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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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EDITORIAL

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Natural and Environmental Science Coordinator

What do you think when you hear the word Science? When people think about Science usually the first images that comes to mind are experiments, blowing up things, technology, robots and fun. There's always a big expectation about this discipline, which becomes a great challenge for teachers to prepare their classes. We are always looking for interesting and useful projects for students to learn and enjoy, even though, many times the topic is tricky to communicate since many concepts are theoretical and difficult to apply in a classroom. One of our best allies for teaching Science is Math, since we are always telling the students "Everything is related with Math", and so it is. We work together to assure that students can find a connection between all subjects and are able to apply their findings with a logical mathematical and computational thinking.

One advantage of Science is that there's always something new to learn and teachers will always manage to find a way to teach it. As you will find in this magazine, there are several strategies we use during class to develop scientific skills such as performing laboratory practices, using animals as models to understand laws of physics, using real population statistics to project ecosystem dynamics or having guest scientists to explain important topics such as UV radiation, all of these of course, under the frame of Sustainability, which is one of our School's pillars. Our certification as a Platinum LEED School helps us not only being recognize as school that cares about the environment, but gives us the tools to teach students how to choose to include sustainability in everything they do.

We hope you enjoy the articles we have prepared for you in our magazine and that you can choose to learn, as our students do, that Science and Math are everywhere and are part of everything.

CONTENTS

Class Foundations

Sustainability

Class Foundations

RocheS²TEM

SUSTAINABILITY · SCIENCE · TECHNOLOGY · ENGINEERING · MATHEMATICS

Common Basilisk *Basiliscus basiliscus*, by Shannon Potter, 2021.

Emerald Basilisk Basiliscus plumifrons, by Ray Harrington, 2021.

Basilisk by Aleksandar Misic. 2021

THE ANIMAL MOMENTUM

Juan David Rendón García – Karla Varela

The Water Reptile: The Basilisk

Have you ever heard about the Basilisk? Well, this animal —which is named after the European folk creature that had the shape of a snake with rooster's head and dragon wings— is a reptile that is abundant in rainforest areas in Central and South America, and lives on trees not too far from bodies of water like lakes, rivers and ponds. Because of its size, it may be the prey of many predatory species that may put at risk their lives, but they count on a "miraculous" ability of "walking" on water, just as it is said that Jesus Christ did in the biblical stories.

When threatened by a predator, the Basilisk throws itself from the tree top into the water and start running across the surface up to 1.5 meters per second!

But, you may ask, how is this even possible? Well, in order to do this, this escape master has long toes with skin fringes that expand when being in contact with water, increasing the surface area. Added with a rapid angular movement and an effective torque applied on their legs, these animals can sprint in water and escape from predators as easily as if on solid land.

Although they cannot run in water for such a long time, after they sink after sprinting due to gravity, thanks to their anatomical aerodynamic characteristics, they also have the ability to swim in order to escape successfully.

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Chameleon on a branch, by Gareth Newstead, 2014.

The Chameleon and its Weapons

When thinking about ways animals eat, we think about using their teeth or claws to catch their prey if carnivorous, or when being herbivorous we think about animals reaching plants and chewing on their leaves, but, have you ever heard of an animal that sticks its tongue out like a toad to catch its prey, but instead, with a tongue twice longer than its body? Well, the Chameleon is an incredible reptile that uses this technique to survive masterfully.

You may ask yourself, in the first place, how can an animal like this have such a tongue? Well, their 'prey catching' weapon, when inside them, twirls up and rolls like an accordion inside their mouths and behind a bone called the hyoid bone which holds back the tongue when at rest, forming a 'U' shape with its tongue.

Now, for eating, chameleons could stick out their tongues fully in approximately 1/16 of a second, which is extremely fast and effective to catch an insect or other bug to eat.

In order to achieve such velocity and power when using their apparatus, aspects from circular motion such as torque and angular acceleration can be seen. An effective torque should be used to apply a certain amount of force to the tongue to move rapidly and catch the prey easily without escaping, while angular acceleration can also be seen by analyzing the change in velocity of the tongue when coming out of the hyoid bone cavity.

So, next time you think about how animals nourish, do not take for sure that all of them eat the same way.

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Mantis Shrimp by Amber Wolfe, 2021.

