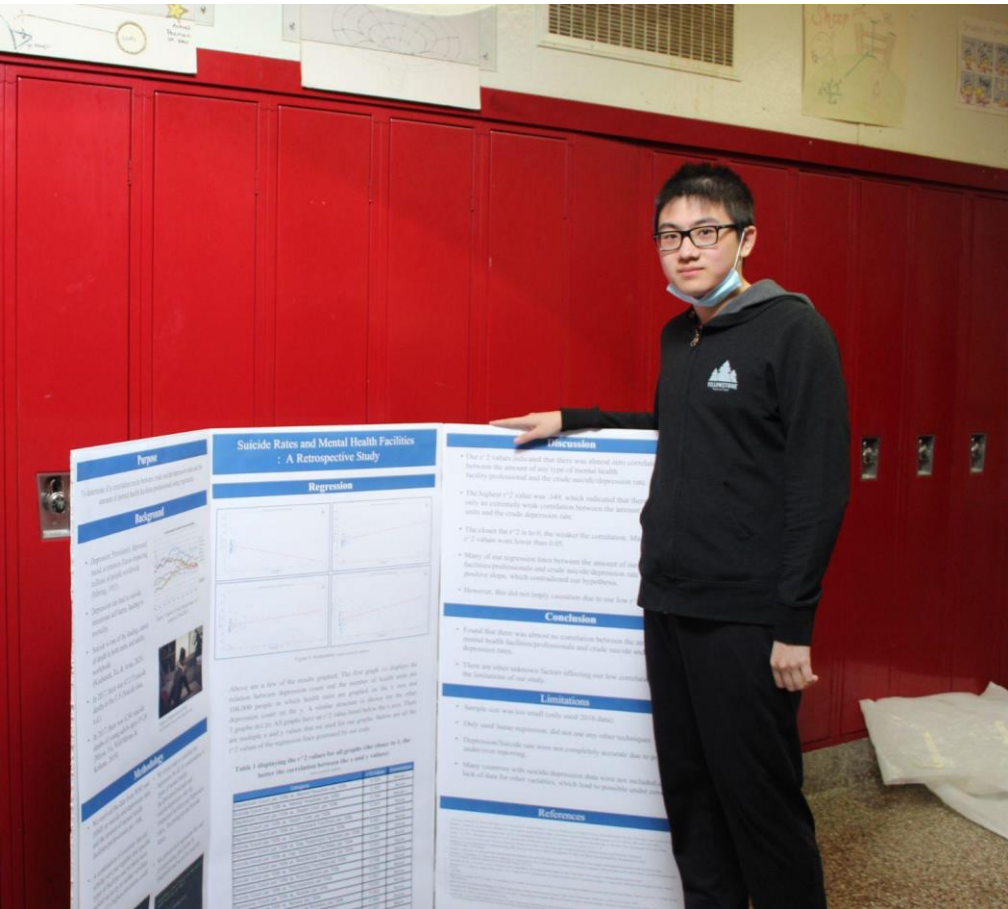




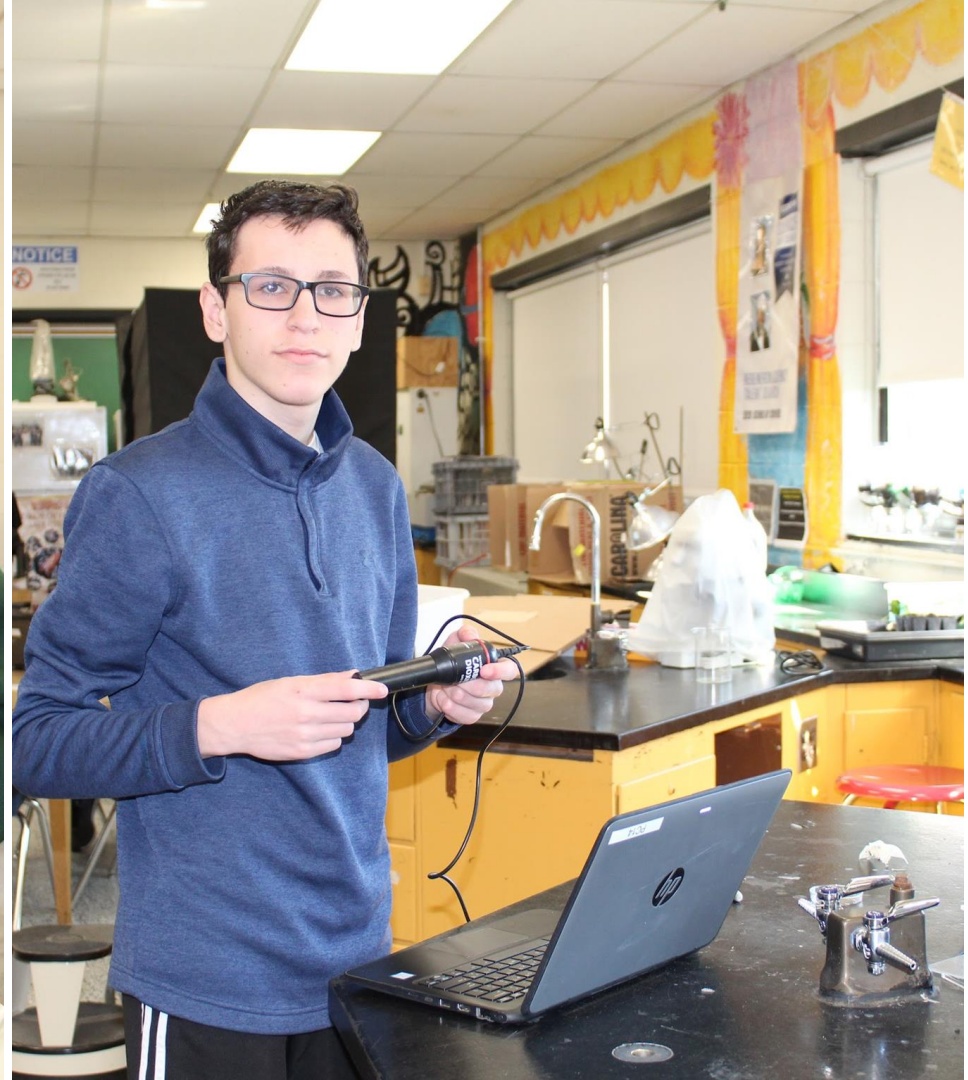










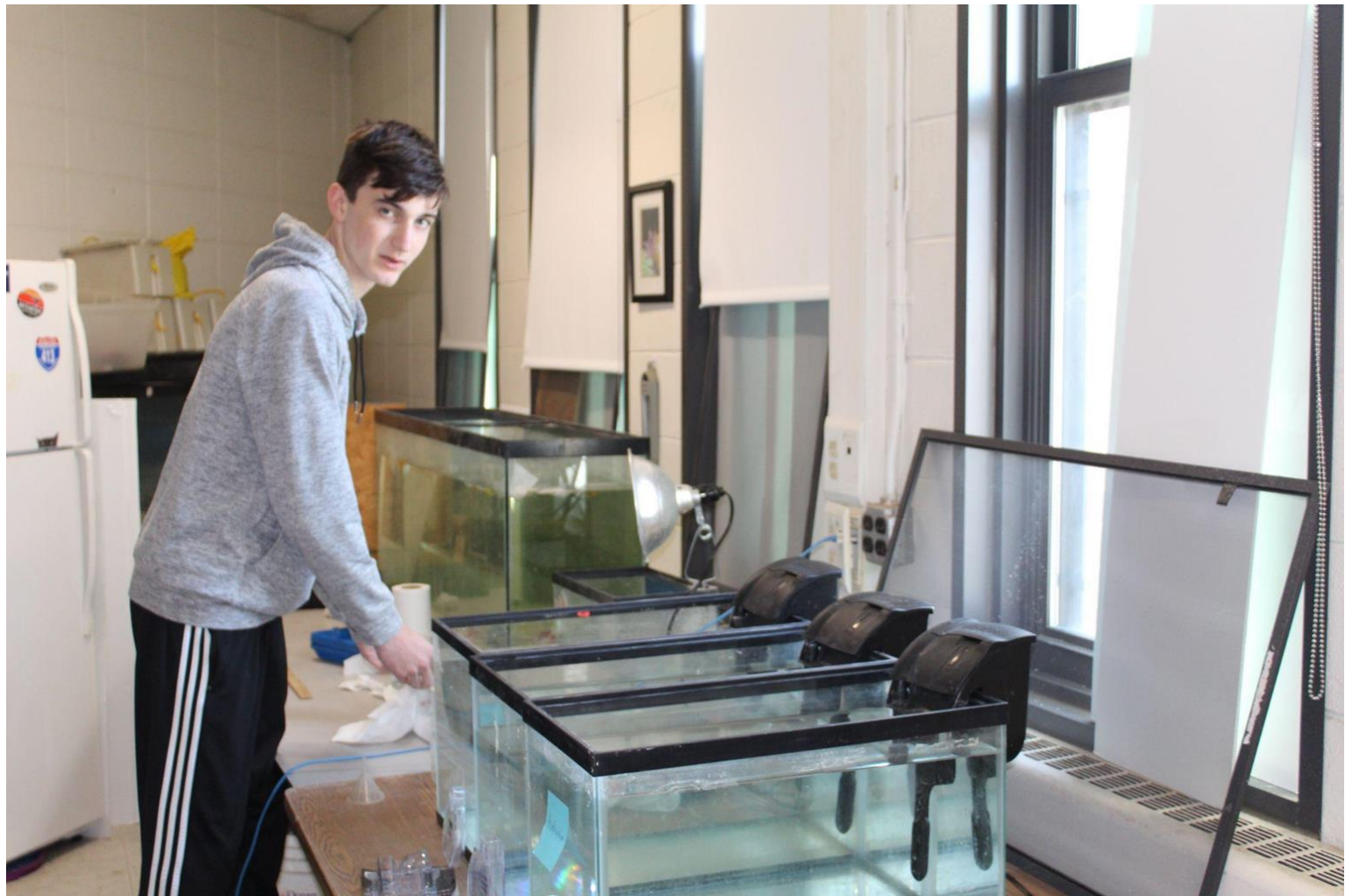




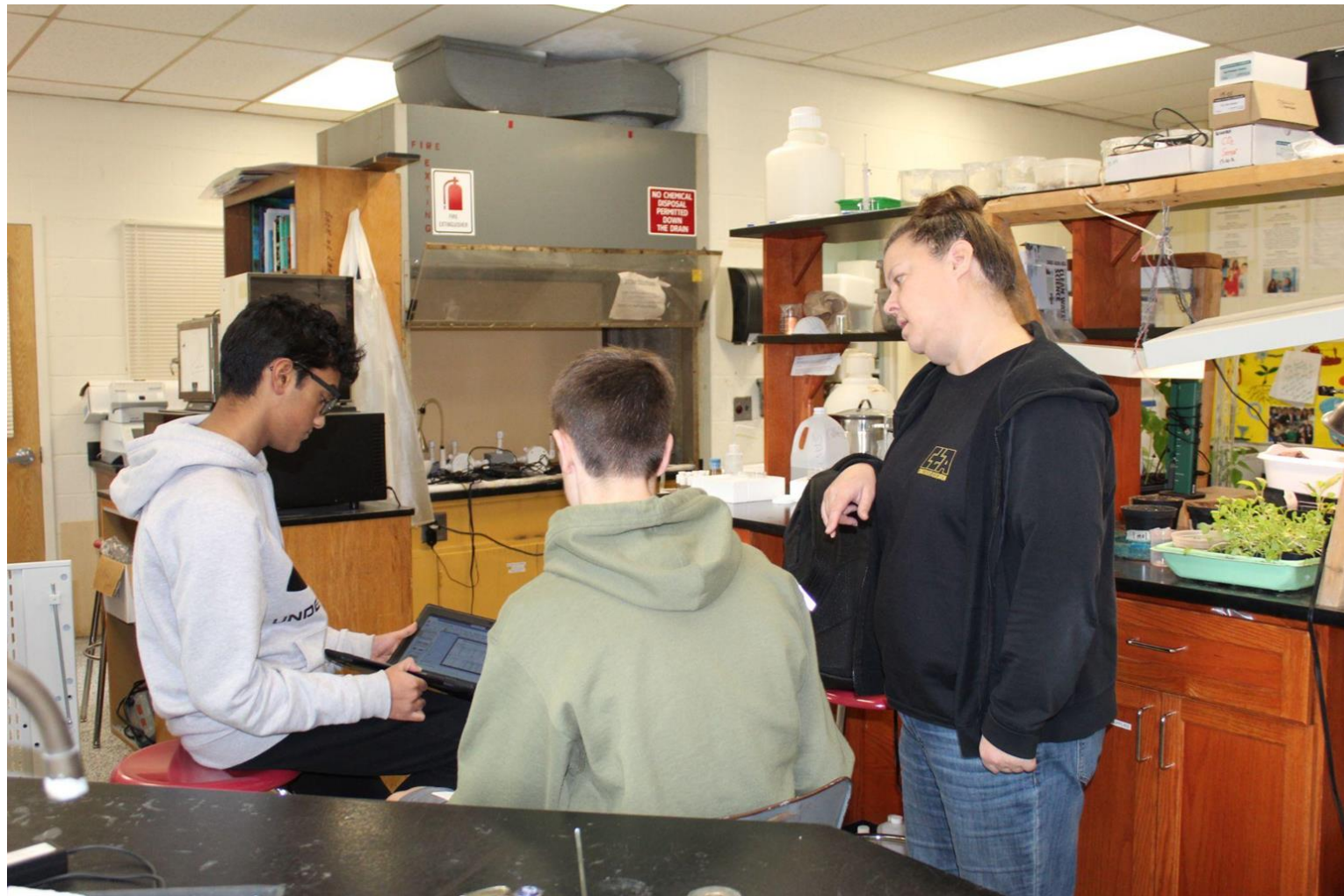
STOCK SOLUTION
Do Not Place an Animal Into Stock
a stock solution is a solution of a substance in a liquid
medium. It is used to dilute a substance into a solution.
NEVER put back into a STOCK

WPI





















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Molloy
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Background

FTL123 is a pathogenic bacterium...
 FTL123 is secreted in a T6C-dependent manner...
 FTL123 is secreted in a T6C-dependent manner...
 FTL123 is secreted in a T6C-dependent manner...

Computational Analysis

FTL123 protein structure and sequence alignment with other FTL proteins.

Purpose

FTL123 is secreted in a T6C-dependent manner...
 FTL123 is secreted in a T6C-dependent manner...
 FTL123 is secreted in a T6C-dependent manner...

Methodology/Data

Genetic constructs and experimental workflow for FTL123 secretion studies.

3-FLAG Construct

Diagram of the 3-FLAG construct used in the study.

Characterizing the Secretion of the *Francisella tularensis* protein FTL_1123

Methods/Data (cont.)

B) Restriction Digestion, Ligation, and Transformation

Restriction digestion and transformation protocol for FTL_1123.

C) Bacterial Lysis Protocol and Western Blot

