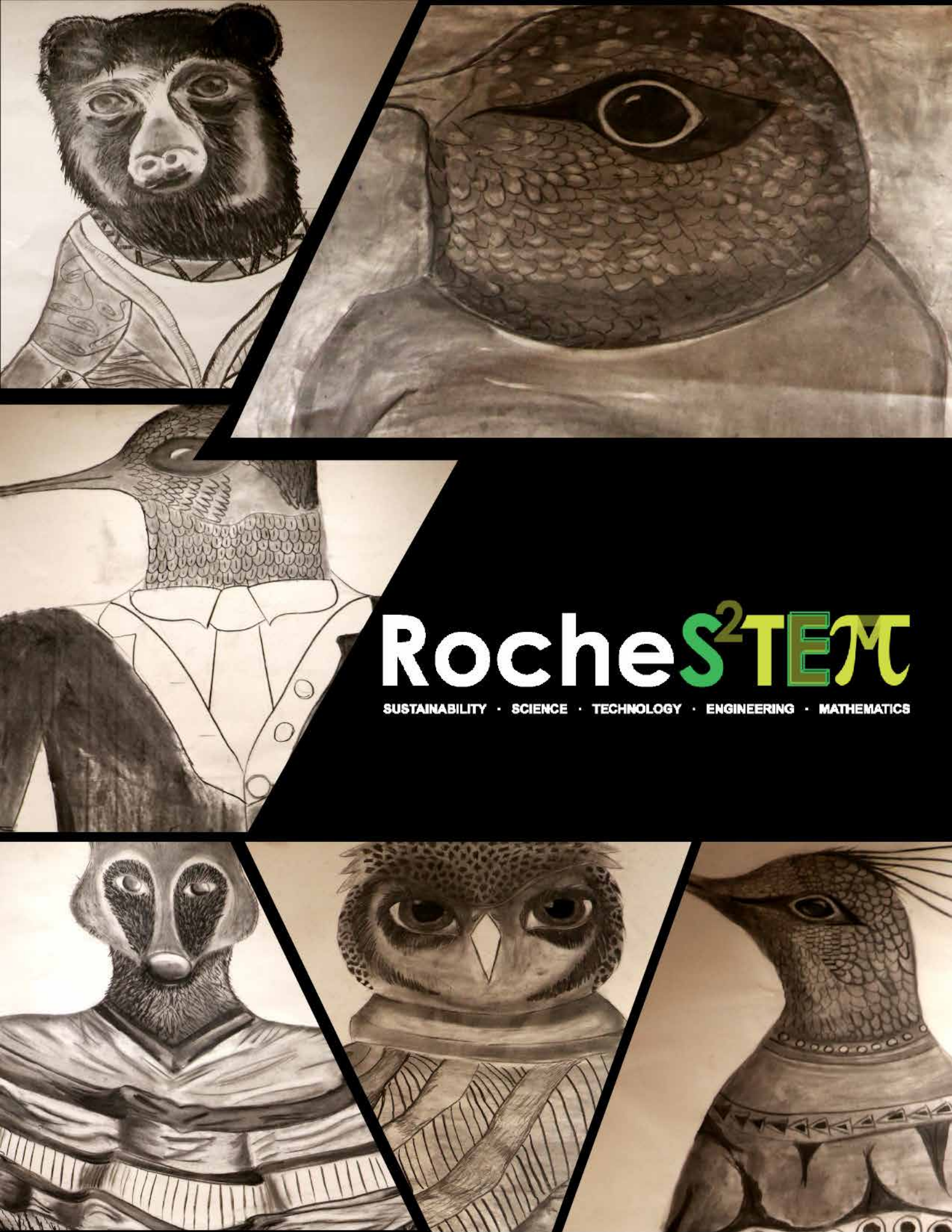
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SUSTAINABILITY · SCIENCE · TECHNOLOGY · ENGINEERING · MATHEMATICS

Bianual journal with a sustainability, sciences, technology, engineering and math productions focus from the community of Rochester School in Chía, Cundinamarca, Colombia

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Romero Daniel
Serrano Freddy
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Torres Sara
Benitez Maria Camila
Aportaron al proyecto los estudiantes de 11° de manera individual.
IMBACUAN NEIRA SOFÍA
MARÍA PAZ CASTILLO
LONDOÑO MARTÍN
GARCÍA VALENTINA
BUSTAMANTE GABRIEL
Técnica del carboncillo sobre papel reciclado.

EDITORIAL

María del Pilar Tunarroza Sierra
Natural and Environmental Science Director Rochester School

Cooperation among species allows them to survive better than they would as individuals. We see examples in nature of cooperation in multiple scenarios, sadly, not so often in human species. At Rochester, we promote cooperative work in the classroom because we believe students can always learn from their peers, also, teachers can learn a lot from students too.

In this edition of RocheStem you'll see how integrated projects and working collaboratively between teachers, parents and students have incredible results with attractive and useful projects for the community.

Students from different grades and classes worked together to discover if life was possible on other planets based on experimenting with plants under different conditions, they put to practice the skills of listening to others, being empathic and trustworthy by sharing their collected data.

Students worked for months on cultivating food they wanted to share with the students from Fusca, researching before hand its nutritious value, best agricultural practices and healthy diets. Rochester students put into practice the skills of being kind, being healthy, and being sustainable.

Students were very motivated on a goal they'll have in common when they grow up: what is the best vehicle to buy? for this, they worked cooperatively on mathematical analyzes that would lead them to the best decision.

Teachers and parents also gave their best to share with students their knowledge by creating fun and useful classes for them; you can check them here in the creativity content.

In these, and the rest of articles from this magazine, you'll find how students developed the skills of research, decision making, solving problems and come up with conclusions, always keeping in mind the three school pillars: healthy and sustainable environment, useful and quality learning for life and the world and internal responsibility towards success and happiness.

CONTENTS

Class Foundations

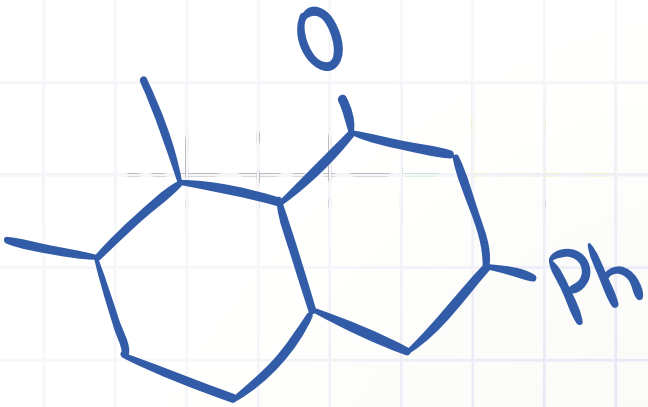
El Casino Matemático es un proyecto de probabilidad que los estudiantes de noveno grado realizaron en el desarrollo de la asignatura de Probabilidad y Estadística. Este proyecto consistió en la creación de un juego de casino usando diferentes técnicas de probabilidad. Los estudiantes aplicaron los distintos procedimientos matemáticos sobre probabilidad vistos durante el semestre para crear su propio juego de casino bajo unos parámetros necesarios.

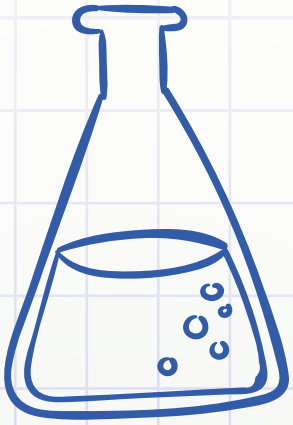
La preparación para este proyecto se basó en la explicación y el entendimiento de los conceptos de probabilidad y cómo estos eran aplicados en la vida real en los juego de casino. Se tuvieron en cuenta distintos procedimientos aprendidos en clase para encontrar la probabilidad en situaciones dadas, por ejemplo, los diagramas de árbol para encontrar las probabilidades cuando hay muchos elementos. Los estudiantes también debieron realizar una autoevaluación en su proceso durante las clases de Probabilidad para de esta manera poder crear y demostrar su aprendizaje. Este tipo de actividades son importantes

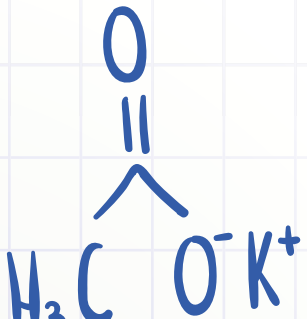
para aprender a analizar y crear diferentes juegos con base en los conceptos aprendidos en la clase. También es importante porque ayuda a los estudiantes a saber cómo analizar resultados probabilísticos de cada juego y de esta manera ver como modificar el juego para obtener diferentes resultados. Estas actividades mejoran el aprendizaje de los estudiantes porque ayudan a aprender de una manera más visual e interactiva conceptos matemáticos y ser capaces de transmitir este conocimiento a otros estudiantes.

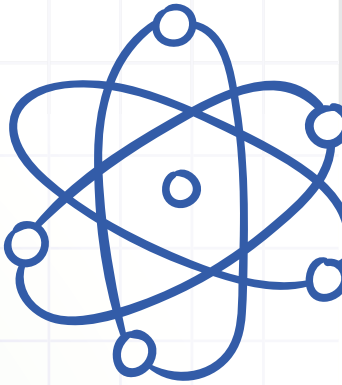
Para realizar este proyecto, se hicieron grupos en cada una de las clases y se trabajó de manera activa para lograr la meta propuesta. Primero, se planteó una idea clara de cómo cada grupo iba a realizar cada juego y como iban a aplicar cada concepto de probabilidad en él. Algunos grupos decidieron ir más allá y aprender nuevos procedimientos para encontrar más probabilidades y de esta manera mejorar el juego. Después, se empezó a trabajar en los procedimientos matemáticos los cuales debían obtener cada una de las probabilidades de cada elemento en el juego y de esta manera, modificarlo para que la casa tuviera menos probabilidad de ganar que el jugador. Una vez los cálculos estaban hechos se pensó en la forma estética del juego para que fuera visualmente atractivo. Al terminar de hacer todos estos pasos, cada grupo jugó su juego por lo menos cien veces para poder comprobar las probabilidades y poder después analizar los resultados. Todos estos procesos fueron al final presentados en cada una de las clases para poder recibir retroalimentación para la presentación final.

La presentación del Casino Matemático es una tradición rochesteriana a la que anhelamos llegar desde que lo jugamos en Escuela Media. Ese día en el que como unas pequeñas niñas nos llevaron al bloque de Escuela Alta, nos presentaron a los profesores y empezamos a jugar con los estudiantes de Bachillerato. Pues ahora, nosotros somos los estudiantes de Bachillerato, y el Casino Matemático era nuestra responsabilidad. Se abrieron las puertas de los salones del piso de matemáticas, se organizaron las mesas y sillas en el aula compartida, toda la promoción de Noveno nos encontramos vestidos de blanco y negro; después de organizar nuestro tablero, dados, ruleta y dulces, vimos llegar a nuestros jugadores. Filas de niños curiosos que, aunque tímidos, estaban emocionados por pasar un rato de diversión. Se ubicaron en nuestra mesa, y ¡que empiece el juego! De a grupos de cuatro o seis, cada 6 minutos, los estudiantes se rotaban de equipos. Los líderes de cada grupo usaban el primer minuto para explicar las reglas y premios del juego. Durante los siguientes 4, los niños y niñas jugaban, aprendían, y se divertían. Tiraban el dado esperando que su predicción fuera correcta y llevarse una gomita más a casa. Apostaban monedas de chocolate, para ver cuántas más podían ganar. Intentaban sacar los cubos de colores correctos a ciegas y llevarse el dulce más grande del montón. Al final del minuto 6, los grupos de estudiantes habían comprendido al menos una ley básica de probabilidad, más de 5 dulces y la memoria que llevarían con ellos por sus años en el Colegio Rochester.





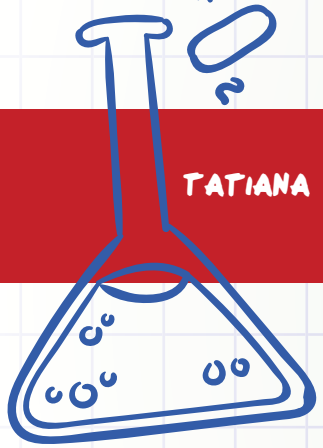


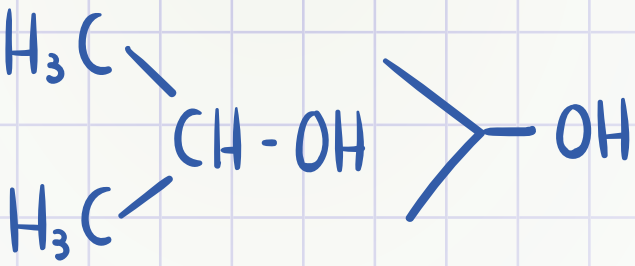


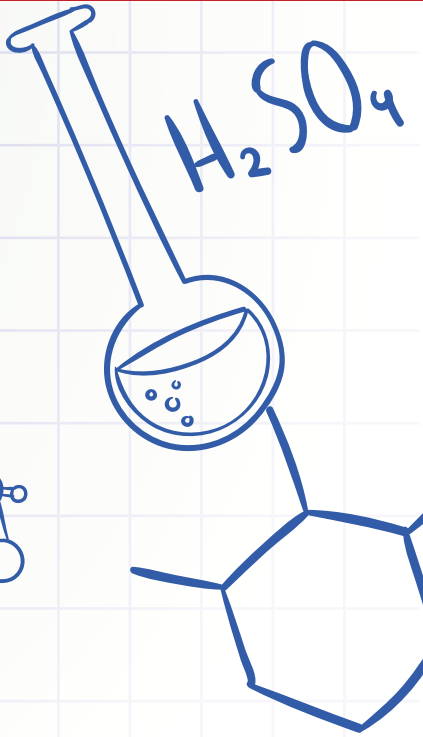
HOW A CATALYST WORKS?

