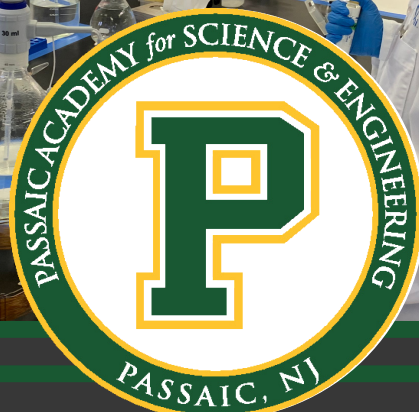


# THE PULSE

of Science Pathways

## PASSAIC ACADEMY FOR SCIENCE AND ENGINEERING



### BIOTECHNOLOGY LEARNING UPDATE

Students in all three pathway classes (Biotechnology, Organic, and Genetics) went on their first field trip to S2S (Students to Science). Students got to be REAL scientists for the day working in a pharmaceutical lab to determine the quality and purity of the active pharmaceutical compound found in the pill. Students learned about HPLC and GC (two industry chromatography methods) and spectroscopy techniques then got to use them in addition to other various lab procedures to assess the drug. Many thanks to PTC Therapeutics for their support in making this possible! Looking ahead we will have 3 more high school trips and 3 middle school trips to this location.

### WHAT'S NEW?

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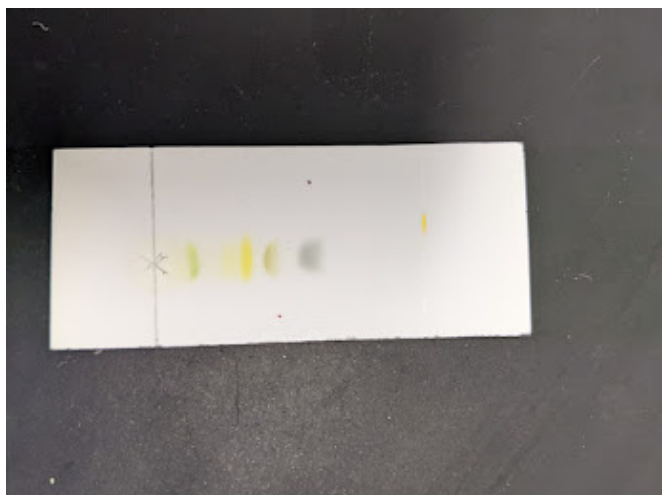
- p2** Biotechnology
- p3** Computer Science
- p5** Biomedical Science
- p6** Engineering
- p7** Data Science



## BIOTECHNOLOGY

### LEARNING UPDATE

In **Organic and Biochemistry** (third year in the pathway) we reviewed important concepts from General Chemistry that will carry over throughout the remainder of the year. During September, we completed our first Organic chemistry lab where we extracted chlorophyll from spinach and separated the chemical components using thin layer chromatography. We have more extraction and separation labs planned in the future - caffeine from coffee and fat from peanuts. Photo description: Spinach = This photo shows the mixture of pigments extracted from spinach using acetone. TLC = Students used Thin Layer Chromatography to separate the different pigments and identified which was chlorophyll (darkest green)



## BIOTECHNOLOGY

### CONTINUED

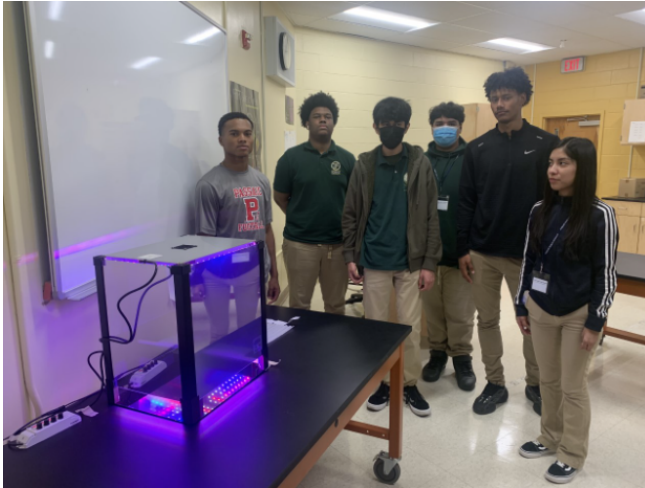
Students in **Genetic Engineering** began the year with a refresher on the basics of experimental design as they will be building on this technique and conducting their own research throughout the year. They went on to learn about some of the history of genetic engineering and the process of making the discoveries that shape our field. They looked at the Griffith, Avery, McCarty, and McLeod experiments, the remarkable contribution that was made by James Watson and Francis Crick who published the structure of DNA and the contributions of Rosalind Franklin and her incredible photo 51 which detailed the structure of DNA. They then examined other historical events in biotechnology where they discussed and ranked the importance of the events.