Bacterial lysis and Western blot analysis of FTL_1123.

2) RTX Experiment

RTX experiment results showing protein secretion.

A) FTL_1123

Western blot analysis of FTL_1123 in various strains.

B) Transformation and Western Blotting

Transformation and Western blotting results for FTL_1123.

Results

Western Blot

1) ToC Experiment Western Blot

2) RTX Experiment Western Blot

Conclusions and Discussion

Future Research

Selected References



Background

Background information on sexual dimorphism and sex hormone receptor expression.

Exploring Sexual Dimorphism and Sex Hormone Receptor Expression in the Bed Nucleus of the Stria Terminalis (BNST) in the Monogamous Prairie Vole

Brain diagrams showing BNST and receptor expression in prairie voles.

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Exploring Sexual Dimorphism and Sex Hormone Receptor Expression in the Bed Nucleus of the Stria Terminalis (BNST) in the Monogamous Prairie Vole

Results and Discussion (cont.)

III. In Situ Hybridization for Androgen Receptors P14 Sample

Brain diagrams showing androgen receptor expression in BNST.

Figure 6

Figure 7

Figure 8

Figure 9

Figure 10

Figure 11

Figure 12

Figure 13

Figure 14

Figure 15



Results and Discussion (cont.)

III. In Situ Hybridization for Estrogen Receptors P14 Sample

Brain diagrams showing estrogen receptor expression in BNST.