The Power of a Bullet

With its 6-inches of size and attractive colors, it has the most powerful punch in the animal kingdom, being even compared with the power and speed of a bullet. The Odontodactylus scylarus, most commonly known as mantis shrimp, is a crustacean from the class Malacostraca that inhabits the marine soils of the Indo-Pacific Basin. When gathering food, the Mantis Shrimp uses its hyper-developed vision —the most developed animal kingdom— to find its prey. With this vision, mantis shrimp can use each eye independently, but together at the same time to find its food, they can see more colors than any other animal, and even see polarized light, which helps it detect its prey so easily. When finding its targeting an animal to eat, the mantis shrimp uses its incredible speed to reach it, and uses its biological 'hammers' to paralyze and kill its prey.

But how does this really happen? Well, the mechanism of these claws works as it follows. It uses elastic potential energy to generate a powerful hit with an angular movement. Let's picture it this way. Energy is packed in the 'springlike' mechanism by using a piece of chitin in the shape of a saddle. With the help of its muscles, this saddle contracts for it to be released, liberating an exuberant amount of energy, generating a super powerful hit, making it possible to break even the hardest surfaces.

But how is angular motion present here? When contracted, the claws retract the same way a Praying Mantis closes its claw-shaped legs. Then, for being released as mentioned before, it protracts releasing energy and generating a powerful punch, and when this happens, joints in the claw need to work. The rotation of the joints of the claw need to work perfectly to optimize the usage of the potential energy to the maximum, and generate an effective and strong punch.


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The Spectacled Bear: South America's Endemic Creature

Behavior and Habitat

The Tremarctos ornatus, or Spectacled Bear, how it is commonly called, is the only left species of bear in Southern America. This mammal inhabits the tempered jungles and Paramos of this continent and is spread throughout countries such as Colombia, Peru, and Equator. It is an omnivore, which means it nourishes from meat and vegetables, but its diet mainly consists of plants and vegetable matter. Additionally, this bear is solitary, which means it does not live with more individuals (except for their children in the case of female mothers).

Physical Characteristics

The Andean Bear is from the Ursidae family in the animal kingdom, which hosts animal species, including all mammals that have certain characteristics, In the case of the Andean Bear, it is one of the smallest species of bears ever existing. With a size of 2 meters long and a weight of approximately 120 kg in males, the Andean Bear is unique in its own way. Not only it has these particular characteristics mentioned, but also, as an informational fact, each bear counts with a unique white or yellowish patch on its face, with two black spaces around the eyes assembling the spectacles from which it takes its name.

Threats and Survival

Unfortunately, the Spectacled Bear is an endangered species. These animals suffer mostly from the consequences of deforestation, hunting and misinformation from people that coexist with this animal in its habitat. Regarding deforestation, the Andean Bear is also an arboreal creature, meaning that they are mostly situated on trees looking for food, resting or camouflaging with their environments to avoid threats. This means that without trees or vegetation as a whole, this animal will have a rough time trying to survive, which has led to the diminishment of this species over time. Hunting has also been a huge problem affecting the well-being of this bear. People hunt these animals in order to: collect their meat and eat it, collect its body parts and use them as hunting trophies, or because (and this brings me to the third point of misinformation), people kill them because they are supposedly a threat to their crops and cattle.

Movement and Survival

Now, how would torque and circular motion be related to this creature? Well, because it is necessary to climb above trees and tall places, the bear needs to have very strong muscles and a strong grip to hold onto different surfaces. For this to be done adequately, the joints in the bear's legs and paws need to work optimally and need to have an effective torque to apply a certain force to the tendons and muscles. Plus, when escalating a tree, external forces such as gravity may affect the way the organism climbs onto something effectively.

Now, imagine a spectacled bear that managed to climb up to a tree to eat some Bromeliads. These plants have extremely hard leaves, which can be difficult to chew on if there is not enough force or an effective torque being applied to the mandible. Fortunately, due to the bear's force when chewing something hard, its mandible is strong enough to munch on it without much effort. Also, the teeth of the bear make this work a thousand times easier.

Because of its shape and anatomy, the Spectacled Bear has many challenges every day. Having to take such mass from side to side and up and down is not easy, but also, because of the bear's ability to climb up and use its force and make the most of it always, it has no problem on going to have a nap on a tree after a cold and humid day in a Colombian forest.