They also participated in Growing Beyond Earth or GBE, a classroom-based citizen science project operated in partnership with NASA, designed to advance NASA research on growing plants in space. The program involves students with the task of being able to grow plants given the conditions they were exposed to as seeds, with some seeds being exposed to space at the ISS. In December, they will propose their own research project to using GBE hardware to conduct. They will share results from this at a NASA symposium later in the year.

These students were also able to partake in experiments at Students 2 Science Inc. at East Hanover to learn more about how medicine is tested for quality and durability. Using major tests like HPLC (High performance liquid chromatography), and infrared spectroscopy, and minor tests like appearance and durability of the medicine. These tests and more determine if medicine is able to be sold to the general public without causing any possible damage to patients.



With some guidance from professors at Kean University, students engineered guide RNA sequences which they will use to conduct research on cancer cell metathesis using the CRISPR - Cas9 system.



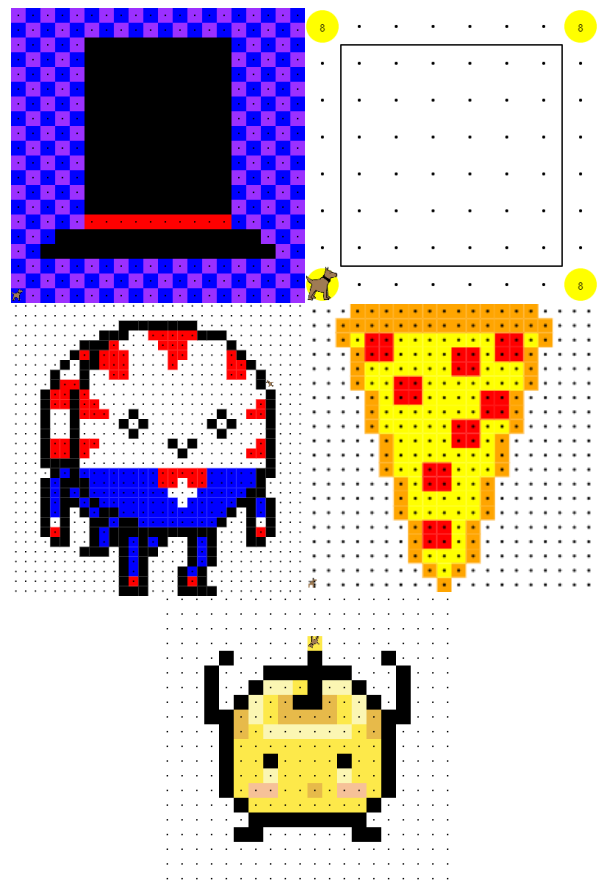
Students with the GBE habitat they constructed.



Students planting the samples for the GBE experiment.

## COMPUTER SCIENCE LEARNING UPDATE

In **AP Computer Science Principles**, students learned how to program a dog named Karel who only knows how to move, turn left, and place tennis balls in her world. We discussed the need for programming languages, the uses of programs, how to write programs to solve computational problems, how to design algorithms, and how to analyze and compare potential solutions to programming problems. At the end of the unit, students worked together in teams and used the grid coloring functionality of Karel to program and create a digital image.