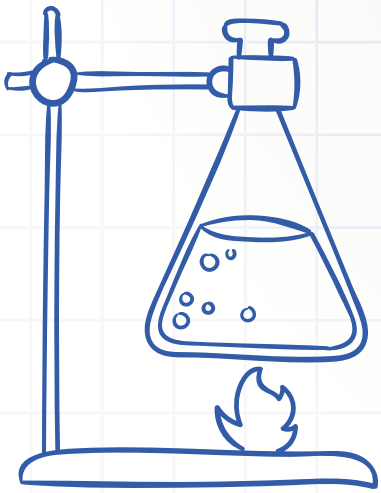
ENZYMES AND REACTION RATES

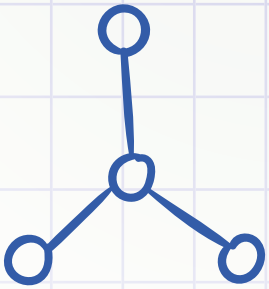
TATIANA MORENO SUAREZ, SARA MARÍA LOZANO BERNAL AND ANA MARÍA CAMPOS
CHEMISTRY AND CONSERVATION-+











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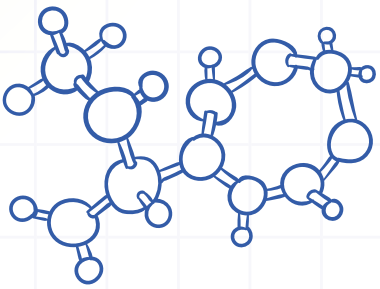

Which is faster: walking to school, or riding in a bus or car? Determining how fast a person can get to school is not all that different from calculating the rate of a chemical reaction. However, fast and slow are inexact terms.

Chemists, engineers, chefs, welders, concrete mixers, and others often need to be specific. For example, a chef must know the rate at which a cake cooks to determine when it will be ready to serve.

Regarding rate reactions, the students of Chemistry and Conservation-2 are encouraged to apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs, and it is not always an easy assignment for students.

To study this topic, the students do different experiments in order to get the evidence from temperature, concentration, and rate data in a chemical process, then they analyze qualitative and qualitative relationships between these parameters. Finally the students provide an explanation about these relationships.

In order to design a lab experiment to better understand these concepts, as a model, we use "enzymes" that are a specialized class of proteins responsible for catalyzing chemical reactions within the cell.

Enzymes are biocatalysts that, within the mild conditions of temperature, pH, and pressure of the cells, carry out chemical reactions at an amazingly high rate. They are characterized by remarkable efficiency and specificity.

In this investigation, students deepened their understanding of cause and effect and stability and change through a study of reaction rates and equilibrium.

Students investigated and developed explanations and system models of rates of reactions, energy change in reactions, and environmental effects on enzyme function, as well as other related phenomena related to catalyst.

ENZYMES LAB REPORT ABSTRACT

This laboratory was made to develop an experiment that allows analyzing the results of the tests taking into account the topic of enzymes seen in class. When carrying out the experiment, it was necessary to observe and analyze the reactions that each potato and spinach homogenates enzymes had while exposed to different conditions such as: temperature, pH and substances like hydrogen peroxide (H_2O_2) and reach conclusions.

Keywords: Reaction rate, enzymes, catalyst, substrate, denaturalization

THEORETICAL FRAMEWORK

The reaction rate is the speed at which reactions take place and is expressed by the formula: average rate= △ quantity/△ time (1). Enzymes are a biological catalyst and protein that speed up the rate of a specific chemical reaction in the cell. A cell contains thousands of different types of enzyme molecules specific for each particular chemical reaction (2).

The rate of an enzyme-catalyzed reaction increases with an increase in the concentration of an enzyme. At low temperatures, an increase in temperature increases the rate of an enzyme-catalyzed reaction. At higher temperatures, the protein is denatured, and the rate of the reaction decreases dramatically (3). The enzyme's activity depends on certain physical and chemical agents: substrate concentration, enzyme concentration, presence of activators, presence of inhibitors, the pH of the solution and the temperature of the reaction (4).
On the other hand, a catalyst is a substance that, without being modified or consumed during the process, changes the speed of a chemical reaction. Catalysts can be positive, when they speed up the reaction rate, or negative, when they slow down the reaction rate (5). Enzymes are specific catalysts: each enzyme catalyzes a single type of reaction, and almost always acts on a single substrate or on a very small group of them. In a reaction catalyzed by an enzyme: the substance on which the enzyme acts is called the substrate (6). Because active sites are finely tuned to help a chemical reaction happen, they can be very sensitive to changes in the enzyme's environment. Enzymes may change to the different environmental conditions, for example when enzyme is exposed to excessive heat, substances that modify the pH, alterations in concentration, high salinity, molecular agitation, etc., the chemical bonds that maintain the structure of the protein are broken, this process is called denaturation (7).Finally, an enzyme inhibitor is a molecule that binds to an enzyme and decreases its activity. The binding of an inhibitor can stop a substrate from entering the enzyme's active site and/or hinder the enzyme from catalyzing its reaction. Inhibitor binding is either reversible or irreversible (8).

The enzyme catalase converts hydrogen peroxide into water and oxygen, thus helping an organism cope with toxic O_2 species. According to the structure and sequence, catalases can be divided into three classes (Fig. 1): monofunctional catalase or typical catalase, catalase-peroxidase, and pseudocatalase or Mn-catalasee (Zhang et al., 2010). Catalase performs its rapid destruction of hydrogen peroxide in two steps.

First, a molecule of hydrogen peroxide binds and is broken apart. One oxygen atom is extracted and attached to the iron atom, and the rest is released as harmless water. Then, a second hydrogen peroxide molecule binds. It is also broken apart and the pieces are combined

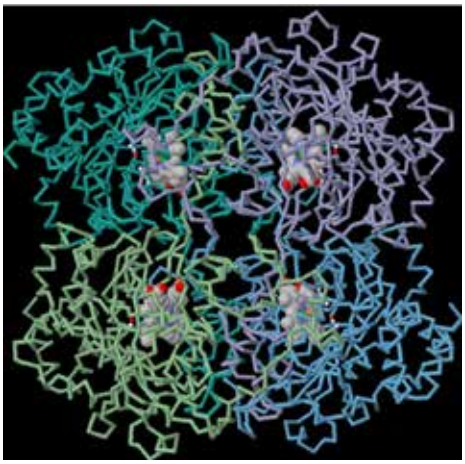

Figure 1. Catalase, image from RCSB PDB Protein Data Bank https://pdb101.rcsb.org/motm/57

with the iron-bound oxygen atom, releasing water and oxygen gas.

Currently, there are at least eight strains that can produce catalases (Zhang et al., 2010): Penicillum variable, A. niger, S. cerevisiae, Staphylococcus, Micrococcus lysodeiktious, Thermoascus aurantiacus, Bacillus subtilis, and Rhizobium radiobacte. Catalases are used in several industrial applications such as food or textile processing to remove hydrogen peroxide that is used for sterilization or bleaching.

EXPERIMENTAL DEVELOPEMENT

Materials and reactives:

- Test tubes (20
- Creole potato (100g)
- Hydrogen peroxide (5%)
- Spinach (100g)
- HCl (3M)
- Pipettes (1)
- NaOH (3M)
- Water (37 degrees)
- Water (80 degrees)
- Phosphate buffer (0.02M pH 7)
- Droppers (2)
- Distilled water
- Thermometer
- HgCl2 (2%)
- MnO2(s)
- Tube tweezers
- 5 mL pipettes (3)
- Pipettes of 1 mL (2)
- Heating plate (1)

Safety information about the reactants used in the lab:

1. Make sure group members wear their lab coat, gloves, and goggles properly.

2. Be careful when using hydrogen peroxide for the experiment and avoid contact with skin and eyes.

3. Make appropriate use of materials borrowed for the laboratory.

PROCEDURES

Tube	Time of incubation
1	80°C (place tube for 7 minutes)
2	37°C (place tube for 5 minutes)
3	Room temperature
4	In freezer 4°C (leave for 40 minutes)

Table 1. Effect of the temperature in the reaction rate of catalase.

For this experiment we use vegetable cells, from spinach and potato fragments.

1. Preparation of the homogenates: It is the mixture, separately, from fresh potato fragments (50g), and spinach (50 g) in a blender with 150 mL of distilled water, until part of the sample. Place each homogenate in a previously labeled beaker.

2. Verification of catalase activity: Take 3 test tubes, in the first and second tube use 3 mL of each homogenate (shake them before use) and in the third distilled water as a blank. Make a mark on each tube to indicate how far the homogenate reaches. Then 3 mL of hydrogen peroxide was added to each tube. Observe and record the change in the liquid level of each tube.

3. Recognition of the exothermic or endothermic character of the reaction: To a test tube placed in a rack, add 2 mL of the potato homogenate and take its temperature. Add 2 mL of hydrogen peroxide to the tube and begin to observe the temperature variations.

4. Temperature effect on enzyme activity: Take 4 test tubes, add 5 mL of homogenized potato, then label and incubate according to the table 1.

Add 2 mL of hydrogen peroxide to each tube, observe the reaction and describe. Write down the observations and results in the corresponding table.

5. Effect of pH on enzyme activity: Take 3 test tubes, add 1 mL of potato homogenate to each tube, then label and add reagents according to the table 2.

Tube	Reactive added
1	3mL of HCl 3M
2	3mL of NaOH 3M
3	3 mL of phosphate buffer 0.02 M (pH= 7.0)

Table 2. Effect of pH in the reaction rate of catalase

6. Comparison between the activity of the enzyme and that of an inorganic catalyst and evaluation of inhibitors of the enzyme activity: Take 7 clean and dry test tubes, measure the reagents indicated in the table 3.

	Tube						
Reactive	1	2	3	4	5	6	7
Potato (piece)	1					1	
H2O2 0.5% (drops)	10	10	10	10	10	10	10
Mercury chloride (mL)			1				
Potato extract (mL)			1				
MnO2 (g)				0.01	0.01*	0.01	1

** Tube 5 should be heated with manganese dioxide (MnO2), then cooled to add hydrogen peroxide.*

Compare the results in each tube and write your observations in your notebook.

RESULTS AND DISCUSSION

In the first experiment with the potatoes and the spinach homogenate, we observed that once the H2O2 was added to the blended potato, it triggers bubbling of oxygen (Figure 2). This happened due to a special protein produced by the potato to protect itself against oxidative stress(9) (oxidative stress is an interference in the balance between the production of reactive oxygen species and antioxidant defenses).

With spinach, the same thing happened. It also triggered bubbling of oxygen, this is due to the reaction of the enzyme catalase with the H2O2. Once (10) the enzyme catalase comes into contact with H2O2, it starts breaking it down into water and oxygen. Oxygen is a gas and therefore wants to escape the liquid, which then causes the foaming in the reaction. Finally, the tube with water did not have any reaction, as the water does not have enzymes.

Regarding the energy involved in the process (experiment 2), it was observed that there was an increase of temperature after adding the hydrogen peroxide. The temperature before adding the reagent was 20°C and then after it was added the temperature rose about 6°C until it reached 26°C in a period of two minutes. That means that the reaction catalyzed by the catalase enzyme in an exothermic process (Figure 3).

In the third experiment, as mentioned before, there are some factors that affect the activity and the function of the enzymes. In this part the factor that had to be taken into account was the temperature. Increasing the temperature generally speeds up a reaction, and lowering the temperature slows it down. However, extremely high temperatures can cause an enzyme to lose its shape (become denatured) and stop working (11). This analysis is correct according to the observations made in table 4.

Tube	Incubation conditions	Observations after adding 2mL of H_2O_2
1	80°C (7 minutes)	There was no reaction since the enzymes at 80° are cooked and denatured
2	37°C (5 minutes)	The rate of reaction was fast, and it produced quite a lot of oxygen.
3	Room temperature (25°C)	The reaction was slower and the amount of oxygen was less than the others.
4	4°C (40 minutes)	There was a slow reaction, once the 2 mL were added to the tube, the temperature started to rise.

Table 4. Temperature effect on the enzyme reaction.

Each enzyme has optimal environmental conditions, one of them is the pH because a change in the optimal pH will slow down the activity of the enzyme. Extreme pH values may cause enzyme denaturation (11). As is shown in the results (Table 5), when the pH reagent exceeds the pH range in which the enzyme can carry out the reaction, that is why in the first and second tube the enzymes are not in the conditions to accomplish a reaction. In the third tube a normal reaction was observed, we can conclude that the optimal pH for the catalase activity in 7, as many other biochemical processes of the human being.

Tube	pH	Observation
1	1	There was not a reaction, and after adding the 3 mL of HCl 3M the color of the solution changed to a dark green.
2	14	There was not a reaction, and after adding the 3 mL of NaOH 3M the color of the solution changed to a dark green.
3	7	There was a normal reaction.

Table 5. pH effect on the enzyme reaction.

Finally, in the last experiment the reaction with inorganic catalysts was observed, the effect of the particle's size of the catalyst and the presence of inhibitor in the reaction.