Figure 16

Figure 17

Figure 18

Figure 19

Figure 20

Figure 21

Figure 22

Figure 23

Figure 24

Figure 25

Conclusions

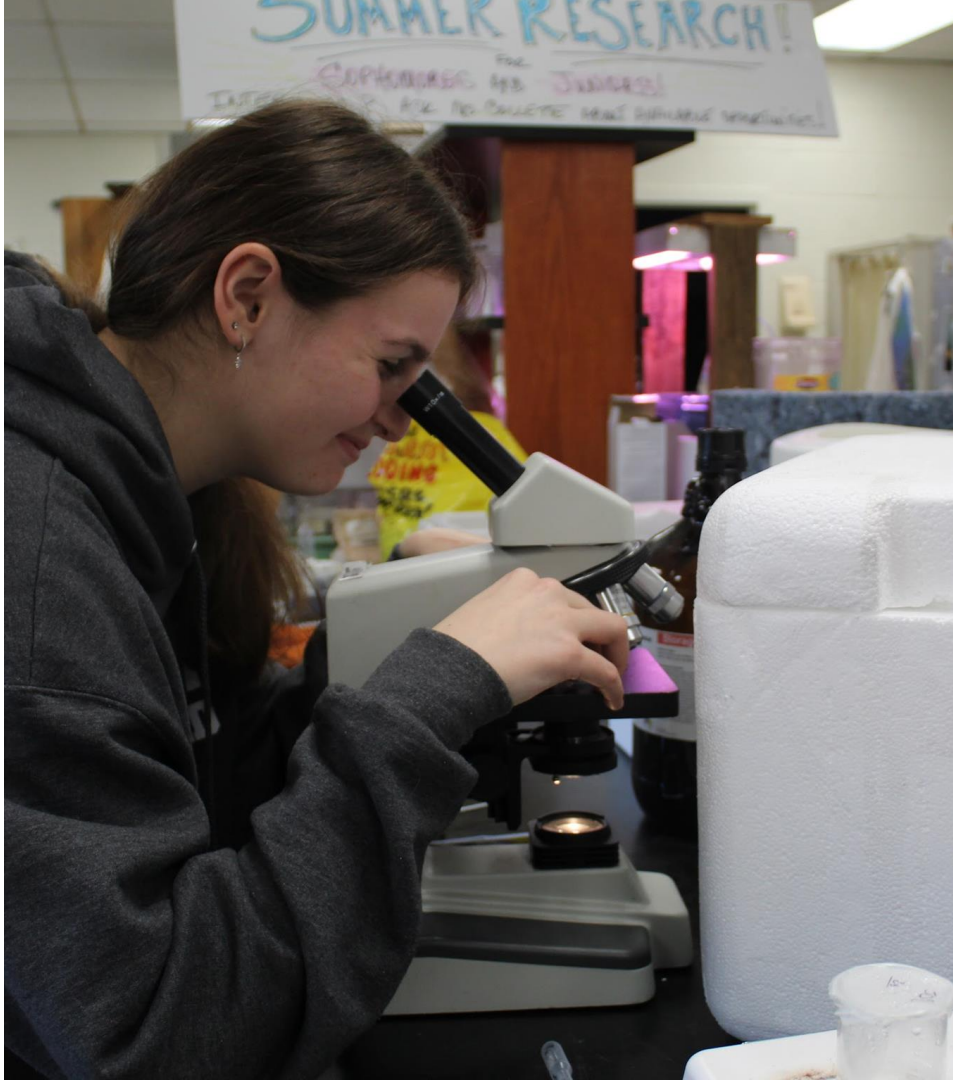
Future Work

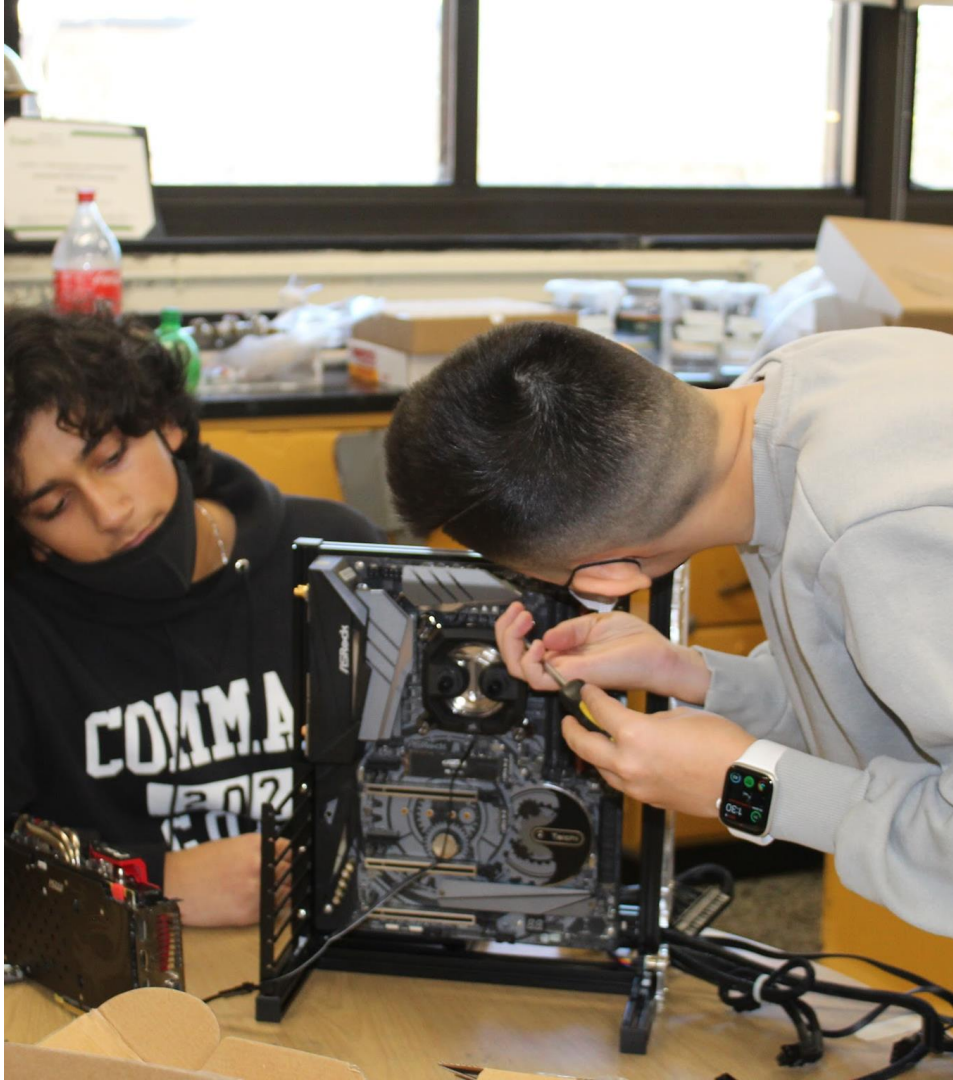
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RESEARCH

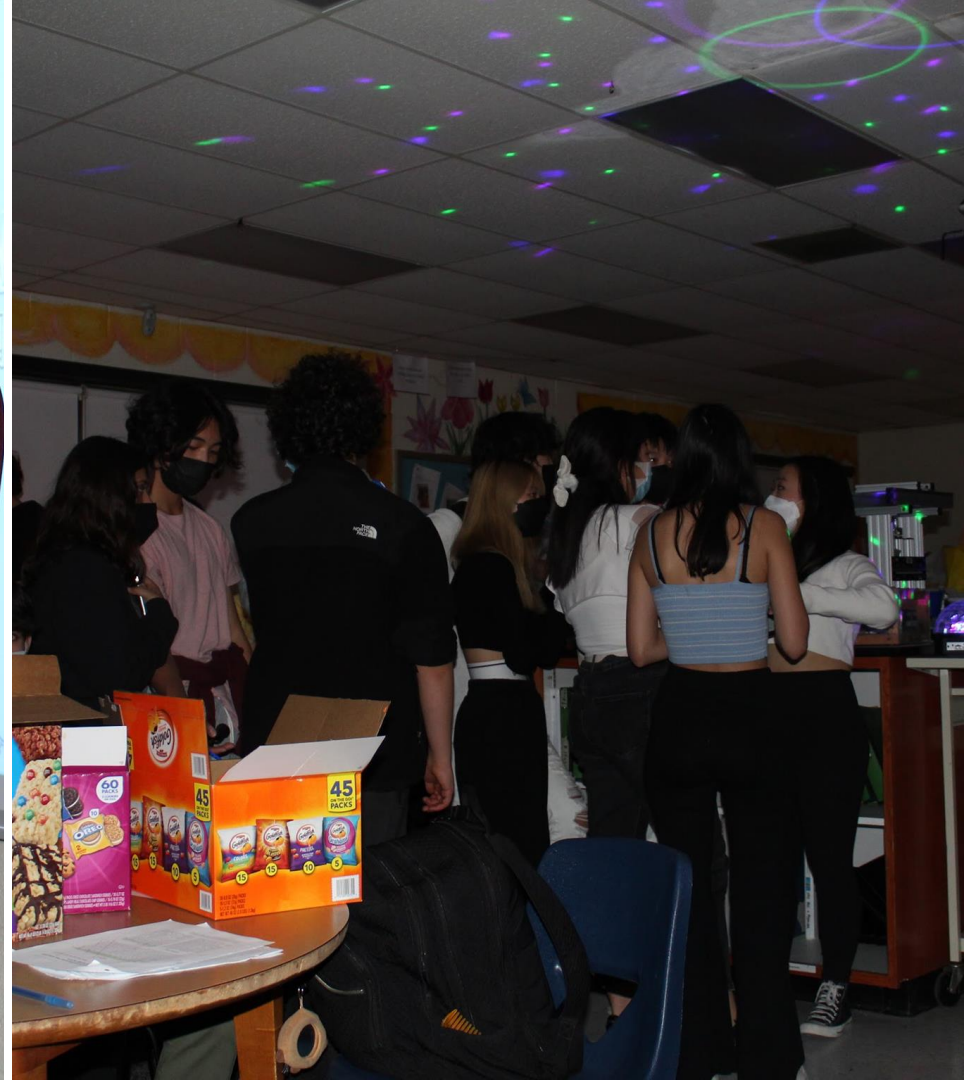
JUNIORS!