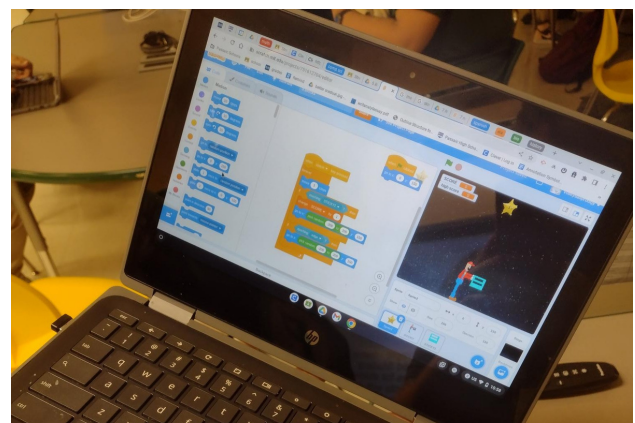
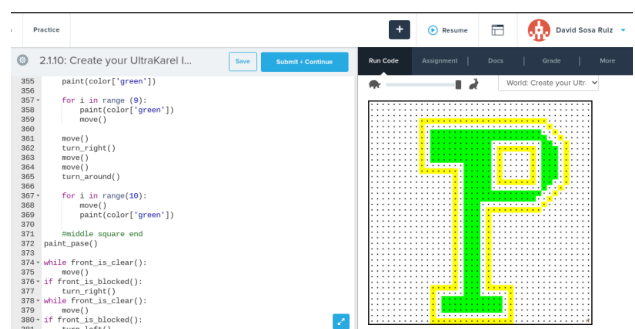
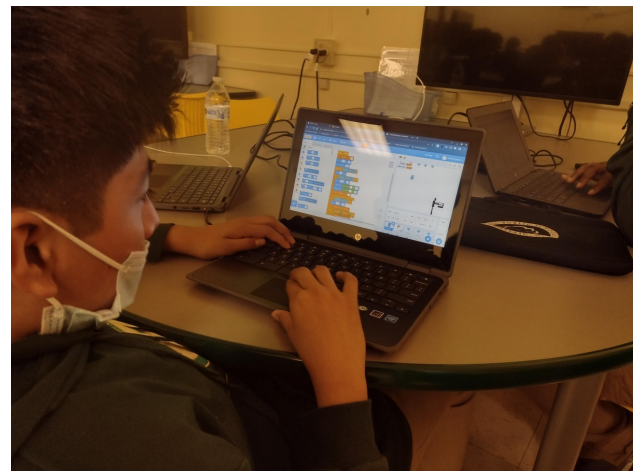
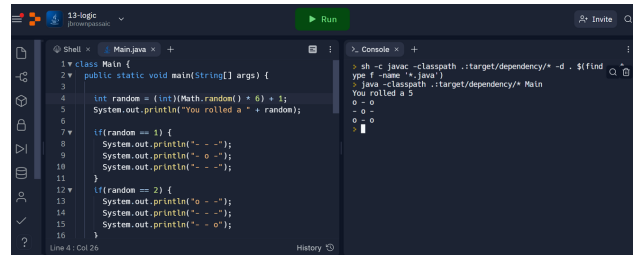
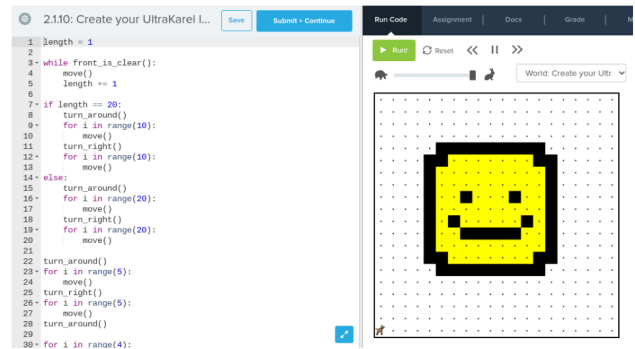
In **Introduction to Computer Science**, we cover a lot of ground so our students are prepared for their future careers in the industry. This year we've covered the concepts of computer hardware, pragmatic problem solving, computer vs human intelligence, algorithm creation and more! Students are now starting to experiment with Scratch and coding. We're teaching loops, conditionals, and animations.