As shown in table 6, in tube one since there were just a few bubbles, it is possible to analyze that since the enzyme was in a pretty big particle, the reaction rate was slower and lesser, because the smaller the particles, the faster the reaction must be (12). In the third tube, there was not a reaction after adding the mercury chloride, because mercury irreversibly binds to an enzyme by changing its conformation and preventing its normal substrate from binding (13).

Lastly the tubes from 4-7 that had manganese oxide that is an inorganic catalyst, it is shown that under different conditions it can still accomplish its function, because since it is an inorganic catalyst they won't be affected by external factors such as temperature.

Tube	Observation
1	Few bubbles
2	No reaction
3	No reaction
4	Bubbling and color change
5	Reaction and bubbling faster than tube 4
6	Reaction and bubbling faster than tube 4
7	Few bubbles

Table 6. Comparison with inorganic catalysts, the effect of the particle's size and the presence of inhibitor

CONCLUSION

At the end of the experiment after doing the analysis and observing the results, it was possible to prove that the hypothesis proposed in the introduction was right. In each of the parts of the experiment the enzymes were exposed to different conditions, and in those where the enzymes could not make their function correctly, it became denatured.

Another hypothesis that can be concluded after making the analysis is that if temperature, substrate concentration, enzyme concentration and pH are factors that dictate the rate at which enzymes denature proteins, then an increase in these factors will result in an increase of the rate of these reactions. And finally another way to study how enzymes work, could be proposing a different lab that has a focus in understanding the enzymes active sites.

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Advanced Rythm

Car Depreciation

Juliana Lozano, Mariana Vásquez, Josué Ariza, Maria Camila Benites,
Manuela Rodriguez, Gabriela Guzmán and Catalina Guerrero

Description of the Problem:

We needed to analyze the prices of three different cars over time as if we were going to buy such. For this situation, we used a Ford Fiesta, a Nissan Versa, and a Chevrolet Sonic. What we were asked to do was to look for the prices of the car in excellent, good and fair condition over the past 5 years. Do some graphs and take out the equations for each and then analyze if the functions accurately describe the relationship between the age of the car and the suggested retail price, what is the depreciation rate, which car is better for purchasing and what do the values mean.

Scan to know more about the mathematical procedures

FORD FIESTA (2015)

FIESTA SEDAN SE AUT			
Years	Price when in excellent conditions	Price when in good conditions	Price when in fair conditions
0	46,99	46,99	46,99
1	40,5	39	35,4
2	31,8	30,3	27,5
3	30,1	28,8	25,6
4	26,5	24,8	22,5
5	22,8	23,6	21,4

NISSAN VERSA (2015)

NEW NISSAN VERSA AUT			
Years	Price when in excellent conditions	Price when in good conditions	Price when in fair conditions
0	44,49	44,49	44,49
1	40	38	35
2	33,1	31,1	28,1
3	31	29	26
4	27,6	25,6	22,6
5	31,9	29,9	26,9

FORD FIESTA (2015)

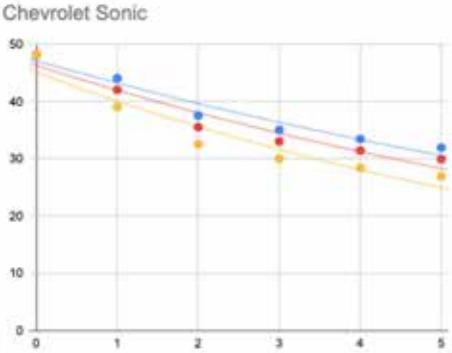
FIESTA SEDAN SE AUT			
Years	Price when in excellent conditions	Price when in good conditions	Price when in fair conditions
0	46,99	46,99	46,99
1	40,5	39	35,4
2	31,8	30,3	27,5
3	30,1	28,8	25,6
4	26,5	24,8	22,5
5	22,8	23,6	21,4

GRAPHS & EQUATIONS

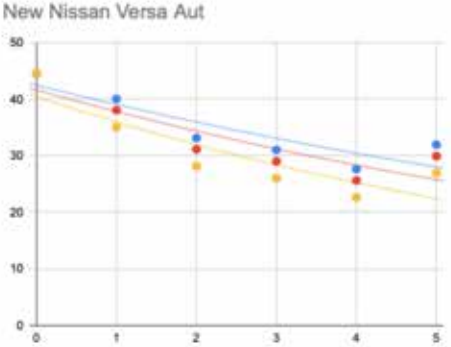
Excellent Good Fair

Ford Fiesta

Chevrolet Sonic



Nissan Versa



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Equations by **excel**

- **Excellent condition:** y = 46.1e^-0.144x
- **Good condition:** y = 43.4e^-0.164x
- **Fair condition:** y = 46.99e^-0.16x

Depreciation Rate: **-0.156**

Equations by **excel**

- **Excellent condition:** y = 47.1e-0.0864x
- **Good condition:** y = 46.3e^-0.0983x
- **Fair condition:** y = 45.1e^-0.119x

Depreciation Rate: **-0.1012**

Equations by **excel**

- **Excellent condition:** y = 42.4e^-0.0832x
- **Good condition:** y = 41.6e^-0.0961x
- **Fair condition:** y = 40.4e^-0.118x

Depreciation Rate: **-0.0991**

Equations by **hand**

- **Excellent condition:** y = 46.99e^-0.15x
- **Good condition:** y = 46.99e^-0.14x
- **Fair condition:** y = 46.99e^-0.16x

Depreciation Rate: **-0.1466**

Equations by **hand**

- **Excellent condition:** y = 48.13e-0.08x
- **Good condition:** y = 48.13e^-0.10x
- **Fair condition:** y = 48.13e^-0.12x

Depreciation Rate: **-0.0979**

Equations by **hand**

- **Excellent condition:** y = 44.49e^-0.07x
- **Good condition:** y = 44.49e^-0.08x
- **Fair condition:** y = 44.49e^-0.10x

Depreciation Rate: **-0.0823**

Overall equation Fiesta:

$$y=46.99e^{-0.147x}$$

Overall equation Chevrolet:

$$y=48.13e^{-0.098x}$$

Overall equation Nissan:

$$y=44.49e^{-0.082x}$$

Model for the equation:

y=Ce^rx

Full charts with procedures

C

- The initial price of a new car
- Y-intercept

r

- The depreciation rate the price of a new car
- How much the the value of the car falls per year

Does the function accurately describe the relationship between the age of the car and the suggested retail price?

After the process of making the functions we think the function does accurately describe the relationship, this is because as the years go by the car's price will decrease in an exponential way, as it is shown in our functions. The retail price for a car in excellent conditions may vary within those three models. For example, the price for a Nissan Versa in excellent condition is significantly greater than what happens with the Ford Fiesta. But regardless of those types of differences, the functions show a correct relationship. There are differences between the equations obtained by the graphing calculator and the ones obtained by making them by hand, but this is only due to the different calculations and does not imply a big difference in the final relationship.

Representation of Variables and Depreciation Rates

In the multiple equations created for the different depreciation rates for each car model, each variable represents different components that are key for solving the suggested problem. Taking into account that each equation created is an exponential function, the X represents the age of the car in years or how much time has passed since the launching of each car model. Y represents the retail price depending on how old is the car and C represents the initial retail price of the car when the model was launched. Lastly, r represents the depreciation rate of each car model or how much the price decreases as time passes. In our case, for the Ford Fiesta, the depreciation rates were the following: in excellent conditions 14.5%, in good conditions 13.8%, and in fair conditions 15.7%. For the Chevrolet Sonic, the depreciation rates were the. following: in excellent condition 8.2%, in good conditions 9.5% and lastly in fair conditions 11.6%. Last but not least the depreciation rates for the Nissan Versa were the following: in excellent conditions 6.7%, in good conditions 7.9%, and in fair conditions 10.1%. To determine which car is the best to buy, the depreciation rate must be the least between the three of them since in the case of selling it in the future the profit will be higher than if we choose to buy the car with the highest depreciation rate.

Which car would you purchase?

With the information that we were able to get, we can analyze which car would be the better purchase. First of all, just by seeing the depreciation rates in general we are able to see that the depreciation of the Ford Fiesta is the highest, with a rate of -0.1466. This is the highest depreciation rate, given that the Chevrolet rate is -0.0979 and the Nissan is -0.0823. With that in mind, we can choose the car that we could buy, which would be the Nissan Versa. Is the car with the smallest depreciation rate which would make better purchase and will give us the importunity to earn more if we ever were to sell it. Also, the price of a Nissan in excellent condition is much higher than any of the other two models. So if we bought a Nissan Versa in excellent conditions, kept it that way, and sold it in a few years it would be the best-sold car out of the three models.

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The Beta of a Stock

Juliana Lozano, María Camila Benites, Josué Ariza, Catalina Guerrero, Manuela Rodriguez, Gabriela Guzmán and Mariana Vásquez

PHASE 1

Choose a well-known company, and one from S&P500. Find the weekly closing prices of their stocks at finance.yahoo.com. Copy the data into a spreadsheet. By using the adjusted closing price, find the percentage change for each week. What do these percentages represent?

Percentage of change

$$\%\ \text{of}\ \ change = \frac{P_1 - P_0}{P_0} \cdot 100$$

For each week we find the percentage change, it represents the degree of change in the stock market over the year 2021 for both companies. Stock changes every day by market forces (supply and demand), these changes can mean prices to go up or down.

Scan here to see the charts

Mercedes Benz

The company overall kept a steady and consistent change over the year, except for December. In this specific week, the stock decreased 17% from $97 to $80. According to Forbes (2021) "The fall is primarily due to the spin-off Daimler's commercial vehicle business and the subsequent listing of Daimler Truck Holding AG 0n December 10 on the Frankfurt Stock Exchange."

This launch means a rebranding of the different brands under Daimler Ag such as Mercedes-Benz.

Ford Motor Company (S&P500)

The Ford company kept a usual rate of change during the year 2021, however, in the last week of May and October there was an evident peak in stock. In May the stock increased 19% from $12 to $14.

The main reason for this is that during this week, the company announced the launching of the new Ford F-150 Lighting 2022 which is "the company's first battery-electric full-size pickup truck" (Ford Authority, 2021). After this launch, there were over 20,000 reservations already done. Then as for the last week of October, the stock increased 15.2% from $16 to $19. This is mainly due to the release of the financial performance disclosure, which revealed that "the automaker still made a decent profit despite the ongoing microchip shortage" (Ford Authority, 2021), this caused more interest from investors as well as the reveal that Ford plans to electrify most of its global lineup.

PHASE 2

Use Excel to draw a scatter plot diagram. Treat the percentage of change in the S&P500 as the independent variable (x), and the percentage change in the stock you chose as the dependent variable (y). What type of relationship seems to appear between the two variables?

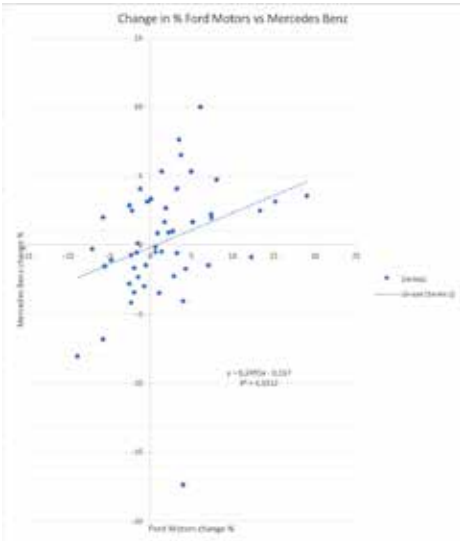
Relationship

The relationship between Ford (USA) and Mercedes-Benz (Germany) is that both were affected by the pandemic, lack of chip production, and location of assembly factories.

During the pandemic, the production of chips used for cars severely diminished, people didn't think about buying cars, technology was the priority. Overall, in 2020, car production dropped by 16%. Specially impacting Europe with an average 21% drop with cases of even 40% drop and in the US it dropped by 19%.

In this case, Ford (US), made an alliance with Global Foundries, a company based in the US, that produces chips, so Ford could continue production at a faster rate than Mercedes-Benz (Europe) buys the chips from TSMC, a Taiwanese company that produces 70% of the chips worldwide.

During the pandemic, shipping the chips overseas, especially from an Asian country, was basically impossible.



Scatter plot

Data from tables in Phase 1, including percentages of change for Ford Motor (x) and Mercedes-Benz (y)

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PHASE 3

Find the line that best fits using least-square regression. Find the beta of your stock and provide an interpretation.

What is beta?

A coefficient that measures the volatility of a stock compared to the entire market. If a stock has a beta of 1.0, it indicates that its price activity is strongly correlated with the market.

Function: y= 0,2491x - 0,157
Beta: 0.2491 = 80% less volatile than the market

β = 1 exactly as volatile as the market (stable)
β > 1 more volatile than the market (good)
β < 1 less volatile than the market (risk)
β = 0 uncorrelated to the market
β < 0 negatively correlated to the market

As said, Beta (β) measures the volatility of a particular stock compared to the market. The car stock market (taking Mercedes Benz and Ford data) has a Beta of 0.2491, meaning it is 80% less volatile than the market.

This is very high and shows that the car stock market was at enormous risk in terms of rentability during the last year. Low Beta = high volatility, and high volatility means the prices analyzed have been very different between them and present a big risk, which was what happened during the pandemic with these two companies.

Car stock market

Due to the pandemic and the sanitary restrictions the productions of semiconductor chips was affected and it had to be stopped for a while.

Automobile companies stopped production to avoid declines in sales.