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ESSENTIAL ELEMENTS IN THE CONSTRUCTION, TEACHING AND LEARNING OF SCIENCE

By: Aida Ostos

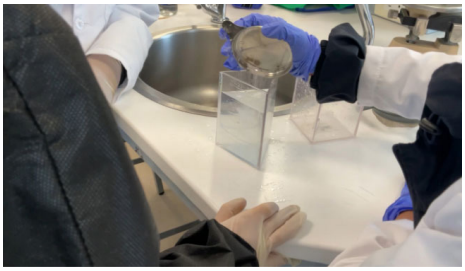
Introduction:

This paper aims to highlight some ideas about the importance of laboratory practices in the teaching of natural sciences, understanding that experimentation is a key element in the teaching and learning processes, with objectives aimed at knowing the meaning of science, at its learning and how to do science.
In the article "Laboratory practices in the teaching of Natural Sciences" published in Revista Latinoamericana de estudios educativos, written by Ana Milena López Rua, Óscar Eugenio Tamayo Alzate, the authors emphasize the value of experimental activity as a resource for the achievement of the conceptual, procedural and attitudinal objectives that are a fundamental part of the curricula in the different areas of study (Osorio 2004).

Some theoretical foundations

There are many ways to approach science curricula. Among this search for strategies by those of us who have energized subjects in the area, we can understand that experimentation represents a strong parameter within meaningful learning, because the contrasting of hypotheses and conclusions, as essential elements within the scientific method, help us to establish our academic bases in a demonstration context above the merely theoretical bases that could be acquired in a classroom devoid of this type of practice. Based on this thesis, we could ask ourselves about the validity of any type of experimental practice; Although it has been proven that they support theoretical concepts in any area of study, this type of procedure is often mistakenly associated with scientific work, "reaching a recipe level, instead of obtaining the expected scientific character, without reaching at this level", according to the approaches of Gil et al., (1999). This is because following a step-by-step in the laboratory to achieve a result precisely, can neglect the development of a methodology that promotes scientific learning, the refinement of previously acquired concepts and the generation of new hypotheses to continue exploring. science and formulate new conclusions. When practices are proposed that promote clear recognition of problems in students, the formulation of hypotheses, the exploration of the proposed variables, experimentation, the analysis of the results obtained and the conclusions, clear tools are provided for the development of learning. scientific.

Authors such as Chin and Brown, (2000) Ramírez and Tamayo, (2011) emphasize the importance of using the previous ideas that students have to face a laboratory practice; in such a way that they establish relationships between what they know and what happens, connecting the theoretical models and the phenomena observed in practice. When the teacher intends to be a facilitator, to connect theory and practices in a balanced way, through the choice of practices, knowledge elaborated as a social construction is fostered.



How can experimental practices be classified?

In general, experimentation helps the development of scientific skills, cooperative teamwork, the generation of connections with elements of the environment and interdisciplinarity. However, a first phase of practices would have a more limited purpose than others; For example, practices that specialize in very specific objectives can be classified as reinforcement, exercise, or research practices, as indicated by Caballer and Oñorbe (1999). In these, students reach a level of strengthening their concepts, however the formulation of new hypotheses is somewhat limited because the primary objective formulated from the beginning was achieved. Another type of practice, proposed by Herrón (quoted by Tamir and García, 1992), which suggests levels of work that can reach the level of research, as follows:

An initial level (zero) in which students are given a question, the method, and the answer or result they should arrive at. In the next level (one) a question and method are given, however students are expected to come up with an answer they don't know yet.
In the slightly more advanced level (two) the question is proposed and the students propose the method and arrive at the result by themselves.

The major level (3) proposes that students be shown a phenomenon to study. Based on their concerns about investigating the phenomenon, they will formulate the appropriate question, the method and the result will be consistent with their research process. Reaching this level could encourage our students to climb to a stage of research that favors curiosity and scientific exploration; that goes beyond the classroom. Although it is very likely that the inclusion of experimentation in the different areas of study encourages curiosity for scientific learning, it is expected that by exceeding the proposed levels of experimentation, it will open the spectrum for students with a more far-reaching scientific perspective.

The need to identify the difference between guided practices, such as recipes, (Gil et al., 1999) without a scientific purpose, and practices that seek to refine previously acquired knowledge, is evident if students are to achieve significant learning with utility in different environments. The use of the laboratory on a regular basis becomes a vital space that invites students to be interested in research, in the use of practical resources to verify and develop the skills required to advance in the global context in which we are immersed.

POPULATION GROWTH IS ALSO A MATTER OF GLOBAL CITIZENSHIP

María del Pilar Tunarroza Sierra
AP Environmental Science Teacher

All populations of living things change in size over time, depending on limiting factors like food, fresh water, clean air, shelter, temperature, and also the behavior of other populations that could affect their survival. The human population is no different. We also depend on resources, and although we have an advantage over the rest of living organisms, we can create technology that could extend our life and comfort us.