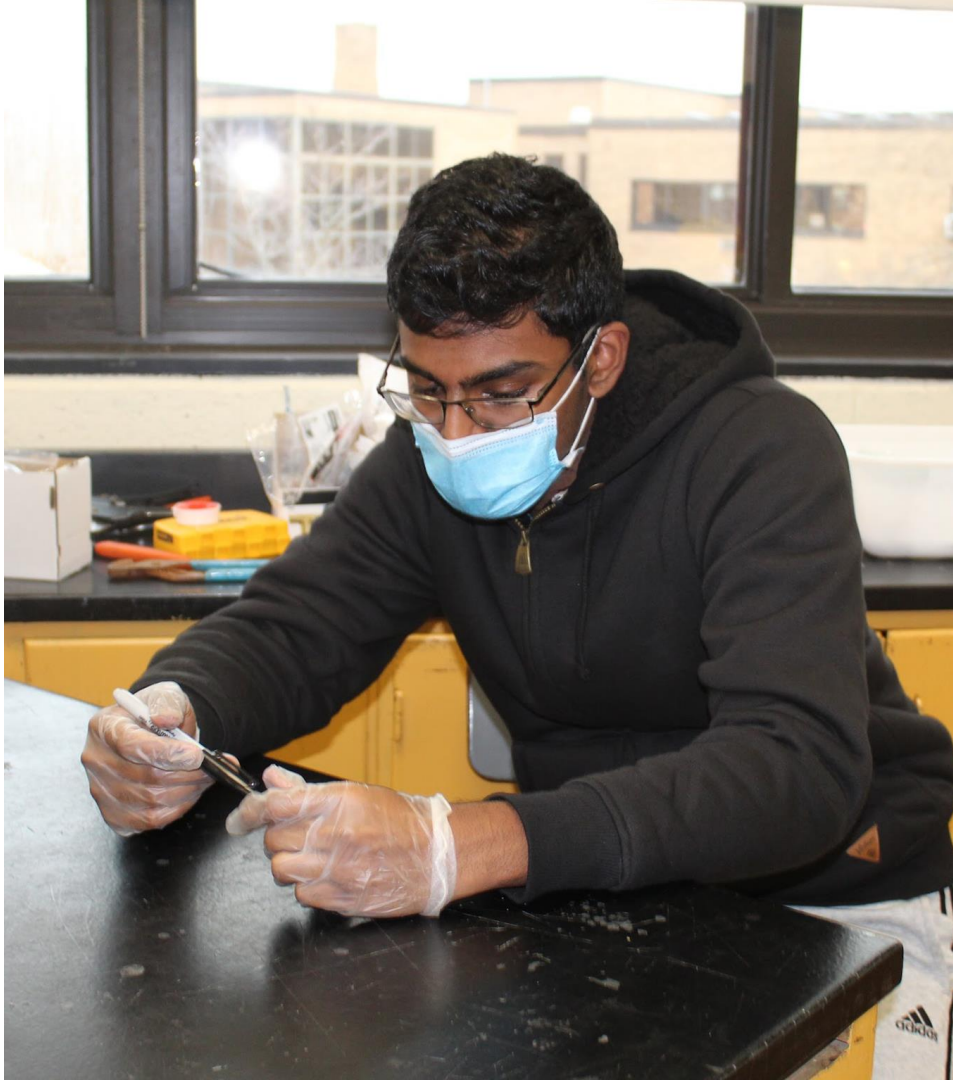






















Developing a Compact Method For Cleaning Water

Topic
I want to see what happens...

Set-up Conditions

- Not up 40, which had 1g of each... 2g of activated charcoal... 2g of sand, and 1g of rock...
- Not up 30, which had 1g of rock, and 1g of charcoal, and 1g of sand...
- Not up 40, which had 1g of 1/4" of activated charcoal, and 1g of sand...
- Not up 40, which had 1g of sand...

Background

- The water in the world is not clean...
- The water in the world is not clean...
- The water in the world is not clean...
- The water in the world is not clean...



Research Question
How can we make water clean...

Methodology

- The water in the world is not clean...
- The water in the world is not clean...
- The water in the world is not clean...
- The water in the world is not clean...



Effect of Varying Doses of Calcium on *Drosophila* with Alzheimer's Disease

Research Question
How does calcium affect the progression of Alzheimer's disease in *Drosophila*?

Background Information
Alzheimer's disease is a neurodegenerative disorder characterized by the accumulation of amyloid plaques and neurofibrillary tangles in the brain. It is the most common cause of dementia, affecting approximately 6 million people worldwide. The disease is associated with cognitive decline and memory loss. The amyloid hypothesis suggests that the accumulation of amyloid plaques is a key factor in the pathogenesis of Alzheimer's disease. Calcium plays a crucial role in neuronal function and is involved in the regulation of neurotransmitter release and synaptic transmission. Dysregulation of calcium homeostasis has been implicated in the pathogenesis of Alzheimer's disease.

Purpose
The purpose of this research was to investigate the effect of varying doses of calcium on the progression of Alzheimer's disease in *Drosophila*. We hypothesized that increasing calcium levels would reduce the progression of the disease and improve cognitive function.

Hypothesis
The more calcium that is added to the diet, the less severe the symptoms of Alzheimer's disease will be in *Drosophila*.

Hypothesis Explanation
Calcium is essential for neuronal function and is involved in the regulation of neurotransmitter release and synaptic transmission. Dysregulation of calcium homeostasis has been implicated in the pathogenesis of Alzheimer's disease. Therefore, increasing calcium levels in the diet may help to regulate calcium homeostasis and reduce the progression of the disease.