## COMPUTER SCIENCE CONTINUED

In **Cybersecurity**, students are introduced to the tools and concepts of data protection. The class encourages students to create solutions that allow people to share computing resources while protecting privacy. Some of the concepts addressed so far have been how to protect your personal computer, examining password-cracking algorithms, and knowing how to address email and social media risks. We look forward to soon learning more about firewalls, file management, and how to properly secure web browsers. Cybersecurity is a rapidly expanding field with new innovations being developed all the time.

In **AP Computer Science A**, students are learning how to code using the Java programming language. It's quite a bit different from coding that they have done in the past, as this language is strongly typed (ask one of our students what that means!). They are using CompuScholar and Replit.com to create and test their programs and are learning how to debug when things go wrong. When they're ready for the AP exam, they'll be required to write their own original code.

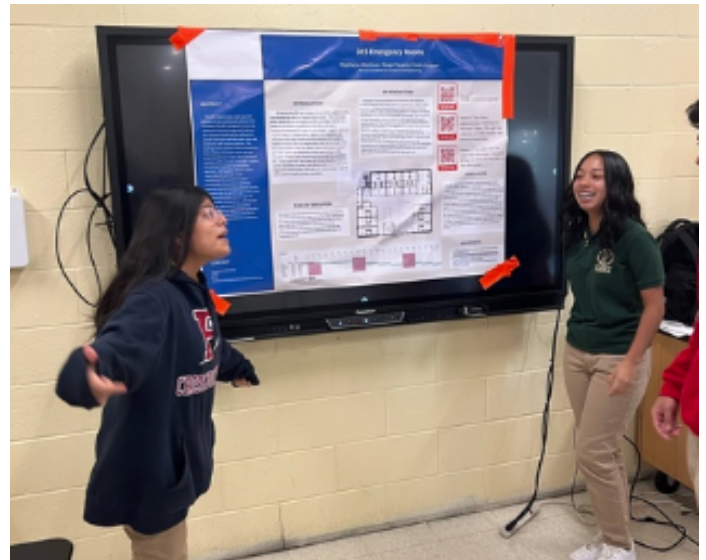
**AP Computer Science Principles** is an introductory course that teaches the foundational concepts of computer science. The students are using Codehs which is based off of the College Board AP Computer Science Framework. They are using Python within the online coding section on Codehs. Students are completing real life coding applications as well as using their Algebra skills to problem solve. For the AP exam students are expected to complete a create task which involves code along with the multiple-choice test that is administered.





# BIOMEDICAL SCIENCE LEARNING UPDATE

**Biomedical innovation** students identified and tackled a current problem in emergency rooms. These students researched common issues associated with emergency rooms and developed solutions based on research and developed models showcasing their improvement. They also had to present their solutions via posters. This allowed the students to learn basic research and poster making skills. Currently they're working on carrying out research identifying simple physiological processes and collecting data and making sense of the data using simple statistical analysis.



## Do Non-Athletes Have a Higher Heart Rate Than Athletes After Exercise?

Stephanie Martinez, Estela Vazquez, Diego Payares  
Passaic Academy for Science and Engineering

### Introduction/ Background

Aerobic exercise have supported the idea that it strengthens the heart which allows blood to pump smoothly. When exercising, people's heart rates increase because of the oxygen tissues that reach all parts of the body to regulate blood flow. Since athletes exercise more than non-athletes, logically its expected for athletes to perform better than non-athletes in heart rate. The experiment was designed to track if non-athletes have a higher heart rate than athletes. The goal is to identify a difference in heart rate between non-athletes and athletes and conclude which group's heart rate is higher.

### Abstract

25 students were gathered and separated into two groups. Group 1 had 12 people which are non-athletes and Group 2 had 13 people consisting are thletes. Both groups held a heart rate monitor that tracked each subject's heart rate before and after , with a selected amount of exercises. These exercise included; 15 jumping jacks, 10 sit ups, 5 lunges, 3 push ups and a 1 minute plank. The purpose of the exercises was to raise each group's heart rate to identify which group had a higher heart rate after exercise. To accurately get results, the procedure was followed for each subject.