When demand increased for every automobile company the chip shortage began.

Car companies from around the world started experiencing drops on their market, one of those companies was Mercedes-Benz. The Mercedes-Benz market dropped since the chips they used came from Asia, while companies like Ford had made alliances with globalfoundries to get their chips within the USA.

This way Ford Motors' sales were not affected and their stock did not drop like with companies like Mercedes-Benz.

Mercedes' stocks faced a huge drop because their chips come from Asia and they assemble cars in Germany, while their biggest buyers are in the USA, while Ford's chips come from the US, they assemble in the US and their biggest buyers are in the US.

Scan to watch the discrepancy in the stock market explanation video.

Mercedes-Benz

Parent company: Daimler AG
Country: Germany
Assemble: Germany
Chips: TSMC (Taiwan) sells to Nvidia Corp
TSMC: productor of 70% of car chips worldwide
Highest demand: China and USA

Ford Motor Company

Parent company: Ford Motor Co
Country: USA
Assemble: USA
Chips: GlobalFoundries (USA)
GlobalFoundries: global leader in feature-rich semiconductor manufacturing
Highest demand: USA and Latin America

The graphs above show how was the stock market for both car companies in 2021.

For Mercedes-Benz, it seems they didn't do too well.

Overall, the stock fell for about -24.3% due to the affected semiconductor shortage of the premium car's market production. The company said "a lack of semiconductors delayed the supply of vehicles despite strong demand for passenger cars and vans in all segments and across all regions."

Regarding Ford Motor Company, the stock increased +19.97% over the whole year.

Some of the reasons according to the investor Rekha Khandelwal are "its upcoming all-electric pickup truck, the F-150 Lightning."

Also she mentions that the increase in stock for Ford may be due to "Ford boosted investment to increase capacity of its Rouge Electric Vehicle Center in Michigan" causing a high demand.

The beta calculation is used to help investors understand whether a stock moves in the same direction as the rest of the market. It also provides insights about how volatile–or how risky–a stock is relative to the rest of the market.

A beta that is greater than 1.0 indicates that the security's price is theoretically more volatile than the market.

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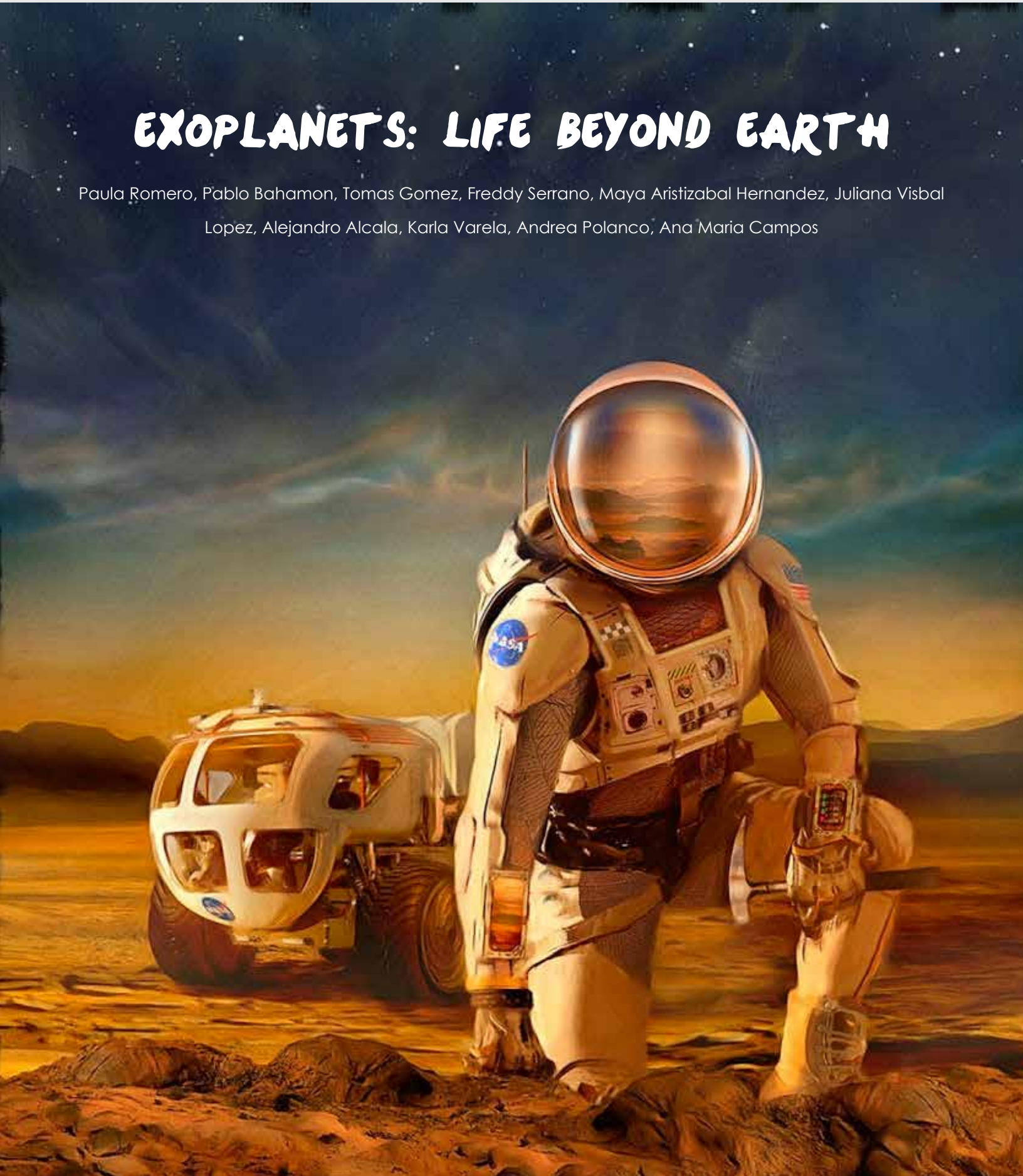
EXOPLANETS: LIFE BEYOND EARTH

Paula Romero, Pablo Bahamon, Tomas Gomez, Freddy Serrano, Maya Aristizabal Hernandez, Juliana Visbal Lopez, Alejandro Alcala, Karla Varela, Andrea Polanco, Ana Maria Campos



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Abstract

Why is it important to know how to find life on exoplanets? Is it possible to grow plants on exoplanets?

The answer to these questions is very simple, humanity looks for life on exoplanets to learn more about our own origins, and that normally doesn't mean aliens like portrayed in movies, but microscopic organisms that are impossible to see normally.

In this paper you will find information about exoplanets and if finding life is possible. The purpose of this research is to understand the necessary elements a planet needs to have in order for life to exist.

All of this research has a huge connection with Johannes Kepler and his understanding of circular motion hence relating it to physics, with the physicochemical conditions required for plant growing and how these conditions have an effect on the plant characteristics.

This is an interdisciplinary project with students and professors from the areas of physics, biology and chemistry, in which a prototype was built with the aim of creating different controlled environments for plant growth in a hydroponic medium.

Scan to watch the video

Introduction

Are humans alone? An interesting question that humanity has tried to answer since the beginning of time.

Astronomers have tried to find life on other planets to begin to answer this question. In addition, they believe that an exoplanet atmosphere might answer the ironic concept of life beyond Earth, although there is not a concrete definition of life beyond Earth, signs of life in an exoplanet atmosphere are being researched. Therefore, exoplanets are planets that orbit around other stars that are not the solar system's sun. They do not orbit in the solar systems.

They are often very hard to find with telescopes, as they are hidden in the star that they orbit as they are usually very bright. Therefore, astronomers use other study methods to find and study these planets.

Astronomers look for exoplanets by looking at the effects that planets have on the star that they orbit. More than 4,000 exoplanets have been confirmed to exist in the Milky Way, but most likely more than a billion exoplanets might exist.

The habitable zone is a commonly known concept that explains the orbital distance from a star where temperatures could potentially allow liquid water to form on a planet's surfaces.

Although many other conditions are related to the seeking of habitable exoplanets, the habitable zone is the first cut to it. On the other hand, the possibility of life beyond Earth would refer to the complete change of humanity.

As a fact exoplanets are being discovered for a purpose of revealing humanity's place in the universe. It could reveal a self-reflection of Earth, with this in mind the slightest chance of life in exoplanets would mean that humans are not alone.

Johannes Kepler displayed a new perspective of circular motion by explaining three laws of planetary motion. A planet is characterized by mass, radius, and mean density which also relates to its orbital distance and atmosphere.

The different types of exoplanets have a certain mass and radius to understand their meaning.

Taking this into account, humans might not be alone in the universe. All of the possibilities and the number of exoplanets are important to reveal humanity's place in the universe.

Regarding the physicochemical conditions for growing plants on other planets, research suggests that most of the exoplanets have some of the nutrients plants need to grow and survive (Figure 2).
But because of the extreme conditions, plants would need to grow inside a controlled environment.

Figure 2. The 16 essential elements for plant growth.
https://activeagriscience.com/nitrogen-why-managing-it-matters/

Also, just like on Earth, nutrients in soil may vary from place to place.

When soils are rich in nutrients such as nitrogen, phosphorus and potassium, plants grow well. But when the soils are not as rich, plants do not grow as well.

In that case, fertilizers help to double or triple the crop yield and contain 5% or more of primary plant nutrients.

These fertilizers also supply nutrients that some soils do not have.

To grow inside a controlled environment nutrient management is a method of using nutrients as efficiently as possible to improve productivity without harming the environment.

In hydroponics, nutrient management would be a very necessary step.

Total salt concentration, pH, acidity/ alkalinity and nutrient concentration ratio are four main characteristics to focus on for nutrient management in soilless culture.

THEORETICAL FRAMEWORK

Kepler's laws of planetary motion:

Johannes Kepler defined three laws of planetary motion to understand how planetary bodies orbit around the sun. Kepler was a recognized astronomer from the 17th century. When working in the understanding of the orbit of Mars, he defined that planets orbit in an elliptical way, not in a circular way.

Ellipses are defined by two points called focuses. Based on that, Kepler defined his first law: each planet orbits about the sun in an ellipse. The sun's center is always located at one focus of the orbital ellipse.

Kepler's second law states that there is an imaginary line joining a planet and the sons' sweep with an equal area of space during an equal time. Thus, planets do not move with constant speed along their orbits but their speed varies so that this line moves to equal parts of an area at equal times.

Kepler's third law states that the period for a planet to orbit the sun increases rapidly with the radius of its orbit.

The Habitable Zone:

It is defined as the distance from a certain star at which liquid water could exist orbiting the planet's surface. These are also known as Goldilocks zones, where conditions might be just asserted for life.

Based on that, researchers have been trying to find a possibility of habitable exoplanets with Earth-like conditions.

Habitable exoplanets most likely relate to their stars which are the dominant force for any planetary system.

Habitable zones might be capable of hosting life if they're related to hotter stars. On the contrary, dwarf and smaller planets have tougher chances of being considered as habitable.

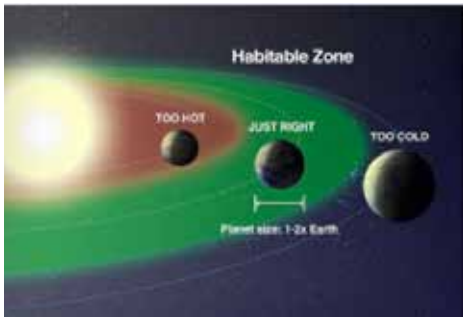


Figure 3. The Habitable Zone (Photo Credit: NASA)

With this in mind, some conditions for habitable exoplanets are temperature as it influences liquid water, source of energy to power metabolism, and growth on the potential life and elemental compositions for the planet. Although there are many limits for habitable zones, life is still being looked for even if it's hundreds of light-years away yet the molecular evidence and the advance in technology could answer if humanity is alone in the universe. Recall that most exoplanets are not tightly connected to stars.

In other words, these might be loosely orbiting between stars.

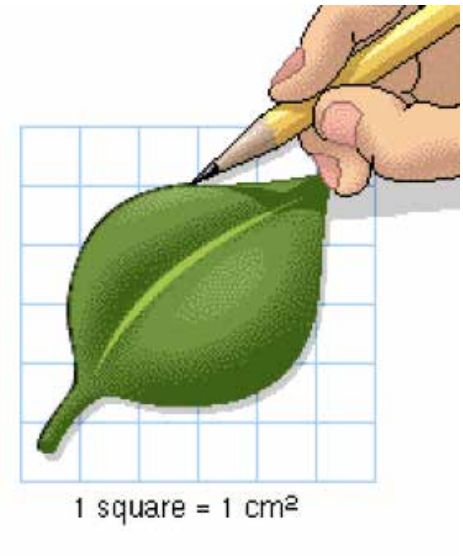


Figure 4. Specific Leaf Area (SLA).

Leaf Area:

It is easy to measure leaves, and they are also the parts of a plant most responsive to their environment.

The combination of these two factors makes leaf area measurement extremely useful to scientists and growers.

Besides, leaves are one of the main plant organs and are responsible for the productivity of a plant, and on a larger scale, of an ecosystem or a farm. Therefore, an understanding of leaf area and the different methods to measure it is important. Leaves are one of the most important organs that plants have. Photosynthesis, the process by which plants produce food using light, carbon dioxide (CO2), and water, takes place in leaves.

The structure and makeup of leaves are designed for photosynthesis.

Adaptation to the environment: Since leaf size is an adaptation and response to the environment, it can be considered an indicator of the conditions plants grow in: climate, topography, soils, etc. These relationships are interesting for geneticists, ecologists, and agronomists.