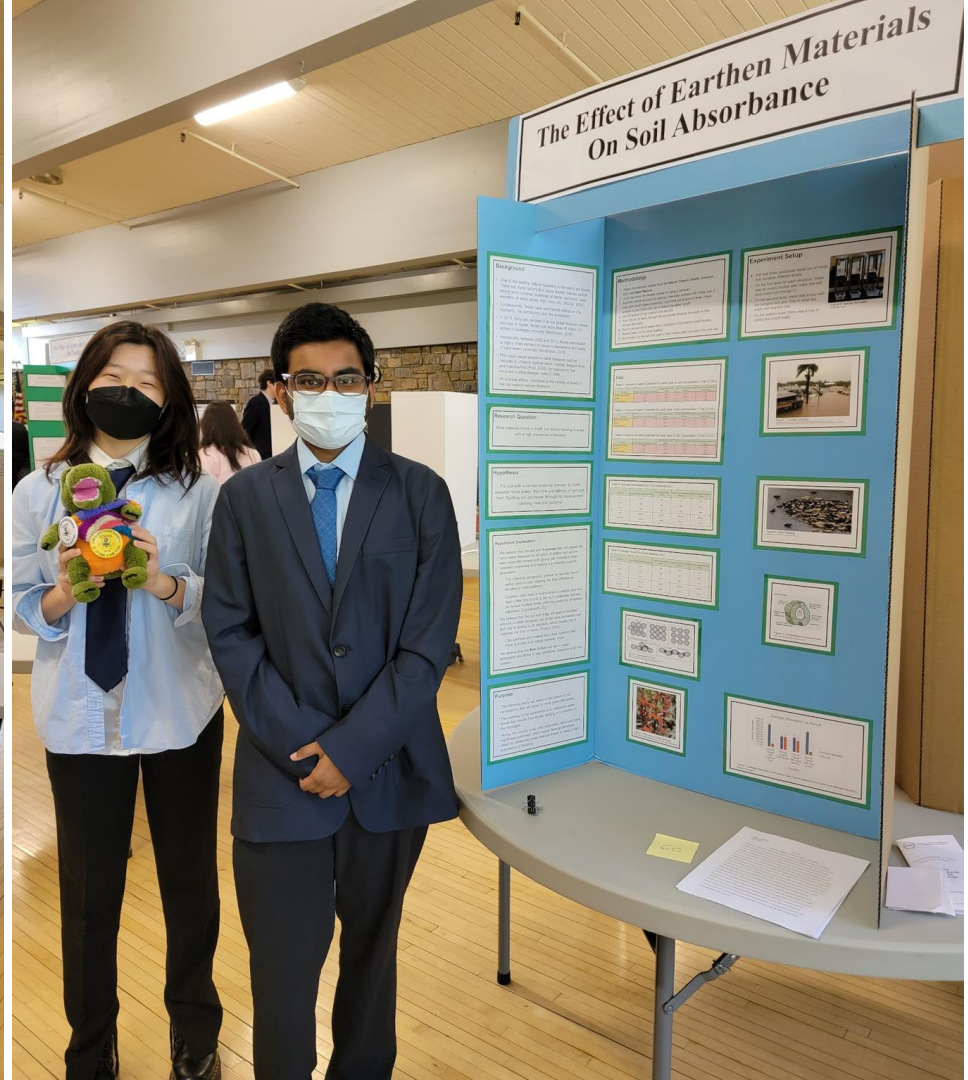
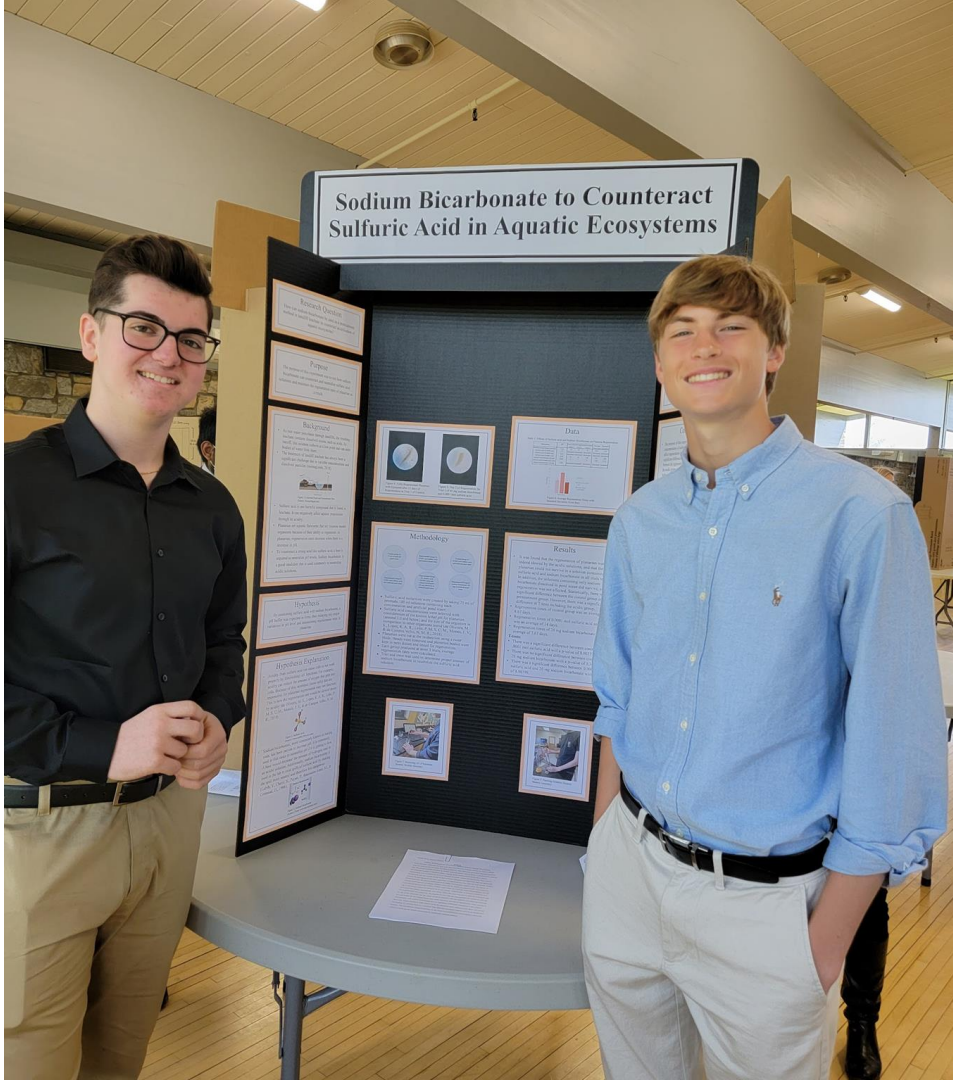
Conclusion
The data from this project were consistent with our hypothesis. We found that increasing calcium levels in the diet of *Drosophila* with Alzheimer's disease significantly reduced the progression of the disease and improved cognitive function. This suggests that calcium may play a protective role in the pathogenesis of Alzheimer's disease.