### Hypothesis

**Alternate Hypothesis:** The mean of non athletes( $\mu_1$ ) is not equal to the mean of the athletes ( $\mu_2$ ). There is statistical difference between the mean heart rate of non athletes ( $\mu_1$ ) and athletes ( $\mu_2$ ).

**Null hypothesis:** The mean of non-athletes( $\mu_1$ ) is equal to the mean of athletes ( $\mu_2$ ). There is no statistical difference between the mean heart rate of non-athletes ( $\mu_1$ ) and athletes ( $\mu_2$ ).

**Dependent Variable:** Heart Rate after exercise

**Independent Variable:** Athletes and Non-Athletes

### Results

When calculating the the mean, standard deviation and the variance for both groups, Group 1 (athletes) numbers are lower than Group 2 (non athletes) supporting that non-Athletes have a higher heart rate.

Mean	21.58 bpm	16.92 bpm
Standard Deviation	6.64	4.36
Variance	239.52	137.06

Alpha Number: 0.05

Degrees of Freedom: 23 Formula:  $n_1+n_2-2$

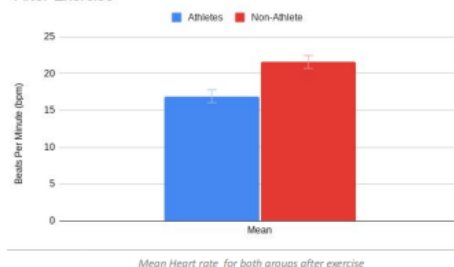
t-statistic: 5.21

Formula:

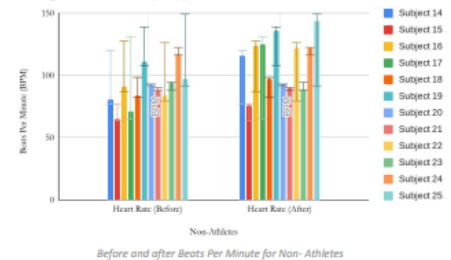
Critical Value: 1.714

$$t = \frac{|\bar{x}_1 - \bar{x}_2|}{\sqrt{\frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1+n_2-2} \left( \frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

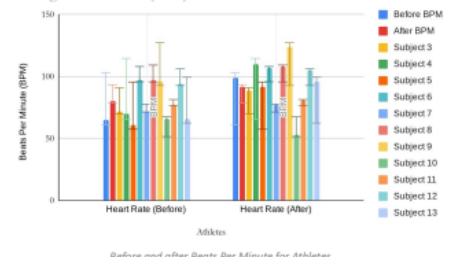
Average Change in Heart Rate in Athletes and Non-Athletes After Exercise



Change in Heart Rate (BPM) in Non-Athletes



Change in Heart Rate (BPM) in Athletes



Before and after Beats Per Minute for Athletes

### Conclusions

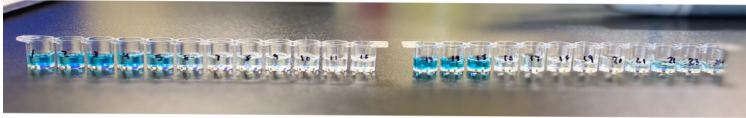
Since the t-statistic is greater than the critical value, we rejected the null hypothesis. The results are statistically significant, meaning there is a difference in heart rates between both groups. The observed difference was due to change. -The amount of subjects was less than 25 which concluding this experiment as an independent t-test. However, the type of sport that the athlete plays and their diet, could have affected the outcome of this experiment. To better this experiment, the amount of oxygen could also be recorded and or their blood pressure to understand a relationship between the two.

### References

1. Yockey. (n.d.). *Low resting heart rates in athletes: Is it safe?* Low Resting Heart Rates in Athletes: Is It Safe? Retrieved November 10, 2022, from <https://www.medicalnewstoday.com/articles/athletes-heart-rate>

## BIOMEDICAL SCIENCE CONTINUED

Students in the **Medical Interventions** class have been investigating an outbreak on a college campus. They completed an ELISA in order to diagnose individuals, and to determine who was the first one to be infected in the outbreak and how it spread from there. Then, students learned about antibiotic treatment. They completed a lab in order to see bacteria exchange antibiotic resistance genes through conjugation.