In 1800, the human population was around 1 billion. Today we are close to 8 billion! We can infer this growth is a result of medical advances, agricultural practices, information and communication technologies, and the fact we can colonize almost any place to live on this planet. Based on this information, AP Environmental Science (APES) students started to ask themselves several questions: Can the human population continue growing beyond the carrying capacity due to its ability to adapt and change the environment? Do we want humans to continue with this growth rate? Is Global Citizenship a factor in limiting human population growth?
To answer these questions, students started by understanding population dynamics in organisms different from humans. Students analyzed logistic and exponential growth models, density, and population range by performing a lab practice. APES students modeled population growth by reproducing yeast in a test tube for five days. They registered the change with the help of microscopes and found out their overshoot and decline, if so, through different samples. Additionally, students did mathematical regressions and integers to model how a population will behave in time if resources were unlimited. See the details in the attached lab report.

After understanding population dynamics in other organisms, students learned how human population growth can be calculated. Students researched the Total Fertility Rate, intrinsic rate, rule of 70, and population pyramids of a country they chose of a given continent. Students calculated how will the human population of that chosen country will be in 2036 and compare it to the total population in 1961, 1976, 1999, 2006 and 22021, analyzing the causes of the population growth or decrease depending on environmental factors, women social role in the country according to its political standards and religious and cultural vision, and environmental and economic factors. See the following infographics.

Students were surprised to discover that several countries are decreasing in number at a high rate, which they found beneficial for the environment but less for the global economy. Students used the sustainability goals to propose how could each country could improve their flaws and concluded that big decisions, that affect a nation and the world, must be done taking in mind the Rochester's definition of Global Citizenship, which includes looking through an intercultural lens, understanding other perspectives different from mine, communicating effectively and respectfully having in mind the self and others' well being.

AUSTRALIAN POPULATION

Catalina Guerrero, Nicole Munevar | Rochester School | AP Environmental Science | 2022-2023

Current Australian Population
26,190,373

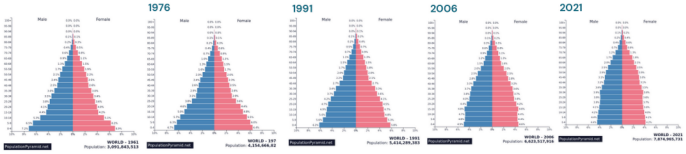
Intrinsic growth rate
0,0933%

△ N = [Births - Deaths] + [Immigration - Emigration]
△ N = [164(365) - 97(365)] + [0 - 0]
△ N = [59860 - 35405]
△ ***N = 24455***

$$r = \frac{\triangle N}{\text{Initial Population}} \qquad r = \frac{24455}{26,190,373} \qquad r = 9{,}3374 \times 100 \qquad r = 0{,}933\%$$

Pyramid Analysis

1976 1991 2006 2021



YEARS 1961, 1976, AND 1991

The pyramids of 1961, 1976, and 1991 show a **rapid growth** model due to the fact that the population number of newborns to 4-year-olds is much bigger than the following age sections, meaning that within these years there was a very **high birth rate**. This type of pyramid means that there is a short life expectancy and that the population of the country was increasing rapidly during these years. During 1961 the percentage of 0 to 4-year-olds was 6.2% for females and 7.2% for males, for 1976 was 6.4% for females and 6.7% for males, and lastly for 1991 it was 5.8% for females and 6.2% for males, which once again describes the fast birth rate tendency, however, the percentages of older age groups decreased as the peak of the pyramid was reached. During 1961 the percentage of 85 to 89-year-olds was 0.1% for females and males, in 1976 was the same exact percentage for both sex and for 1991 the percentage for females was 0.2% while as for males it was 0.1%. **It can be clearly evidenced that the percentage of the population decreased as the top was reached and increased as the bottom was reached.**

Rule of 70: 2036

Exponential Growth Rate Formula: $N_t = N_0 e^{rt}$

N_t: Total Population

N_0: Initial Population

e^{rt}: e(Euler), r(Intrinsic growth rate), t(time)

$$26,190373\, e^{0,0093(14)} = 29,832,306$$

In the year 2036 the population will be 29,832,306 via our calculations, in contrast with the population shown in the web page the data was 29,5 million poeple which shows that our calculations were very accurate with the actual information.