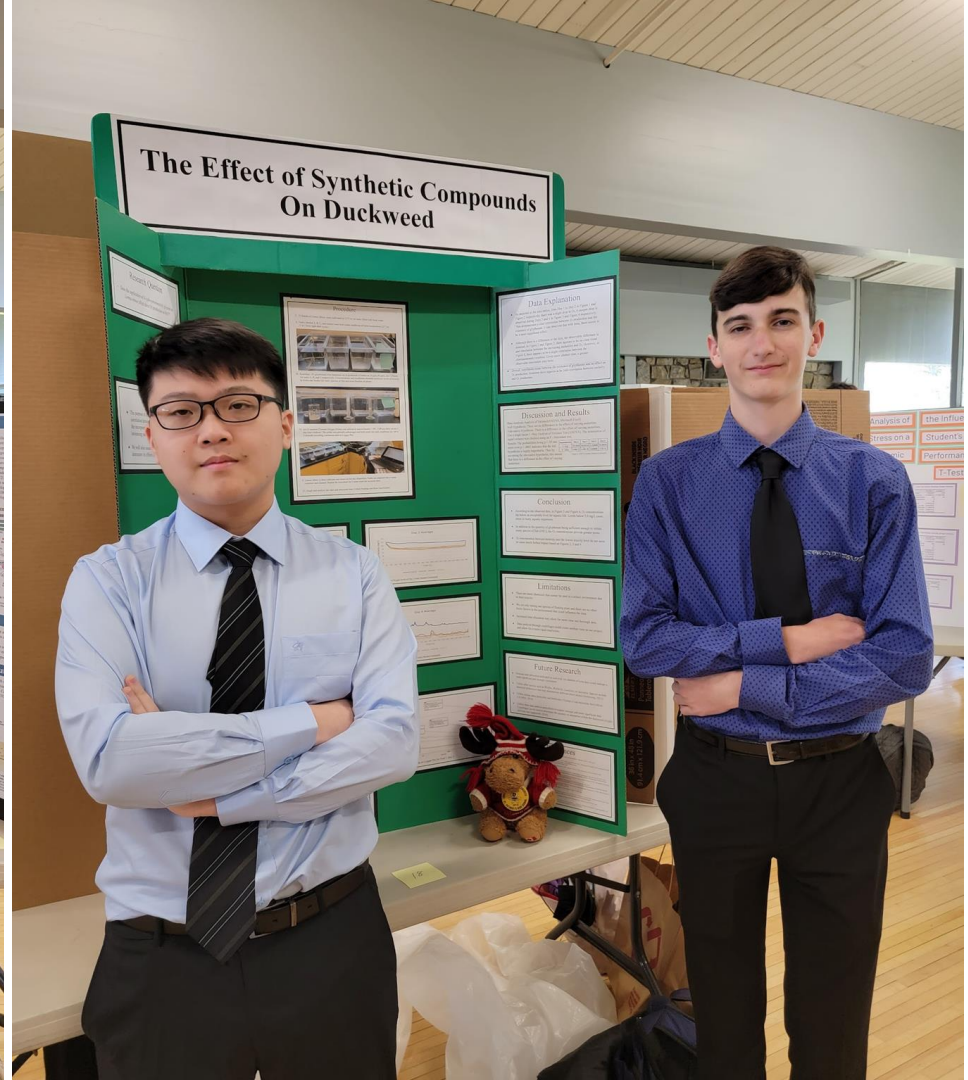
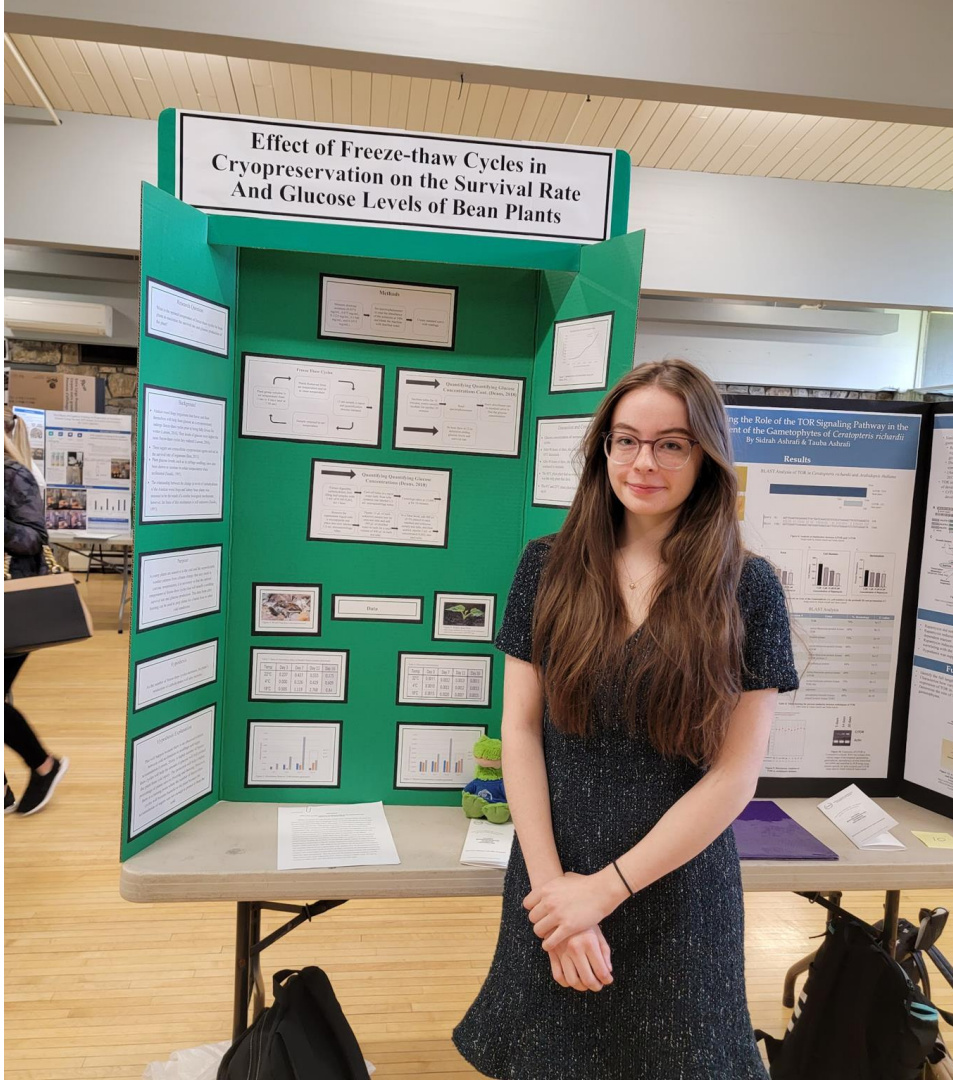
Limitations
The limitations of this study were that we only used *Drosophila* as a model organism and we did not measure the levels of amyloid plaques or neurofibrillary tangles in the brain. Additionally, we did not measure the levels of calcium in the brain.

Future Research
Future research should investigate the effect of varying doses of calcium on the progression of Alzheimer's disease in other model organisms and in humans. Additionally, it would be interesting to investigate the mechanism by which calcium exerts its protective effect.

References
The following references were used in this project:
1. Alzheimer's Association. (2020). Alzheimer's disease facts and figures. *Alzheimer's & Dementia*, 16(3), 255-283.
2. Selkoe DJ. (2001). Alzheimer's disease: molecular biology of the amyloid precursor protein. *Journal of Cell Biology*, 154(2), 105-113.
3. Ghisletti P, et al. (2018). Calcium homeostasis and Alzheimer's disease. *Journal of Alzheimer's Disease*, 63(3), 1055-1065.













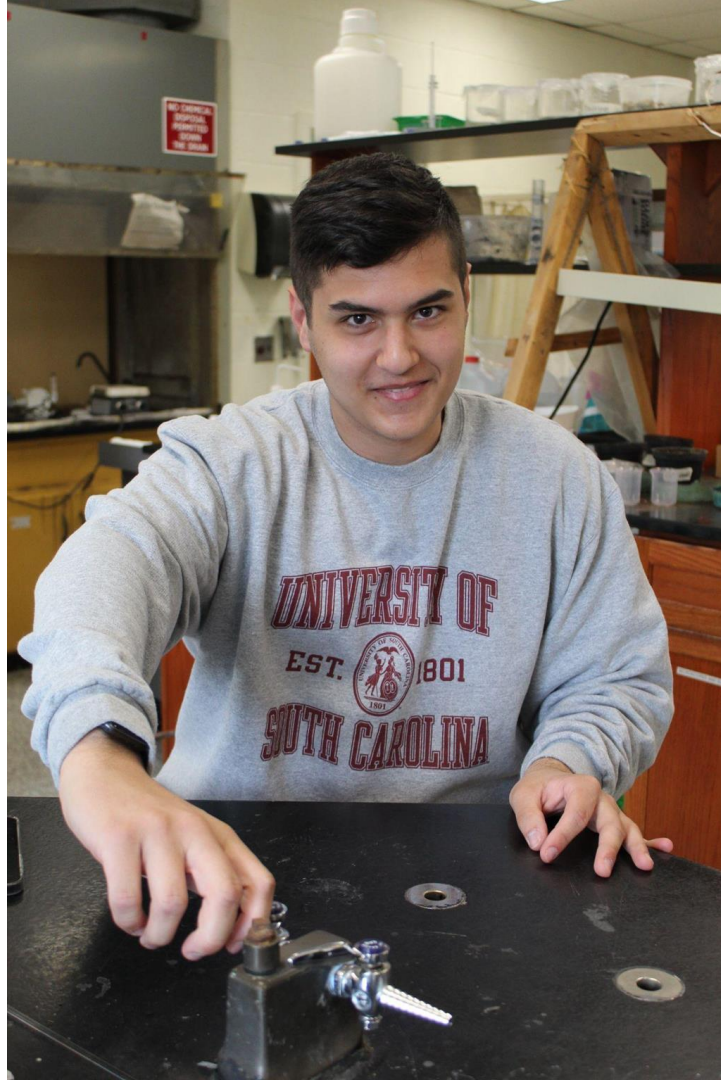
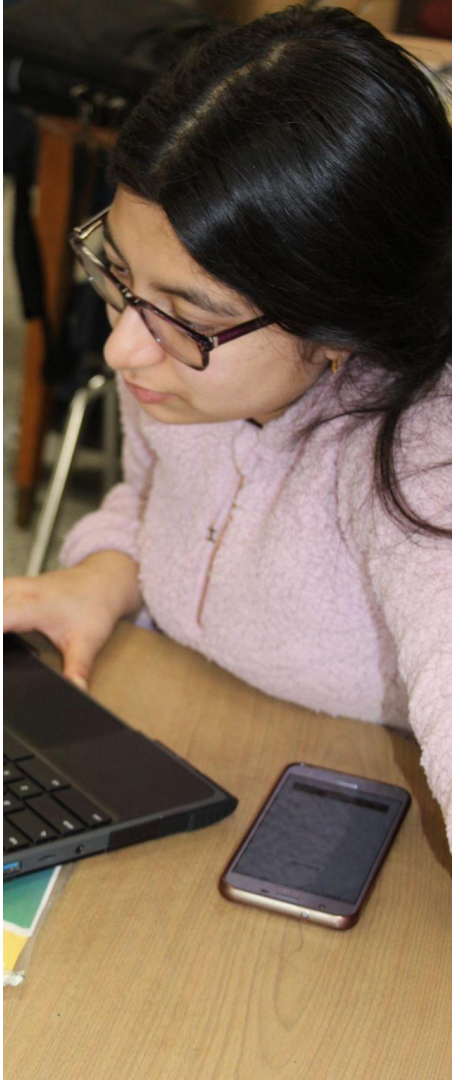


