## ENGINEERING LEARNING UPDATE

In **Aerospace Engineering**, students have been introduced to the physics of flight and the difference between flying and falling. We discussed that Lift is generated by the flow of air above and below an object and that flow of air can be described using pressure, density, temperature, and velocity. We then spent a lot of time studying the equation of state for a perfect gas and practiced our math skills by using the ideal gas law to solve for the properties of flowing air. Additionally, this quarter students have been learning how to build circuits and program using Arduinos. So far, students have been series circuit, parallel circuits, and a Color Mixing Lamp (using a tri-color LED and three photoresistors, students create a lamp that smoothly changes colors depending on external lighting conditions).

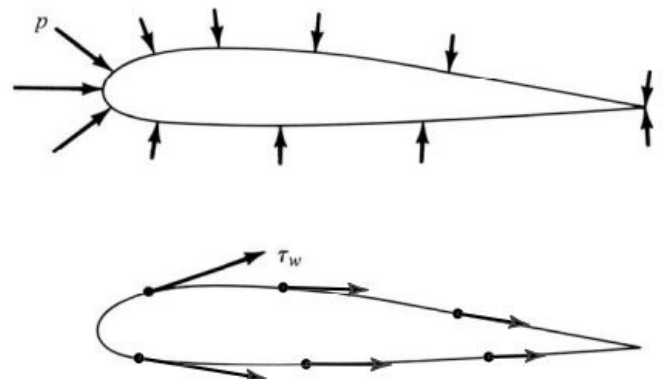
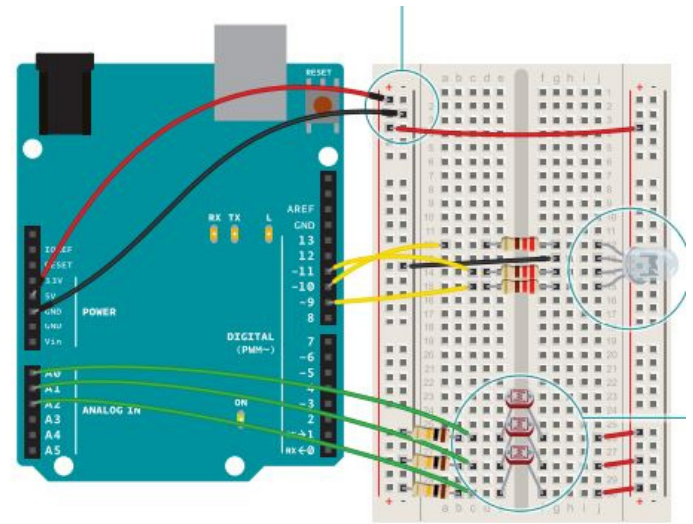
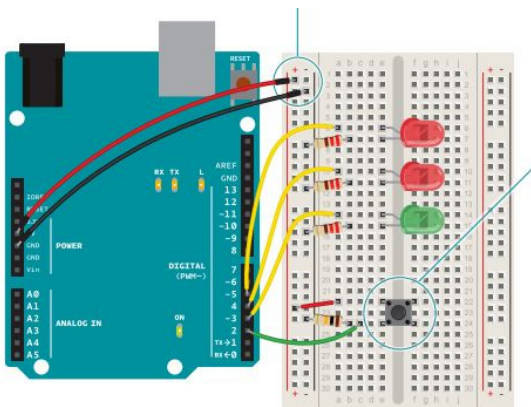


Figure 2.9 Pressure and shear stress distributions.