YEARS 2006 AND 2021

The pyramids from 2006 and 2021 show a **zero population growth model**. This is due to the fact that throughout the pyramid the percentages are much more balanced, and without huge difference between age groups. As an example, in 2006 the percentage for 0 to 4 year-olds was 4.6% for females and 4.9% for males. In the same year, yet different age group, in this case 5 to 9 year-old the percentage for females was 4.4% and as for males 4.8%, which overall, shows that the difference is very slim. That tendency does not only happen within those two age groups, but throughout the pyramid. The same exact thing occurs on the 2021 pyramid, the percentage for 0 to 4 year-olds was 4.2% for females, and 4.4% for males, on the second age group which are 5 to 9 year-old the percentage for females was 4.2% and for males 4.2%. Once again these two years show the zero population growth model which is something all nations wish to achieve and only the developed nations can achieve.

TFR in 2019, 2020, 2021, 2022

$$\text{TFR} = \frac{\text{No. of live births during the year}}{\text{Midyear female population aged 15-49 years in the same year}} \times 100$$

$$\text{TFR 2022} = \frac{164(365)}{5977457} = 1.0014 \times 100$$

Total fertility rate 2022= 1.0014
Total fertility rate 2020= 1.58

Total Fertility Rate

The formula for total fertility rate (TFR) is he number of births in a year divided by the fertile woman that same year, this would be women from 15-49 years old. Then multiply by 100 and you have the fertility rate. The population is Autralia has been growing the past years and we can see that reflected on the babies per woman in Australia. With our calculations the fertility rate in 2022 was 1.0014, but it should actually be around 1.794 and in 2021 1.803. This would show a 0.5% decline from 2021 to 2022. In Australia the average age of a pregnant woman is 29.4 years old which shows why there is not an incredible big TFR. In Australia most woman choose to wait until they are around the age of 29 because that is when they are reching their prime in their economical earnings so it is a good time to have kids. In 2020 de TFR reached its all time low in Australian history with a number of 1.58, this is probably becawuse of the uncertainty that the COVID-19 pandemic brought that many couples decided to postponed having children as the pandemic brought many economical struggles to people. A factor that has also impacted the TFR is that woman in Australia have started to decide between work life and family life which is why there has been some declines.

Environmental problems that affect the Australian Population

One of the biggest environmental problems that have affected the Australian population are the wildfires. This wildfires have burned around 42 million acres and killed many people and animals. This wildfires that have become common in australia are linked with climate change, because of thisit makes the air dryer and hotter which increases the chances of fires and the fire season becomes longer and more dangerous for populations in this country. Also because of climate change it rises the temperature on both land and oceans and this increasment on temperature makes worse outdoor air pollution like ozone. With the warming of oceans the coral reefs start getting damage and on the long run it starts affecting the whole world population. Another environemntal problem in australia is the plagues that can start affecting water resources and agricultural processes.

Sustainable development goals

Australia is a country that has a very good development of the goals the UN has proposed.Its three main cities are sustainable and 100% of Australian communities has access to clean water. But we think it would be very interesting to see Australia implement more clean energy since it is a country that would be a very good source, because of the sunny weather and water surroundings. But appart from this something the Australian governemnt could work on is the lack of access to opportunities in the rural areas of the country. This lack of opportunities are actual the number one cause of poverty in Australia. So if the government brought more opportunities to rural areas it would be improving the goal of No Poverty and Decent Work. One way the governemnt could create employment in this rural areas would be to have programs for farmers so people can work on the land that they already own. As well as check the coverage of health systems and education systems.

PYRAMID POPULATION

SANTIAGO BERNAL & DANNA GARCIA

INTRINSIC GROWTH RATE

It is a calculation to know the population rate. This rate can be understood as the number of births minus the number of deaths per generation time.

Growth rate

$$N = [\text{Births} - \text{Deaths}] + [\text{Immigration} - \text{Emigration}]$$
$$N = [1491(365) - 960(365)] + [0 - 4(365)]$$
$$N = [544215 - 350400] + [0 - 1460]$$
$$N = [193815] + [-1460]$$
$$N = 192355$$

Intrinsic Growth

$$r = 192355/215,363,253$$
$$r = 8.931653596 * 10^{-4}$$
$$r = 0.0893\,\%$$

Formula

$$r = \frac{\triangle N}{\text{Initial Population}}$$

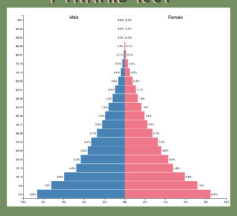
CURRENT POPULATION

Brazil Population as of 10/2/2022 is about 215,363,253

Most of Brazil is sparsely populated with a population density of 24.66 people per square kilometer. The largest city is Sao Paulo with more than 11.9 million residents. The capital, Brasilia, has a population of 2.8 million.