The leaf area is considered the easiest way to measure plant productivity. Since photosynthesis takes place in the leaves it is important to measure the rate of photosynthesis.

Students at Rochester school, learned how to measure the leaf area to compare the leaf growing in plants growing under different conditions.

Even though there are many methods to measure leaf area, such as image segmentation using computer data analysis, doing the method by hand allowed the students to understand how plants grow and relate their knowledge in math with natural science.

Students use a non destructive method to measure the specific leaf area (SLA).

Using graph paper, students draw the leaf area from each plant, choosing one leaf randomly.

As shown in the image, each square represents one centimeter.

Leaves from lettuce and arugula were measured every week to compare the leaf growing under different condition.

Electrical Conductivity and pH

Regarding the chemical elements and salts used for nutrient management in plants, scientists know of 16 essential elements that act as nutrients for plants to grow normally. These elements are classified into macronutrients and micronutri-ents, depending on the amount of elements plants need.

For example, plants need large quantities of macronutrients to allow them to grow, photosynthesis process, and reproduce. These macronutrients are carbon, hydrogen, oxygen, nitrogen, phosphorus, and potassium. Plants take up carbon, hydrogen, and oxygen from air and water from the environment, while other macronutrients are taken up from organic or inorganic sources in the soil.

Micronutrients are important but plants only need small quantities of them. Micronutrients include calcium, magnesium, sulfur, iron, manganese, zinc, copper, boron, molybdenum, and chlorine. Plants take them directly from the soil. Additionally, although plants may sometimes take up other elements from the soil, those elements are not essential for them to survive.

In a hydroponic environment nutrients are applied in the form of salts, and when these salts dissolve into water they break down into ions. For example, NaCl breaks down into Na cations and Cl anions. These ions conduct electricity due to their positive and negative ions. Thus, the conductivity of the solution increases with added ions. In consequence the electrical conductivity is a good measure of the amount of salts in the solution. A higher electrical conductivity (EC) means a higher salt concentration, while a lower EC means a lower salt concentration.

Excessively high levels of nutrients induce osmotic stress, ion toxicity and nutrient imbalance, while excessively low values are mostly accompanied by nutrient deficiencies and decreasing plant growth. In soilless culture, total salt concentration of a nutrient solution is the most important characteristic. The pH is a measure of how acidic or basic the solution is. The pH scale goes from 0 to 14, with 7 being neutral. The pH of a nutrient solution influences the availability of nutrients, so it should be maintained in the optimum range.

Nutrient solutions used for hydroponics should have a pH between 5 to 6 (usually 5.5), so the pH in the root environment is maintained between 6 to 6.5. This is the pH range at which nutrients are most readily available to plants. The pH and EC can be adjusted manually.

Analysis

The topics to be analyzed in detail will be; types of exoplanets, which are: Super-Earth, Neptunian, Gas giants, and Terrestrial; The atmospheres of exoplanets will be taken into

account, then there is also some examples of exoplanets, the first discovery of an exoplanet will also be talked about. These topics are all vital to the development of the conclusions.

To put it simply, an Exoplanet is a planet that is beyond our solar system. These planets are classified in 4 types, which are:

Gas Giant: This type of exoplanet is a large planet composed mostly of gases such as helium and hydrogen, these gases are orbiting above a solid core. An example of a gas giant in our solar system is Jupiter. These types of planets are much closer to the star they are orbiting than anything found in our solar system. There are 1,436 confirmed gas giants (As of October 7th of 2021.)

Figure 5.Gas Giant exoplanet. Hot jupiter

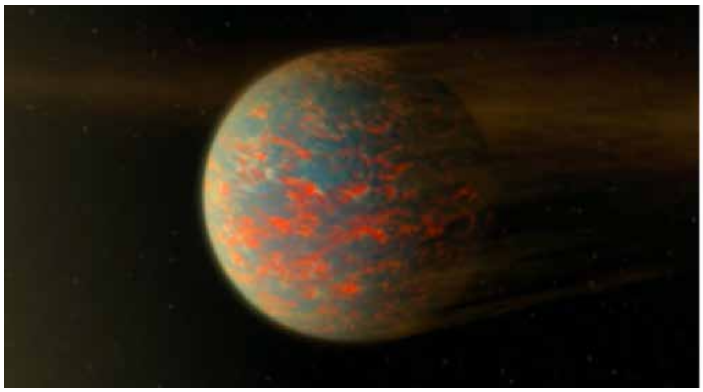


Figure 6.Super-Earth exoplanet 55 Cancire.

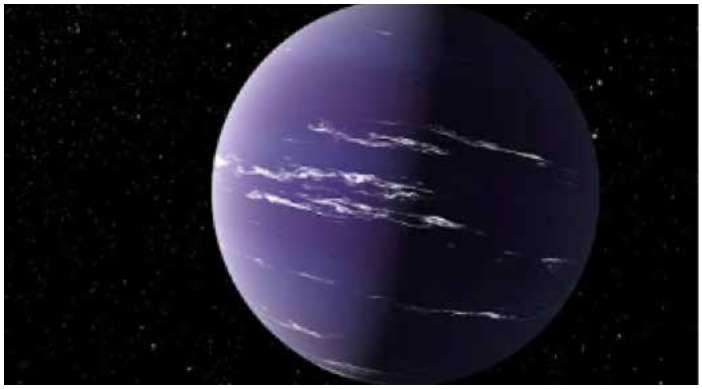


Figure 7. Neptunian exoplanet. TOI-1231 b.

Super-Earth: Super-Earths are exoplanets that normally have twice the size of the earth and can have up to ten times its mass. These planets are usually more massive than Earth but are at the same time lighter than planets like Neptune or Uranus. There are 1,389 confirmed super piles of the earth (As of the 7th of October of 2021)

Neptunian: Similar in size to planets such as Neptune or Uranus. These types of planets usually have atmospheres composed of gases like hydrogen and helium and their cores are made of rock and heavier metals (There are 1,532 planets discovered as of the 7th of October, 2021)

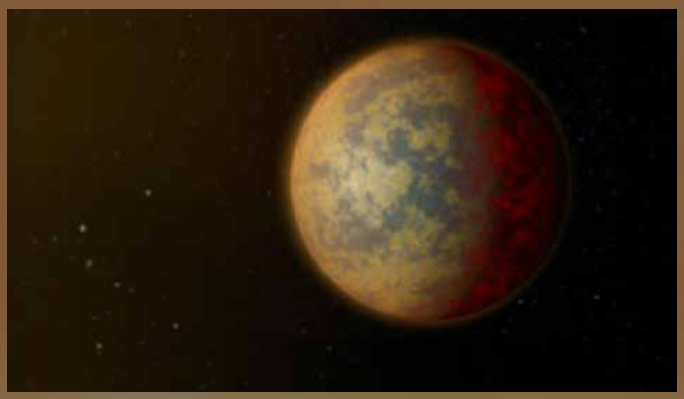


Figure 8. Terrestial exoplanet. TRAPPIST 1d.

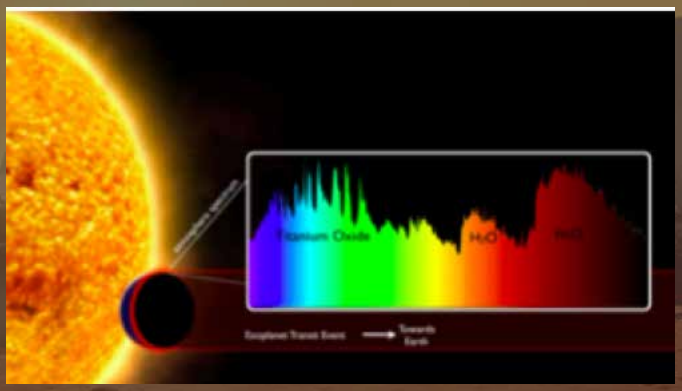
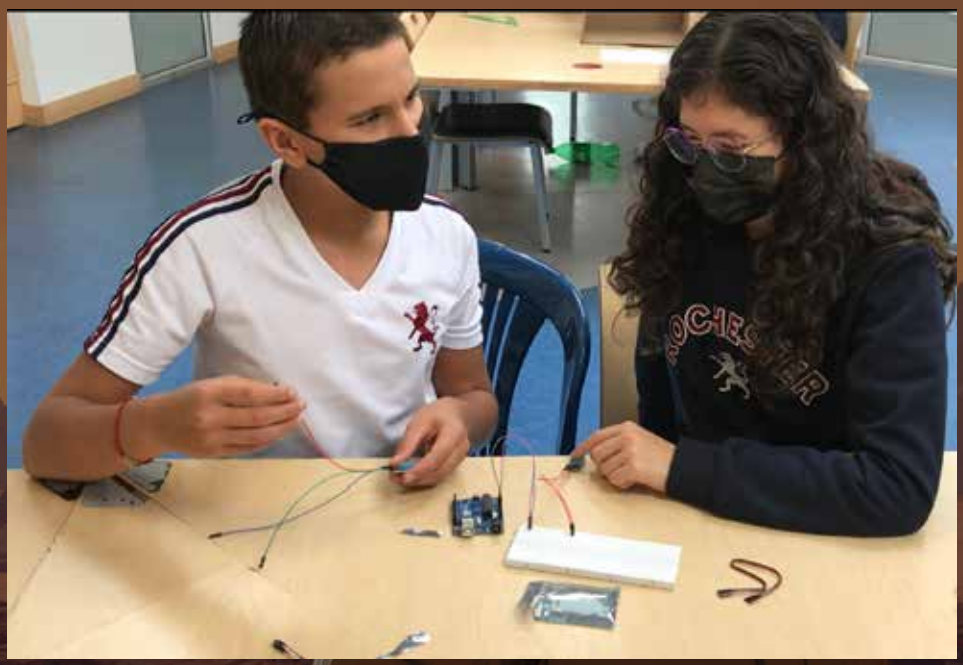


Figure 9. Atmosphere of exoplanets.

Terrestrial: Examples in our solar system of terrestrial planets are Earth, Mars, Mercury, and Venus. Planets that are rocky and are from half to twice their radius are considered terrestrial planets. Anything bigger than that is considered a Super-Earth. Together with super-earths, these types of planets are the ones most possible to have life on them (There are 166 confirmed discoveries of terrestrial planets, as of 21st of September 2021) Although there are various exoplanets they all have a common atmosphere that demonstrates the planet beyond the Earth's solar system. Exoplanets circling sun-like stars were first discovered in the mid-1990s when radial velocity detections began and accelerated. Many of the exoplanets discovered in the first few years orbited near to their host star due to detection selection effects. As a result, exoplanets have an atmosphere that includes: These planets, dubbed hot Jupiters, circle their star several times closer than Mercury orbits our sun. The hot Jupiters are heated externally by their stars to temperatures of 1000—2000 K, or even more, with semi-major axes of less than 0.05 AU. The high temperature and close stellar vicinity of hot Jupiters were recognized as advantageous from the start for atmospheric detection (Seager & Sasselov 1998).

But for a planet to be habitable, it is also vital that it is found within its star's habitable zone. The habitable zone is important because it determines whether or not there can be water (and therefore life) and some other factors. Planets related to bigger stars have a better chance of being in the habitable zone if the star is bigger, but dwarf planets that have less chance of being habitable.

Regarding the physicochemical conditions for plant growth, we carried out an experimental design in which we included several variables such as pH and the concentration of essential elements included in the nutrient solution. We carry out growth experiments with seedlings in pH between 4 and 8, and modifying the amounts of elements such as iron, copper and potassium, which can be found frequently in the soils of many exoplanets. The pH and electrical conductivity were measured once a week and the nutrient solutions were changed every three weeks on average. Temperature and humidity variables were monitored by programmed arduino boards which were tested during physics class.



CONCLUSIONS

One of the conclusions found was that for a planet to be habitable, it needs to be in its star's habitable zone.

The star needs to be a decent size, and the planet needs to be at least 1 earth size, and at most 20 earth sizes. The atmosphere needs to be composed of elements such as nitrogen, ozone, and oxygen. All these things are needed for a planet to be habitable.

In conclusion, there are various ways of finding exoplanets. Exoplanets are found nearly every week. One of them is attributed to Kepler, something called the transit method. When a planet passes in front of its star, it's called a transit. As the planet transits in front of the star, it blocks out a little bit of the star's light.

Exoplanets are a big idea to understand the beginnings of existence and, if necessary, a solution to environmental problems that could cause issues on Earth. Due to Kepler and all of the actual astronomers, finding exoplanets is very accurate. All the requirements an exoplanet needs to be habitable are important for humanity.

Educating others about exoplanets is a useful way of understanding circular motion and how the universe works. Therefore, physics is extremely important when it comes to astronomy, circular motion and exoplanets.

As a final conclusion, the growth of the seedlings in a controlled environment by means of hydroponic cultivation proved to be successful for the growth of the plants. Research on the relationship of the parameters involved in its growth (pH and electrical conductivity) is ongoing.

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Sustainability

Scan to learn how to plant a tree.

GREEN APPLE DAY OF SERVICE

By: Valerie Villegas Toledo

"Environment: is no one's property to destroy; it is everyone's responsibility to protect" - Mohith Agadi.

The Green Apple Day of Service is a day celebrated around the world in many different countries and schools, where the main purpose is environmental service, seeking to contribute, take action and contribute a grain of sand to face the crises and environmental situations that we face every day.

The idea of this is also to create initiatives and projects related to sustainability, more than 3 million students and 1 million volunteers around the world are participants and leaders of various projects.