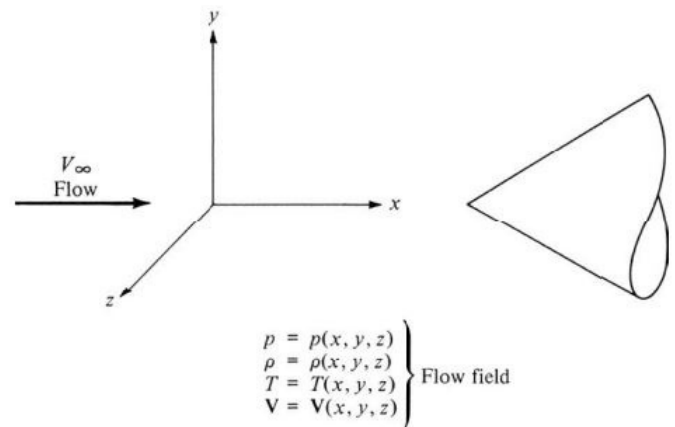


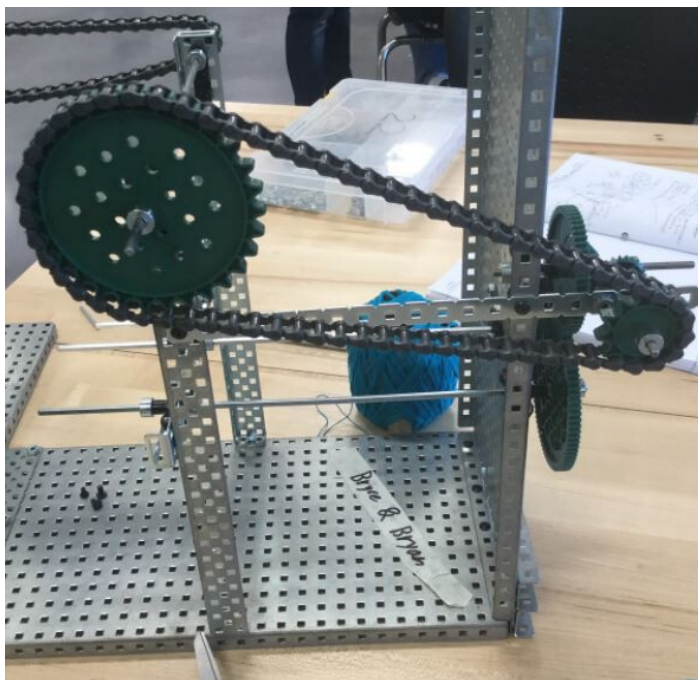
Figure 2.8 Specifications of a flow field.

In **Principles of Engineering**, students have learned about simple machines, gears, mechanical advantage, and gear ratio. Currently they are building a compound machine, where they will aim to achieve the highest mechanical advantage and efficiency possible!



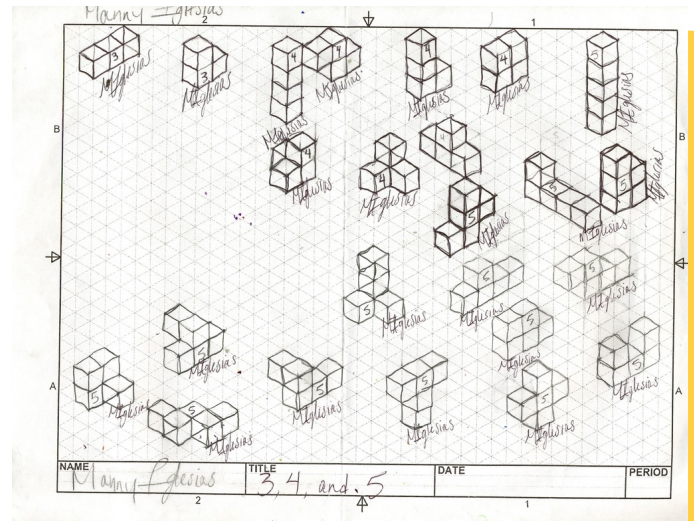
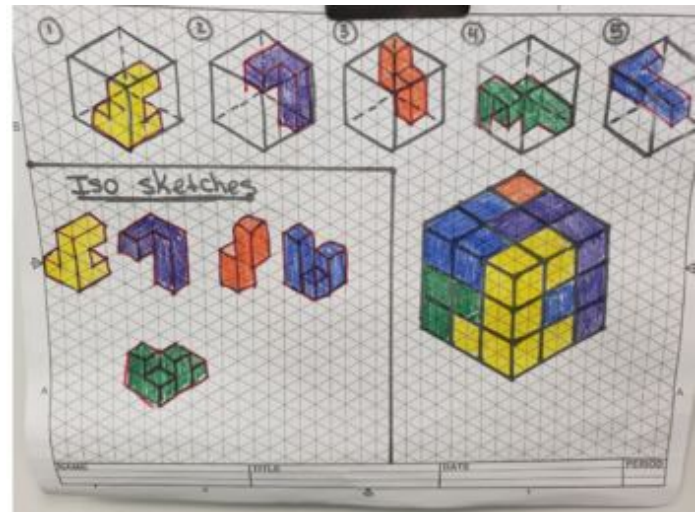
## ENGINEERING CONTINUED