Background

- During the perinatal period, a testosterone surge masculinizes the fetal brain whereas the absence of such a surge results in a feminized brain.
- Gender hormones act in early life to ORGANIZE sex differences in the brain. These differences are ACTIVATED by sex-specific hormones profiles in adulthood (Phoenix et al., 1959).
- Sexual dimorphism is not as evident in prairie vole social behaviors as in related species (Campi et al., 2013). Pair bonded males and females share partner preference, display separation anxiety, defend nest (mate guarding), by parental care (Carter et al., 1981).
- The sexually dimorphic nucleus of the pre-optic area (SDN-POA) of the hypothalamus, a region of the brain also known to represent sexual dimorphisms, is larger in males than females in mice (Carnicelli, 2015).
- Like mice, the BNST is larger in males, which is conserved in primates, including humans (Chen et al., 2019).
- The BNST has shown to be functionally and structurally connected to the ventral region of the rodent BNST (Clausen, 2019).

Figure 1: Sexual dimorphism in the SDN-POA
 Table 1: Sexual dimorphism in the SDN-POA in various species... (Table with columns: Species, SDN-POA Volume, Reference)

Figure 2: Sexual dimorphism in the BNST
 Table 2: Sexual dimorphism in the BNST in various species... (Table with columns: Species, BNST Volume, Reference)

Exploring Sexual Dimorphism and Sex Hormone Receptor Expression in the Bed Nucleus of the Stria Terminalis (BNST) in the Monogamous Prairie Vole

Figure 1: The rodent BNST in the BNST (Clausen, 2019).

Figure 2: Sexual dimorphism in the BNST
 Figure 2 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 3: Sexual dimorphism in the BNST
 Figure 3 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 4: Sexual dimorphism in the BNST
 Figure 4 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 5: Sexual dimorphism in the BNST
 Figure 5 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 6: Sexual dimorphism in the BNST
 Figure 6 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 7: The posterior BNST is larger in adult voles
 Figure 7 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 8: Sexual dimorphism in the BNST
 Figure 8 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 9: Sexual dimorphism in the BNST
 Figure 9 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 10: Sexual dimorphism in the BNST
 Figure 10 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 11: Sexual dimorphism in the BNST
 Figure 11 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 12: Sexual dimorphism in the BNST
 Figure 12 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 13: Sexual dimorphism in the BNST
 Figure 13 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 14: Sexual dimorphism in the BNST
 Figure 14 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 15: Sexual dimorphism in the BNST
 Figure 15 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 16: Sexual dimorphism in the BNST
 Figure 16 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 17: Sexual dimorphism in the BNST
 Figure 17 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 18: Sexual dimorphism in the BNST
 Figure 18 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 19: Sexual dimorphism in the BNST
 Figure 19 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 20: Sexual dimorphism in the BNST
 Figure 20 illustrates which effect estradiol has on the volume of the BNST in male and female prairie voles. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Results and Discussion (cont.)

III. In Situ Hybridization for Androgen Receptors P14 Samples

Figure 21: Results of in situ hybridization for androgen receptors in the BNST.
 Figure 21 shows the results of in situ hybridization for androgen receptors in the BNST. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 22: Results of in situ hybridization for androgen receptors in the BNST.
 Figure 22 shows the results of in situ hybridization for androgen receptors in the BNST. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 23: Results of in situ hybridization for androgen receptors in the BNST.
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Figure 24: Results of in situ hybridization for androgen receptors in the BNST.
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Figure 25: Results of in situ hybridization for androgen receptors in the BNST.
 Figure 25 shows the results of in situ hybridization for androgen receptors in the BNST. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 26: Results of in situ hybridization for androgen receptors in the BNST.
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Figure 27: Results of in situ hybridization for androgen receptors in the BNST.
 Figure 27 shows the results of in situ hybridization for androgen receptors in the BNST. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 28: Results of in situ hybridization for androgen receptors in the BNST.
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Figure 29: Results of in situ hybridization for androgen receptors in the BNST.
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Figure 30: Results of in situ hybridization for androgen receptors in the BNST.
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Figure 31: Results of in situ hybridization for androgen receptors in the BNST.
 Figure 31 shows the results of in situ hybridization for androgen receptors in the BNST. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 32: Results of in situ hybridization for androgen receptors in the BNST.
 Figure 32 shows the results of in situ hybridization for androgen receptors in the BNST. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 33: Results of in situ hybridization for androgen receptors in the BNST.
 Figure 33 shows the results of in situ hybridization for androgen receptors in the BNST. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 34: Results of in situ hybridization for androgen receptors in the BNST.
 Figure 34 shows the results of in situ hybridization for androgen receptors in the BNST. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).

Figure 35: Results of in situ hybridization for androgen receptors in the BNST.
 Figure 35 shows the results of in situ hybridization for androgen receptors in the BNST. Significant differences are observed in the BNST in both males and females (Carter et al., 1981).



Improved Visualization of Dimensionality Reduction Plots with Controlled Downsampling

Background

Advancement of Science

• Single-cell transcriptomic approaches have advanced research, understanding cell types and developmental trajectories.

Single-cell RNA sequencing (scRNA-seq) Data

• Lengths of scRNA-seq data files are increasing exponentially and are often in GBs.

• Ability to compare specific clusters of cells across different datasets.

Analysis

• Sparse and complex data (lower size than full of the original data sets).

• Sampling downsize data.

• Dataset size increases over time, causing storage issues.

Project Goal/Hypothesis

• Control complex datasets into a smaller size (10% and 5%).

• Querying the datasets.

• Gather only what is needed to run the full pipeline.

• Monitor the results to ensure the pipeline is still working.

Proof of Concept

Original image vs. Final image showing downsampling results.

Methodology

Flowchart showing the process: Data set (100k cells) → Preprocessing (Normalization, Quality Control) → Feature Selection (PCA, t-SNE) → Dimensionality Reduction (t-SNE, UMAP) → Visualization (t-SNE, UMAP).

• Data frames: RNA-seq data (100k cells) and corresponding metadata.

• Metadata: Cell types, clusters, gene expression levels.

• Empty data frames created.

• Results: A series of dimensionality reduction plots (t-SNE, UMAP) showing the effect of downsampling on the visualization.

Conclusions and Discussion

Downsampling is a viable method for reducing the size of large high-volume data sets for visualization.

• Improved visualization and reduced storage requirements are achieved by using downsampling.

• Downsampling is a viable method for reducing the size of large high-volume data sets for visualization.

Ongoing/Future Research

• Explore the effect of downsampling on different datasets.

• Investigate the impact of downsampling on clustering and trajectory inference.

• Investigate the impact of downsampling on cell-type identification.