This year, on April 22, 2022, the Green Apple Day of Service was held at our school, a day of learning, laughter and environmental awareness.

Students of the School Social Environmental Committee (CASE) organized a series of activities for students. Each grade had a different theme to learn, among which were: the use of water as energy production, the importance of trees, climate change, renewable energy, construction and development of sustainable cities, among others. Through the Learning Lab platform, the themes were chosen and using the resources provided by this platform, the students received a presentation on the designated theme to then perform an activity connected with what they had learned.

From the youngest to the oldest, all had significant participation on this day.

The students of Pre Kinder and Kinder learned about two endemic species in danger of extinction: the Andean bear and the titi monkey.

First grade students took a tour of the school and learned about the different spaces that the school has, the importance of being a LEED school and the operation of solar panels, the sewage treatment plant, composting, etc.

Also, Second grade students created their own car of the future, taking into account the environment, each of them designed their innovative dream car. Service was also reflected, Twelfth grade students were serving the community, helping to clean up the perimeter of the school.

Each of the topics covered and activities carried out, were directly connected with the school curriculum either with the integrated project or with the topics taught in class.

On the other hand, another service initiative occurred on Saturday, April 23, a tree planting project was carried out, in which students and parents participated, managing to plant more than 1000 trees.

These tree planting events are very important because they are contributing to reforestation, just as they are compensating for the carbon footprint of each of the actions we do that are not very environmentally friendly to the planet.

Why is this day important?

There are many reasons why this day is important, however, as young people, many of us are worried about the lives of others, to know if my friend went out or not, whether they are partying or not, or to know the last thing they said about a certain person.

But very few are concerned about knowing about climate change, the importance of the species around us, the importance of reducing, reusing and recycling, or the effects of our actions on the environment.

We constantly hear: "it is that the generations before did not know how to care and that is why we are facing all these climate crises today" "adults do not know how to care and do not care about any of these issues"...

But, it's not the time to blame, it's time to act! Education and environmental awareness is paramount and is the first step to improve, not everything will be solved overnight, it is true that it takes time.

Together we can bring about the change that the world needs, united and speaking out, we can find solutions to what we face today. Having the opportunity to participate and have a day like Green Apple Day in school, is an important step to be agents of change and leaders of Sustainability.

As a Rochester community, we are an example of citizens, young people, students, parents, teachers, staff, because we are systemic and committed to the planet and future generations.

Days like the Green Apple Day of Service are one more way to contribute to change because through these initiatives, activities and projects we are not only participating, but also educating and forming leaders, because every action counts.

Scan to watch the Green Apple Day video.

Scan to watch the reforestation activity during the second day of Green Apple Day


ROCHE

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ANDEAN ORCHARD AND SUSTAINABLE AGRICULTURE

Introduction

The Andean region is exceptionally rich in biodiversity and domestication on global food. Therefore, the region provides a great potential to re-discover nutritionally rich local varieties. Utilization of native plant crops provides promising solutions to address the wider sustainability goals while providing a local source of nutritious food. Diversification of the local diets enables better nutrition and can also contribute to food security in areas where food production is threatened by climate change. In addition, this can contribute to improve the economic conditions of local farmers and a more sustainable supply chain (https://cultivosandinos.com/en/about/).

In the Andean region exists 1,060 unique endemic food species in danger of extinction (Nabhan, 2008). In the Andean region exists at least a dozen types of tubers, three types of grains and three types of legumes and more than a dozen fruits which are not used or unknown due to the replacement from European species such as wheat, barley, carrots which were introduced when the Spaniards came to our region (National Research Council-NRC, 1989). Many local species have high nutritional value and can be used in low cost diets (Yang & Keding, 2009). For example, cubios (Tropaeolum tuberosum) and chuguass (Ullucus tuberosus) have high contents of vitamin C; Hibias (Oxalis tuberosa) high content of A vitamin.

Specifically in Colombia the Muiscas indigenous group from the Boyacá region used to plant and harvest this local food before the Spanish colonization. After the colonization, those practices were lost and therefore all the nutritional value of this food.

Methodology

For these reasons and thinking globally and sustainably, students at Rochester school designed and developed a sustainable agriculture project taking into account the value from the lost Andean crops. Therefore, students selected a variety of local food from the Andean region to plant and harvest. Students studied the Muiscas indigenous group diets and crops for this selection and used the school orchard to plant. Some of the selected food were: corn, potatoes, cubios, hibias, chiguas, habas, among others. The main objective of this practice was for the students to understand the importance of local crops, their nutritional value and the strategies for planting in a sustainable way. Students from 10th and 11th grade germinated the plants for about two weeks to later plant them and harvest the production three months later.

Results and analyzes

The production was weighed, measured and analyzed depending on the time the crop took to grow and the difficulties we encountered at the moment of germinating,

planting and harvesting. Students found that cubios (Tropaeolum tuberosum) were the tuber that took less time in growing and was the easiest to harvest.

Followed by chuguass (Ullucus tuberosus) and Hibias (Oxalis tuberosa), the last ones being the most difficult to germinate and cultivate since it took longer time to get harvest. The potato and the habas crops were very challenging since the plants got a type of fungus which students were unable to identify; therefore, the potato production was low even though we harvested habas the production was not what we expected. On the other hand, the corn production is still growing and we expect to harvest it in another two months.

Students learned how to harvest with their own hands, just like Muiscas used to do, having the possibility to be in contact with nature and wonder how one single seed can produce so much food.

The production was divided in two. One part was donated to the school cafeteria to prepare food for the students. The other part was donated for low income families outside of the school.

The amazing part of the project was that the students could share with the community organic food harvested in their own school orchard.

The 27 families from the program called: "Pan Compartido" enjoyed local and organic food .

Each family took a bag with cubios (Tropaeolum tuberosum), chuguass (Ullucus tuberosus), Hibias (Oxalis tuberosa), habas (Vicia faba). The students Lucas Mejía Arenas, Samuel Jaramillo Vasquez, David Lineros Suarez and Simón Meza Ortega shared the food with the 27 Fuzca families.

Students learned that local and Andean crops are adapted to the weather of the region, therefore grow faster and do not need permanent irrigation and are used to Regional conditions such us soil water regime (Zimmercer, 1996) . The Andean crops are used to the raining seasons of our region and perform better under these conditions.

Also, farmers can harvest in different moments of the year keeping food supplies all year round. This particularity is very important when the market of food fluctuates.

Finally, they learned that these types of crops are more sustainable since they need less supplies and have multiple eating and medical uses.

Reasons to keep the use of local varieties:

Composición química de los tubérculos andinos (g/100g)			
	Hibias	Cubios	Chuguas
Energía (kcal)	61.0	50.0	52.0
Proteína	1.0	1.5	1.1
Grasa	0.6	0.7	0.1
Carbohidratos	13.3	9.8	14.3
Fibra	1.0	0.9	0.8
Ceniza	1.0	0.6	0.8
Humedad (%)	84.1	87.4	83.7
Fuente: Collazos et al. 1975. (Citado por Ayala G. - 2004)			

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EL PÁRAMO A TRÁVES DE

Morella Zuleta, Luisa Mateus, Juan Francisco Gómez, María del Pilar Tunarroza

LAS ARTES Y LA LECTURA

El Espíritu del Páramo, un libro del escritor Celso Román, trata del escocés Edward Mackenzie, quien está obsesionado con el tesoro de El Dorado. Mackenzie comienza un recorrido por el páramo de Chingaza sin dimensionar la majestuosidad y lo agreste del territorio. Años después, su morral y bitácora de viaje fueron encontrados con el relato de su travesía que nadie se ha atrevido a replicar.

Los estudiantes de décimo, como parte del proyecto integrado del grado, leyeron y analizaron el libro El Espíritu del Páramo desde la asignatura de Español y conectaron la lectura con lo aprendido en clase de Biología sobre la dinámica ecosistémica y adaptaciones de los animales de Bosque Altoandino y el páramo. Con toda esta información partieron al páramo, donde quizá se sintieron un poco como Mackenzie, descubriendo la inmensidad de este maravilloso lugar.

Con el conocimiento previo en mente y su experiencia después de haber caminado bajo la lluvia y entre la niebla, los estudiantes ya estaban listos para y comunicar desde la asignatura de Teatro, su conexión y sentir con la naturaleza en una puesta en escena

La investigación artística de este proyecto integrado desencadena en una profunda reflexión a través de diferentes referentes visuales, corporales e interpretativos.

Nos inspiramos en el texto: "El espíritu del páramo" de Celso Román y decidimos trabajar en conjunto con los estudiantes de las clases de Danza y Teatro del grado décimo, con la finalidad de proporcionar un producto artístico en el que se enalteciera el respeto y el amor por la naturaleza, referenciando a Chingaza como un lugar emblemático y educativo para nuestros estudiantes.

El uso del espacio no convencional fue el punto de partida, para relacionar Chingaza con nuestro colegio como aula viva, en el Rochester seleccionamos algunos espacios propicios para referenciar las imágenes poéticas que queríamos contar del libro a través del cuerpo y la interpretación de nuestros estudiantes.

Usamos el reservorio cerca a la huerta, el reservorio del bloque 1 y 2, la piscina, el parqueadero, el aula de teatro y las canchas del colegio.

Desde las artes escénicas los procesos de creación e interacción colectiva son muy profundos y contemplan varios componentes para lograr un producto, es por ello que las maestras decidimos que realizaríamos un video con referentes estéticos de la videodanza y el videoarte, para que los estudiantes comprendieran a través de esta experiencia el poder del lenguaje audiovisual para experimentar y comunicar en las artes escénicas.

Es importante recalcar la relación gestada en este proyecto con el área de comunicaciones del colegio, ya que su ayuda fue fundamental para lograr un resultado de alta calidad artística y audiovisual.

Nuestros estudiantes a través de textos preliminares analizaron su relación con la naturaleza, desarrollaron escritos justificando momentos y acciones de su cotidiano relacionándolos con las de Mackenzie y su travesía por páramo. Por medio de juegos, ejercicios corporales y expresivos nuestros estudiantes fueron agua, aire, frailejón, laguna, oso y colibrí.

Entendiendo la importancia de cada uno ellos dentro de nuestra vida, el páramo y su ecosistema.

Referenciamos la historia de Mackenzie en busca del dorado, para comprender que el verdadero tesoro que descubriría está en la naturaleza y el cuidado de la misma.

Decidimos llamar este hermoso video: "El espíritu del Rochester" y concluimos gracias a esta experiencia que somos los espíritus cuidadores de nuestra naturaleza, y es por ello que compartimos nuestro lema "En el Rochester somos guardianes de la naturaleza. Valoramos su presencia y prometemos cuidarla" .

Los dejamos con este video, producto de un trabajo colaborativo entre tres disciplinas que buscaban finalmente enseñar a los estudiantes cómo un ecosistema como el páramo, nos ofrece servicios y bienes ambientales importantes para nuestra supervivencia, tal como los ofrece también para especies como el oso de anteojos, diversas aves y plantas que allí habitan.

Los estudiantes quedan con el conocimiento para actuar de manera responsable con su ambiente y el sentimiento de querer hacerlo.

Scan to watch the video


COMMUNITY
Creativity

SERES HUMANOS: CUERPO, APRENDIZAJE Y SALUD INTEGRAL

Andrea Polanco | Profesora Biología Bachillerato

Uno de los ejes temáticos del currículo de Ciencias Naturales y Ambientales es "Seres humanos: cuerpo, aprendizaje y salud integral". Buscamos que los estudiantes conozcan cómo funciona su cuerpo para tener las herramientas necesarias para poder cuidarlo y quererlo. Por esto una de los sistemas del cuerpo que se estudian es el sistema nervioso. Los estudiantes aprenden cómo funciona, cómo se toman decisiones y se asocia a la Teoría de la Elección.

Este semestre tuvimos una invitada especial en la clase de Biología y Conservación II de bachillerato, para enseñarnos más sobre este sistema del cuerpo. La doctora Vivían Hernández es médico anestesiólogo, experta en dolor. La doctora Hernández compartió sus conocimientos con los estudiantes por medio de una clase divertida en la que aprendieron sobre la relación entre el dolor y el sistema nervioso central y periférico. Por medio de un juego con pelotas y raquetas los estudiantes compararon cómo viaja el dolor dependiendo del estímulo.

La doctora Hernández también es madre de nuestra querida estudiante María José Chávez quien ha sido exitosa en la clase de biología y ha mostrado interés en estudiar ingeniería genética después de ver el curso de biología, pues fue ella quien propuso que se hiciera un taller con su mamá. La doctora Hernández manifestó su cariño por la docencia y agradeció por un espacio para poder jugar y enseñar este tema tan interesante que tanto le apasiona. Los dejamos con apartes dela clase.

Agradecemos a la doctora Hernández por su tiempo y disposición a compartir sus conocimientos y a María José por su desempeño y compromiso con la materia. Invitamos a más padres de familia a interactuar con nuestros estudiantes y a compartir sus conocimientos y a mas estudiantes a utilizar el currículo para decidir sus futuros profesionales.

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ALGUNAS INNOVACIONES PEDAGÓGICAS EN EL ÁMBITO DE UN COLEGIO DE CALIDAD WILLIAM GLASSER

Aída Ostos Alcázar, José Luis Zamora Fernández

La convergencia entre conocimiento disciplinar, pedagógico y tecnológico, enmarcados dentro de los horizontes de la teoría de la elección, nos aporta al un panorama de mejora continua y éxito de un estudiante global.