In **Unmanned Aircraft Systems**, students have learned of the different configurations of aircraft, their advantages and disadvantages, and the aerodynamic forces that make flight possible. We are starting a new unit on the elements, where they will explore how the weather affects the performance of an aircraft.



Presently, **Introduction to Engineering Design** students are working on the Rubik Cube Challenge. This is a theoretical-algorithmic challenge that requires students to use both, combinatorial analysis and math algorithms to develop a constrained solution for the 3x3 Rubik cube.

Students most sketch their solution in an Isometric grid to later utilize plastic cube units to assemble their solutions.

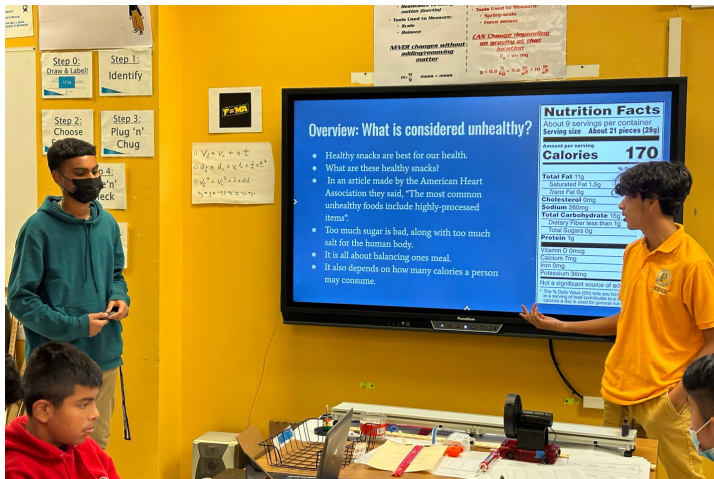


## DATA SCIENCE LEARNING UPDATE

Intro to Data Science is off to a great start! This year we have 16 freshman interested in learning all about how data is analyzed and used to shape our world. Student start the year by analyzing their snacking habits. Student use their IDS app to track every packaged snack they eat for about a week, noting its nutritional facts and how healthy they believe the snack to be. We use this dataset as we explore the ways we can talk about and analyze data using the R coding language. Students explore the Data Cycle and apply it in activities and coding labs. Finally, it all comes together in our practicum. After doing some research and defining their own scientific definition of healthy snacks,

## DATA SCIENCE CONTINUED

students examined the class's data to see just how good the class was at identifying whether a snack was actually healthy or not healthy for them. They presented to the class and engaged in peer feedback and discussion about their findings. Want to know their findings? Ask them!



This year PASE is continuing its participation in the Pittsburgh Dataworks DataJam. The DataJam is a national competition where high school teams compete in data analysis project competition. Students must use data to study a topic and question of their own choice and development. Every week, our IDS students meet virtually during class with mentors from Caldwell College who are studying data science. The mentors help students with everything from refining their research and finding the data to giving them feedback on their ultimate research poster and presentation. In the spring, the students will create a poster and then present at an online conference to present their results and compete. We are off to a great start and look forward to submitting our proposals in early December! With their first IDS practicum done, they have already done a first mini DataJam and did a great job!

# THANK YOU



# SCIENCE

# FOR READING!