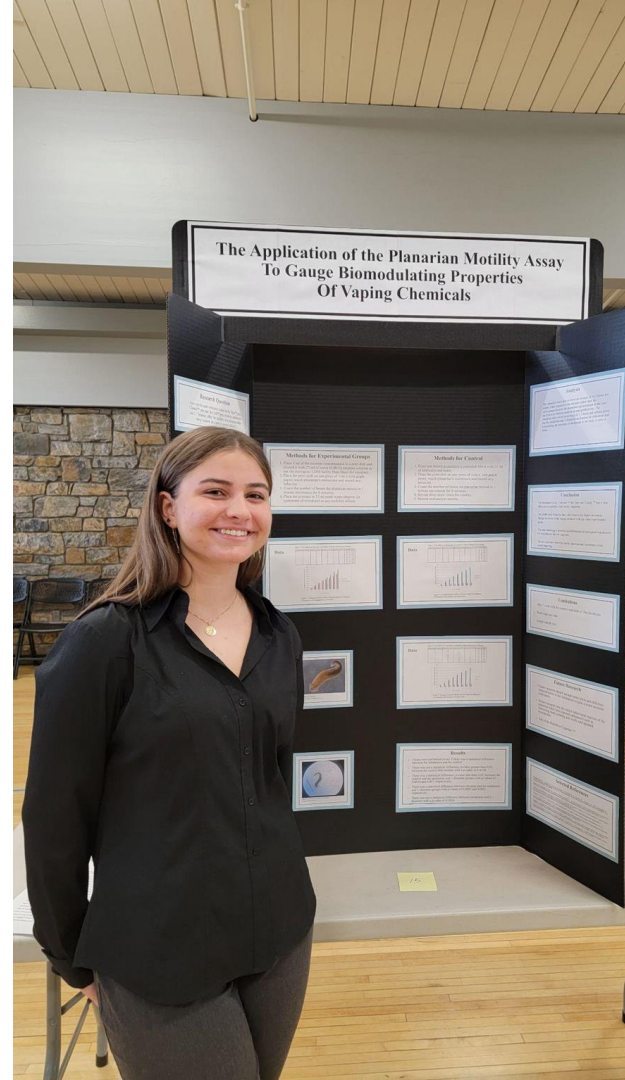
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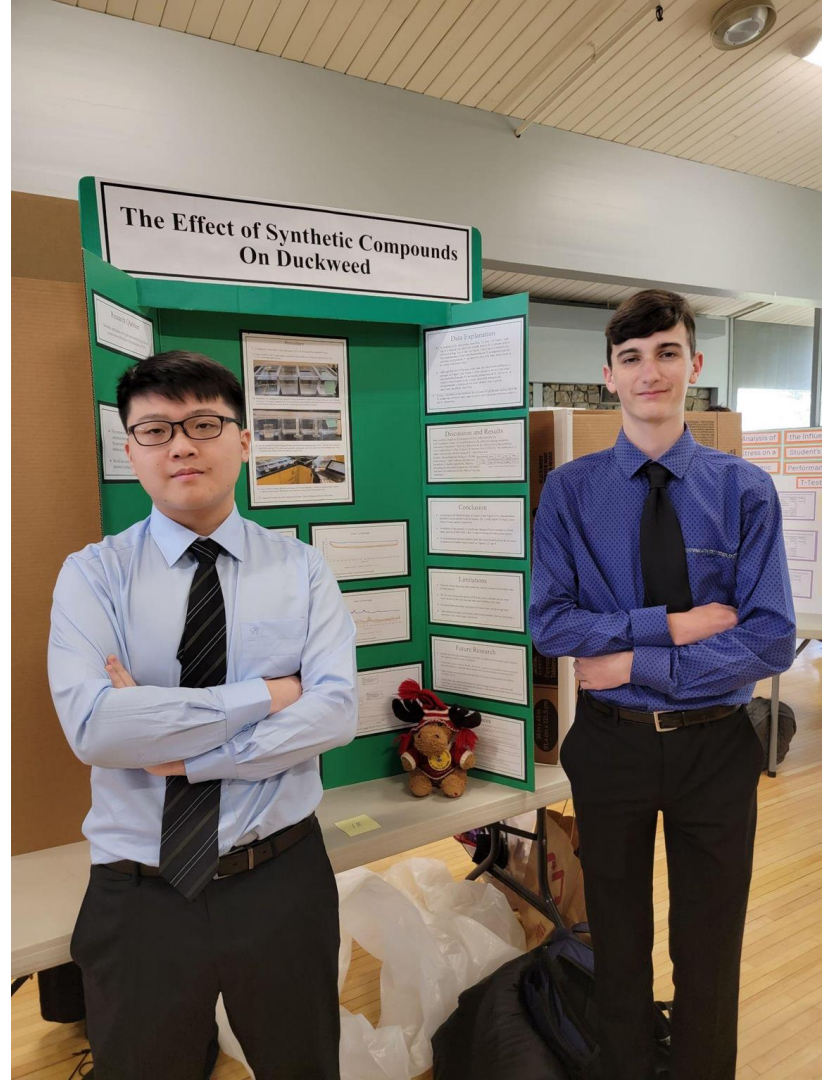
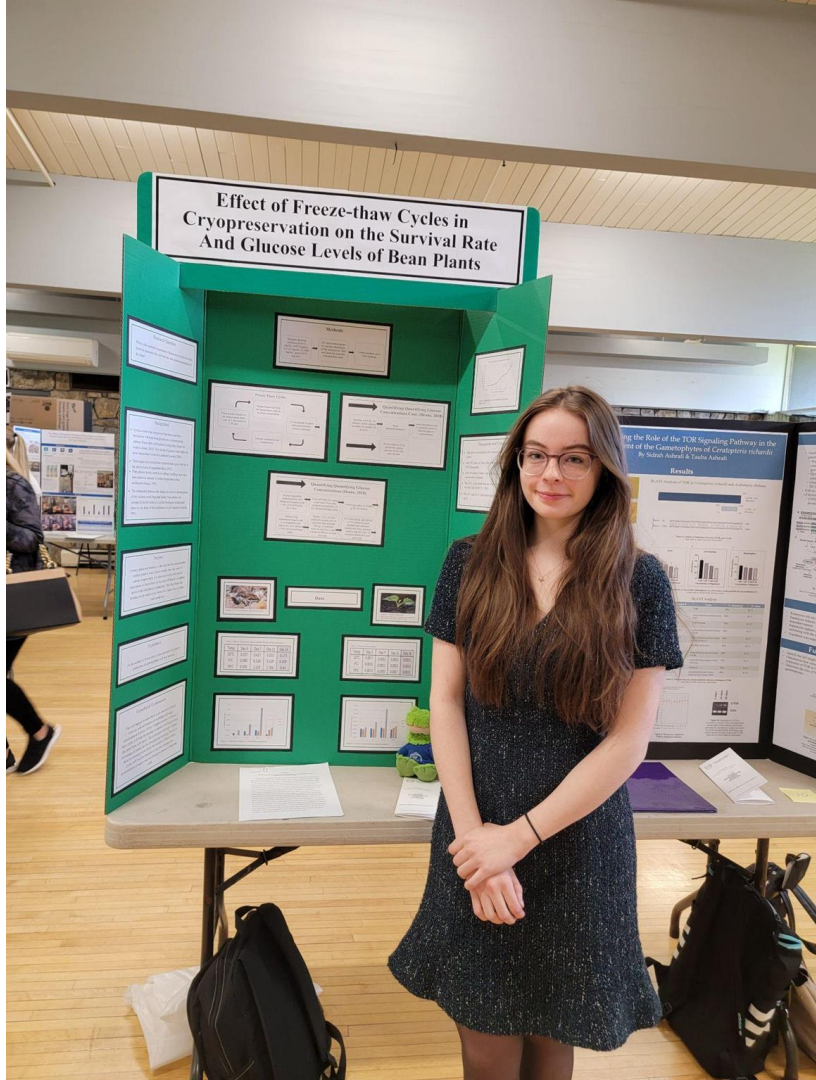
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Conditioning from Musical Experience And its Effect on Blood Oxygen Saturation During Exertion

Introduction
Musical experience has been shown to have a positive effect on cardiovascular health and blood oxygen saturation during exertion. This study aims to investigate the effect of musical conditioning on blood oxygen saturation during exertion.

Background
Musical conditioning has been shown to have a positive effect on cardiovascular health and blood oxygen saturation during exertion. This study aims to investigate the effect of musical conditioning on blood oxygen saturation during exertion.

Methods
The study involved 20 participants who were divided into two groups: a control group and a musical conditioning group. The control group performed a 30-minute exercise routine without music, while the musical conditioning group performed the same routine with music. Blood oxygen saturation was measured before and after the exercise routine.

Results
The results showed that the musical conditioning group had a significantly higher blood oxygen saturation during exertion compared to the control group. This suggests that musical conditioning may have a positive effect on cardiovascular health and blood oxygen saturation during exertion.

Conclusion
The study concluded that musical conditioning has a positive effect on blood oxygen saturation during exertion. This suggests that musical conditioning may be a useful tool for improving cardiovascular health and blood oxygen saturation during exertion.



Methods
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Abstract

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The results showed that the musical conditioning group had a significantly higher blood oxygen saturation during exertion compared to the control group. This suggests that musical conditioning may have a positive effect on cardiovascular health and blood oxygen saturation during exertion.

Conclusion
The study concluded that musical conditioning has a positive effect on blood oxygen saturation during exertion. This suggests that musical conditioning may be a useful tool for improving cardiovascular health and blood oxygen saturation during exertion.