FAITH

Mucho se ha escrito sobre educación y aún así, todos seguimos propendiendo por las mejores prácticas para ser exitosos como docentes y animar a nuestros estudiantes a trascender en su formación integral de manera significativa, a través de las áreas de estudio que escojan para su futuro.

Este escrito tiene como objetivo compartir la manera en que hemos utilizado algunas de estas nuevas metodologías enmarcadas en el horizonte del colegio, de tal manera que sigamos optimizando nuestro potencial profesional.

Los docentes hemos ido desarrollando e incorporando diferentes herramientas para enseñar, que van de la mano con los avances tecnológicos y la innovación, e incluso los desafíos que vivimos de manera global.

Así como el uso de nuevas habilidades se puede dar de manera empírica, basándonos en experiencias exitosas, o tomadas de otros referentes, o, por el estudio e investigación. En ocasiones vemos que algunas de nuestras prácticas diarias han sido formalizadas por diferentes autores.

Uno de los modelos que se propone actualmente es el llamado TPACK (Technological, Pedagogical and Content Knowledge) formulado por Mishra y Koehler (2006).

Este modelo parte de un estudio riguroso sobre la docencia y sus implicaciones en el mundo actual; su eje de estudio gira alrededor de docentes de algunas universidades españolas; con criterios rigurosos de cuantificación de los resultados, y con un carácter descriptivo de la información recolectada.

Después de este estudio, la mayor conclusión radica en que se requiere una formación integral de los docentes no sólo en aspectos tecnológicos, sino también pedagógicos y disciplinares.

Vale la pena como docentes hacernos una autoevaluación sencilla para analizar dónde nos estamos ubicando con mayor frecuencia:

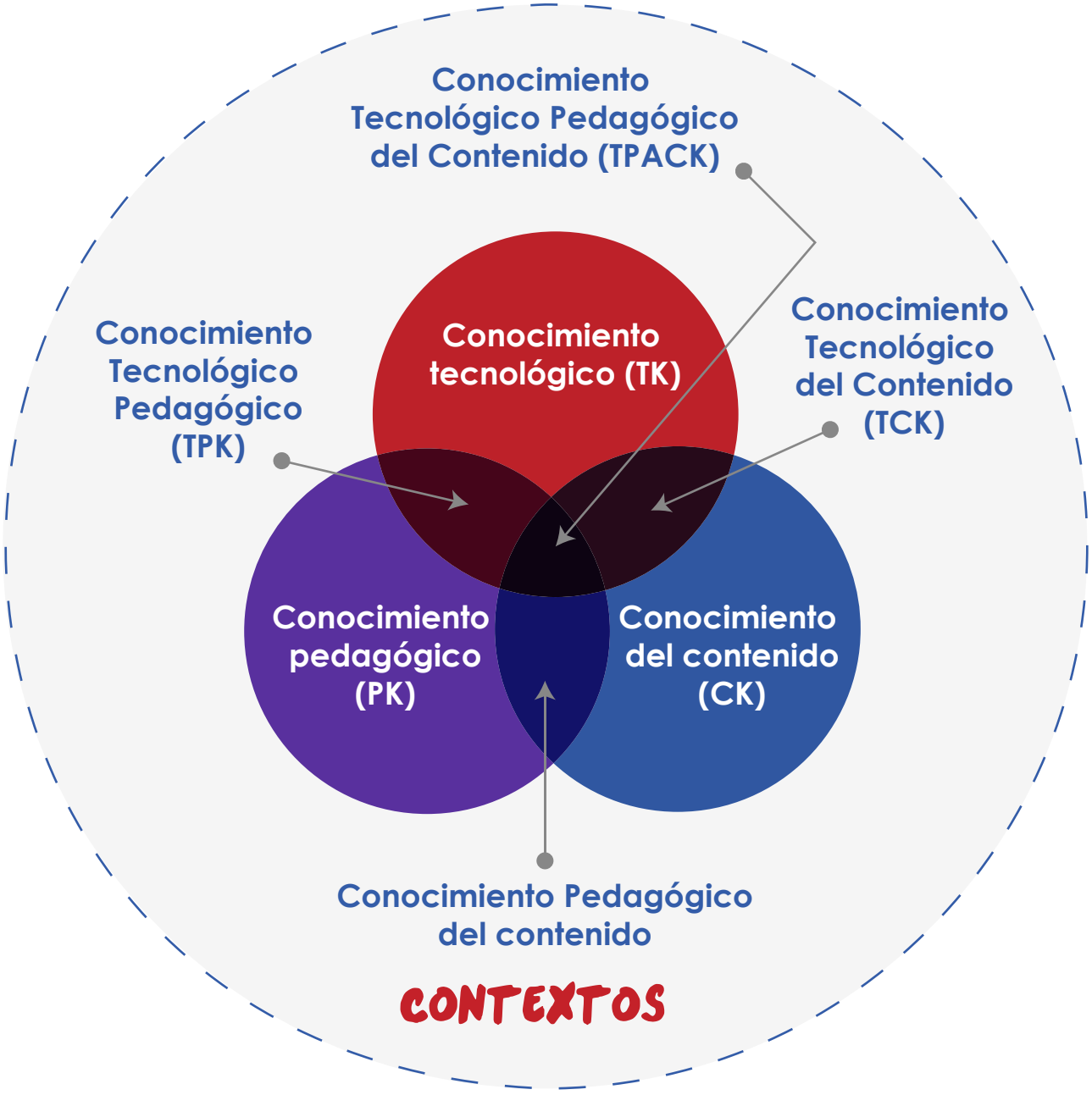
- ¿Somos docentes interesados por la tecnología como una manera de comunicar información útil?

- ¿Somos docentes interesados por utilizar prácticas pedagógicas para comunicar información útil?

- ¿Somos docentes interesados por proponer el uso de la tecnología como una estrategia pedagógica?

- ¿Somos docentes interesados por proponer estrategias pedagógicas innovadoras mediante el uso de la tecnología para comunicar información útil?

Figura 1. Modelo TPACK: disposición de los tres tipos de conocimiento básicos (Conocimiento Tecnológico, Pedagógico y Disciplinar) y las intersecciones correspondientes, generando, así, siete tipos de conocimiento. Fuente: Mishra, Punya, y Koehler, Matthew (2006)



La intersección entre estos tres aspectos nos muestra un docente que está balanceando de manera asertiva los conocimientos: disciplinar, pedagógico y tecnológico.

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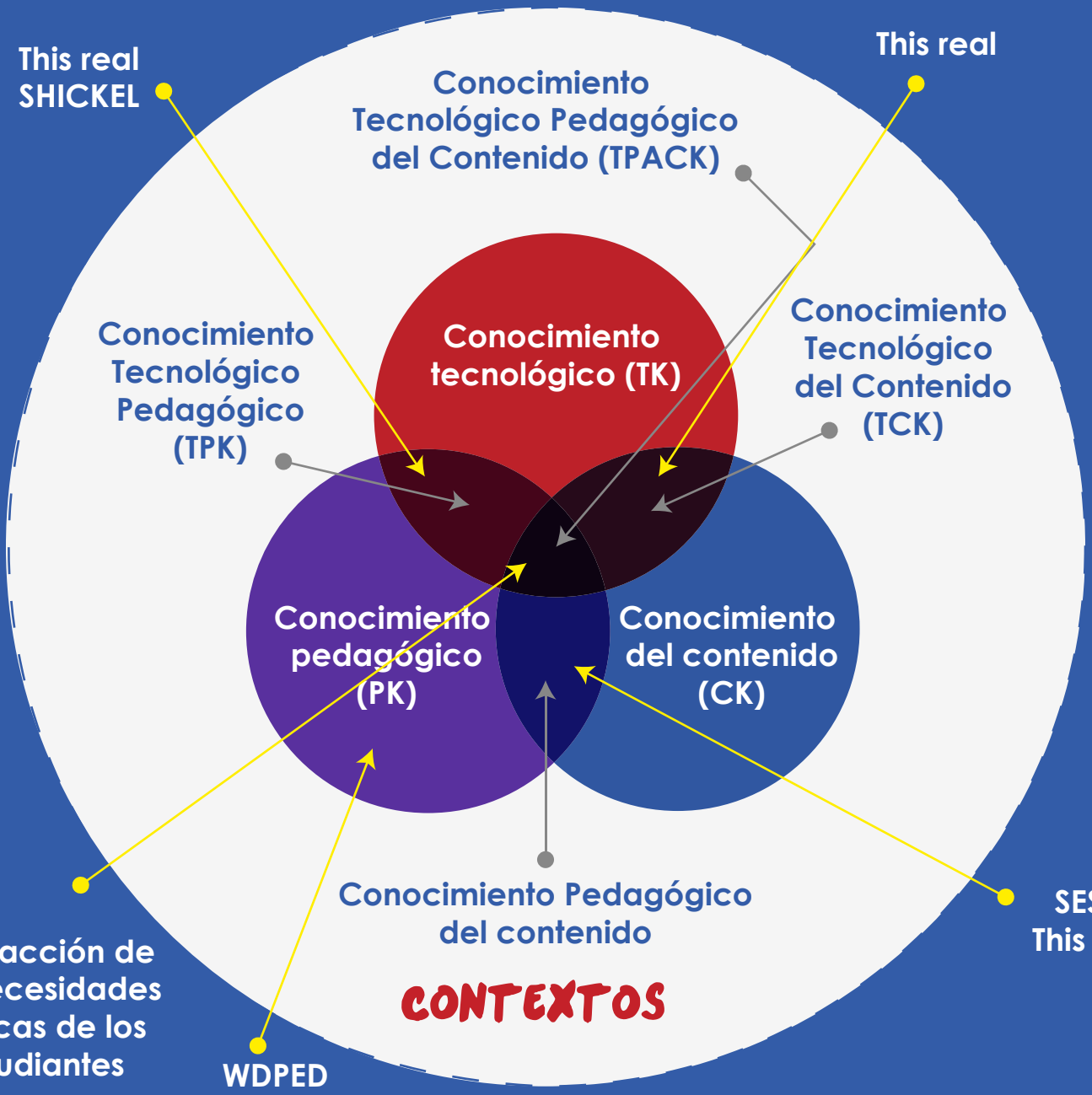
MARCO DE LA TEORÍA DE LA ELECCIÓN

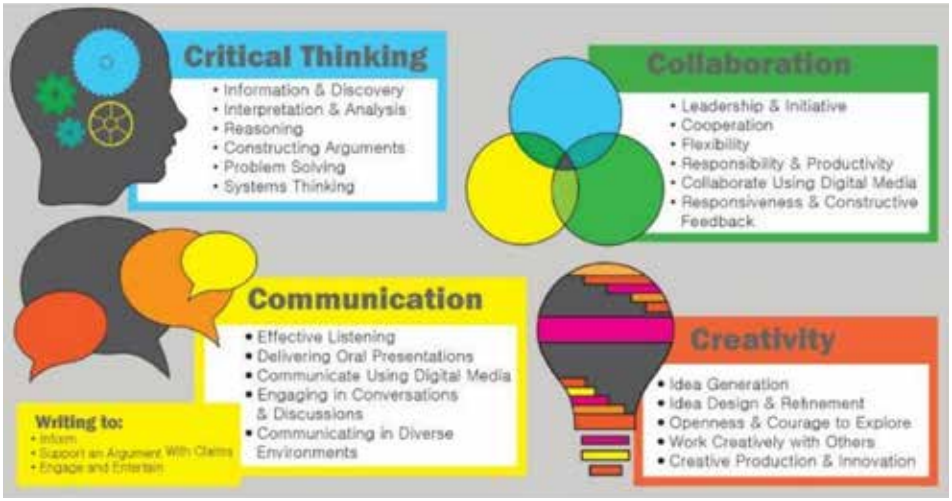


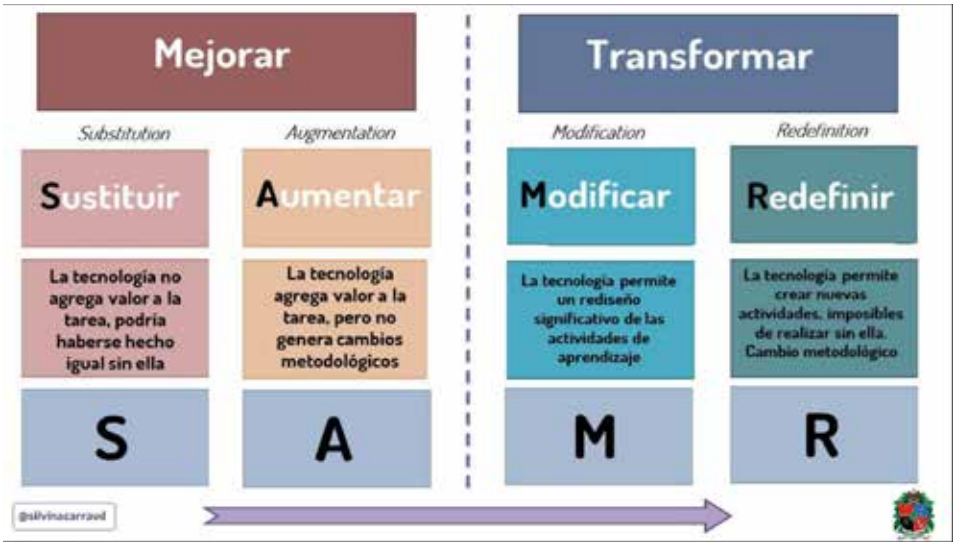
Ambiente saludable y sostenible.	Aprendizaje útil y de calidad para la vida y el mundo.	Responsabilidad interior: Felicidad y éxito.

¿Qué sucede ahora si ubicamos el anterior diagrama en el marco de la Teoría de la Elección?

Vemos que los tres pilares del colegio soportan de manera amplia esta propuesta que va más allá de una metodología. Esto debido a que cada unos de los conocimientos formulados por TPACK forma parte de al menos uno de ellos. Como se ve en el diagrama, proponemos algunas de las estrategias y principios de un colegio de calidad Glasser, como puntos comunes entre los tres aspectos relevantes de TPACK. Existen muchas más conexiones y los invitamos a que incluyan otras en este mapa.

TPACK también fortalece su estructura con las 4Cs; al revisarlas en el diagrama, vemos que están alineadas a nuestro horizonte, por lo que es importante que las tengamos muy presentes, como estrategias en los tres aspectos a los que nos referimos en este escrito.





Otro de los modelos actuales, conocido como SAMR, nos invita a integrar la tecnología con la enseñanza con una visión un tanto similar.

La propuesta intenta que como docentes escalemos niveles del uso de la tecnología con un propósito pedagógico.

Chijioke Kingsley Ogbonna, profesor del Colegio Los Nogales y de La Universidad Nacional de Colombia utiliza el siguiente diagrama para explicar las etapas.

Como docentes podemos revisar en qué etapa nos encontramos a nivel general cuando implementamos la tecnología:

Es probable que no haya una etapa definida en la que nos encontremos, sino que oscilemos entre ellas.

Sin embargo, poco a poco podremos dar mayor énfasis a una de ellas.

También es posible que en algunas prácticas docentes nos ubiquemos solamente en sustituir o incluso aumentar.

De acuerdo con los significados del diagrama, estos niveles se alcanzan al presentar los aprendizajes de manera digital, utilizar recursos virtuales como google Maps en lugar de un atlas para encontrar un lugar, realizar un quiz virtual o proponer una lectura sin ir más allá en los productos esperados, entre otros ejemplos; y es válido dependiendo de lo que se espera en una clase, o como medio para un siguiente desempeño.

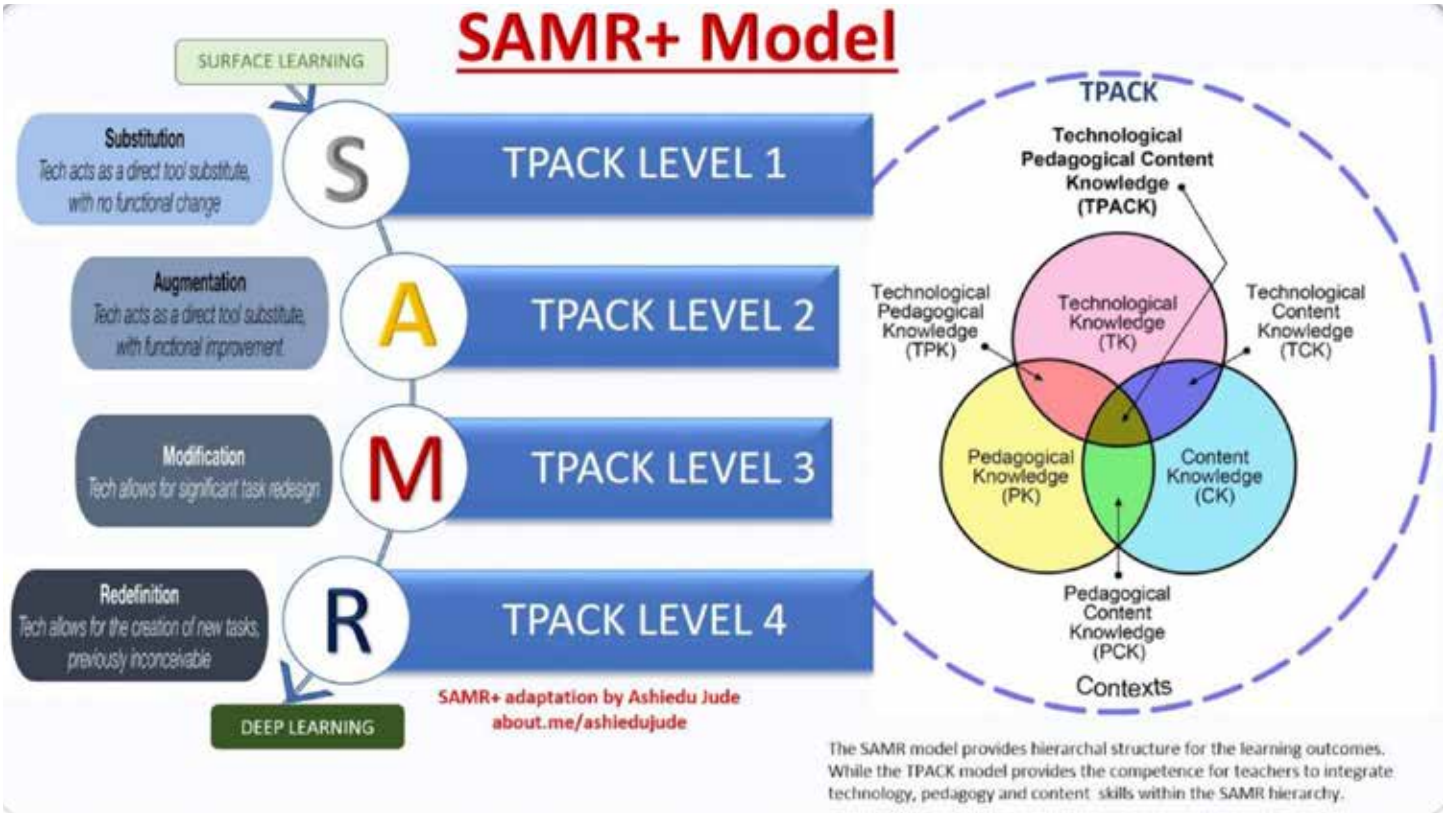
Sin embargo, si el estudiante es desde nuestras clases parte activa de su aprendizaje, alcanzar los niveles de modificación y redefinición serán herramientas clave para el aprendizaje útil de nuestros alumnos.

Prácticas de laboratorio interactivas, desarrollo de la creatividad para presentar productos innovadores en términos de la tecnología, proponer nuevas aplicaciones en su aprendizaje, proyectos en contextos reales, creación de material digital que agreguen valor a las clases, son algunas ideas sobre estos últimos niveles.

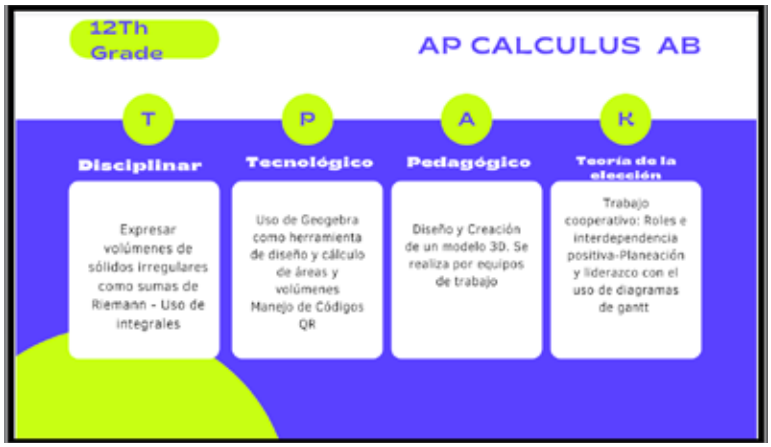
Organicemos algunos ejemplos en una tabla para aclarar estas ideas:

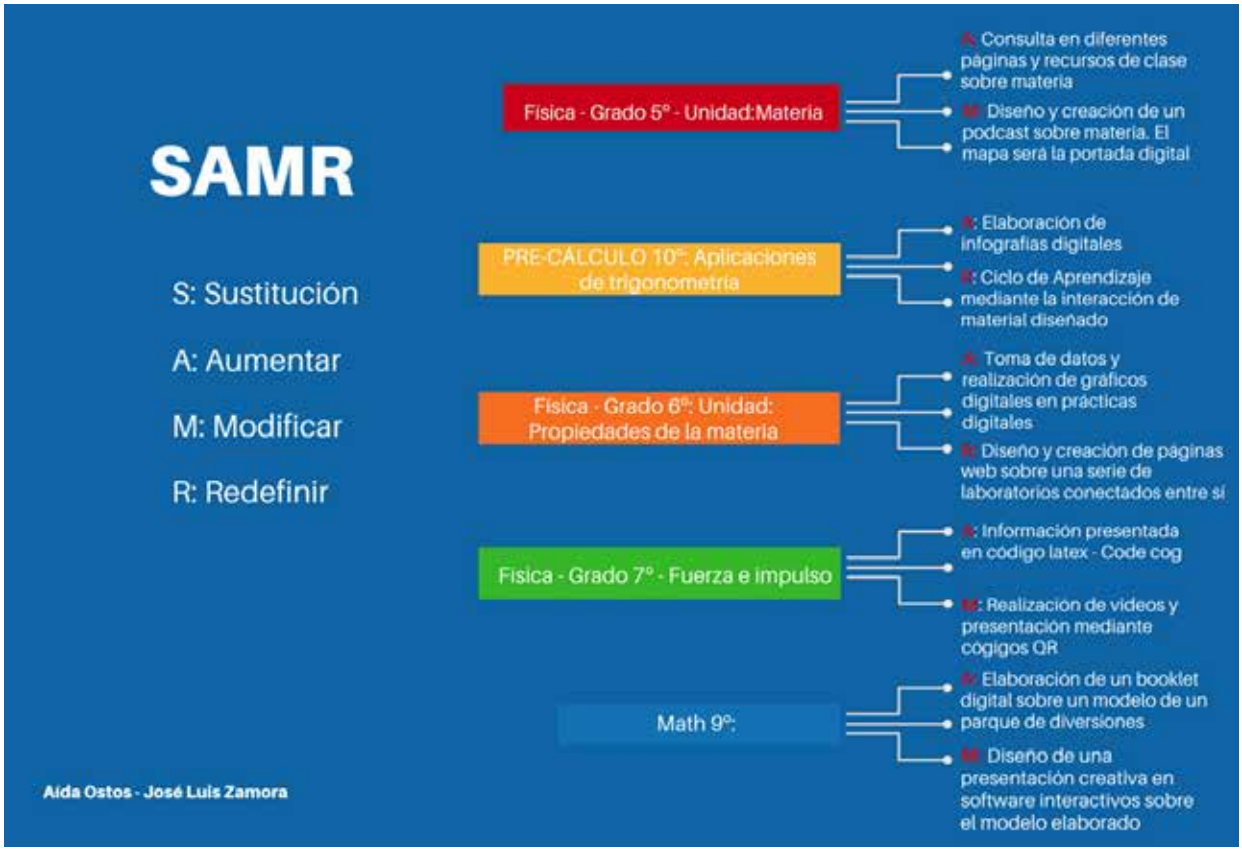
Sustituir	Aumentar	Modificar	Redefinir
Usar Google Maps como reemplazo de un atlas físico.	Utiliza las herramientas de Google Maps para medir la distancia entre dos lugares geográficos.	Utilizar la función "Street View" de Google Maps para elaborar recorridos virtuales por las calles de una determinada localidad con algún propósito de clase.	Crear una guía turística utilizando Google Maps y la comparten con otros en línea, a partir del trabajo de las etapas anteriores.
Ver un Video sobre un tema específico que sustituye la explicación magistral del docente.	Ver un video pausado en periodos predeterminados que incluyen preguntas interactivas para poder avanzar.	Tomar notas con Screencast-O-Matic por ejemplo, agregando grabaciones de Audio. Publicar esas notas de texto y audio para compartirlas con otros en un foro de discusión.	En grupo, crear un Video documental que responda una pregunta esencial relacionada con los conceptos más importantes de un tema. Cada equipo asume diferentes subtemas y colabora para elaborar el video final. Se espera que los equipos investiguen sobre el tema en cuestión y evalúen las fuentes de información utilizadas.
Utiliza un Procesador de Texto para responder las preguntas de un taller.	Investigar en Internet, por ejemplo, sobre la composición de los átomos y hacer una infografía como producto de esa búsqueda.	Escribir un ensayo de opinión en torno a un tema. Además, realizar un podcast que dé cuenta de la información de manera creativa.	Utilizar aplicaciones como BackTypo para crear un libro con notas de clase en formato epub, mobi o pdf. Publicar el libro digital resultante patra ser compartido con profesores y compañeros.
Realizar un quiz en una plataforma	Presentar un examen utilizando una plataforma en lugar de usar papel y lápiz. Luego reformular procesos en una hoja de cálculo.	Los estudiantes proponen actividades interactivas para realizar evaluaciones sencillas a sus compañeros	Diseñar aplicaciones que cumplan con las expectativas de un tema de clase.

Tanto el modelo TPACK como el SAMR tienen puntos comunes que se pueden relacionar entre sí, para optimizar cada aspecto:



Cómo podemos llevar a cabo estas ideas en el aula de clase? Queremos compartir con ustedes algunas aproximaciones a estos modelos, enmarcadas en un colegio de Calidad Glasser:





Esperamos seguir implementando nuevas prácticas basadas en modelos exitosos, que estando enmarcadas en el horizonte institucional del Colegio Rochester, aporten a que los estudiantes se hagan cargo de sus desiciones de manera exitosa y efectiva para cubrir sus propias necesidades, aportando al mundo sus ideas creativas e innovadoras para optimizar la calidad de vida de los y de quienes los rodean.

Referencias http://tpack.org/

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