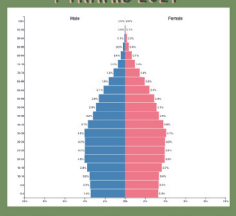
To see the six graphs click me

POPULATION PYRAMID 1961



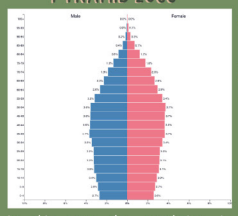
In this year the population was 74,311,337. It is a growing population where the pyramid is almost exact to a "typical" pyramid. This shows a higher percentage of the population in the younger age. It means that it is a population that is growing rapidly and that there are more newborns than people who reach the age of 85-89 years, it also shows that there are more men at birth but in adults - elderly there are more women. In this year there reproducing longer and faster

POPULATION PYRAMID 2021



In this year the population is 213,993,441. It can be seen that it is no longer a typical pyramid like the previous year since the newborns are not many, compared to the year (1961). There is a high life experience and a low death rate since there are women who live up to 95-99 and the rate of 86 - 89 grew by 0.2% unlike the first graph, where elderly men and women live. The best reproductive phase and where there are more people alive is at the age of 35-39. Although the difference is very minimal, there are more women than men from middle age to old age.

POPULATION PYRAMID 2036



In this year the population is 227,572,152 people. This graph shows a better stability than in the first year (1961). This graph has an inverted shape with the graph narrowing at the bottom. Although the best stage is the middle of the life-year where it is located in the reproductive part, between the years 35 to 50. It means that they reproduce easily but not quickly as it was in the first graph. In this year there is a high rate of deaths. This country is having a high social and economic development, where there are more facilities in education and health care but not as highly developed as the United States or Canada.

APPROXIMATION IN THE YEAR 2036

To predict how much population there is in the year 2036, it can be used the 70 rule. This rule divides 70 by the growth rate.

$$70/r = \text{Double time}$$
$$70/0.08 = 875$$
$$2036 - 2022 = 14$$
$$875/14 = 62.5$$
$$215.363.253/62.5 = 3.445.812,05$$
$$215.363.253 - 3.445.812,05 = 211.917.441$$

On the page it said that in the year 2036 there would be 227,672,152 people in Brazil. In our calculations using rule 70, the population in 2036 is 211,917,411, although there is a difference in numbers, it is very similar. The difference is that one has a certain growth rate and in our calculations we use the rate that we had previously calculated. Where it shows that Brazil is a country where reproduction is fast and makes it possible to have more people in the territory.

To see the analysis of the graphs of 1976, 1991 and 2006 click me.

ENVIRONMENTAL PROBLEMS

The human population has experienced a period of unprecedented growth, more than tripling in size since 1950. It reached nearly 7.8 billion in 2020 and is projected to increase to more than 8.5 billion by 2030, the target date for achieving the Sustainable Development Goals (SDGs). This is a major problem of overpopulation, because humans continue to reproduce without any limit but nature does not grow. The earth has been the same for many years and this leads to an overload of humans, where natural resources are overexploited, affecting major factors such as: forest and soil degradation, deforestation, loss of biodiversity, overexploitation of renewable resources and water and air pollution, among others. When there are these factors such as water and air pollution, diseases are produced, some of these are pandemics where the population is also affected, lowering the number of children and elderly people.

POPULATION GROWTH IN Cuba

Josué Ariza & Mariana Carrillo

Current Population (2020)

11,305,648 million people

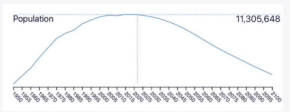


Fig 1. Behavior graph of Cuba's population troughout the years

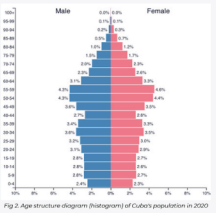


Fig 2. Age structure diagram (histogram) of Cuba's population in 2020

*The statistics indicate that Cuba's rate of population change has been of 0.39% decline from 2021.

Intrinsic growth rate

$$\Delta N = \frac{[\text{Births} - \text{Deaths}]}{\text{initial population}} \cdot 100$$

$$\frac{55(365) - 61(365)}{11{,}211{,}354} = -0.00195337$$

$r = -0.00195337_{x10} \cdot 100$

$r = -0.01953376907\%$

ΔN = change in population

Analysis through the years

Calculate how will the population be in 2036

Exponential growth formula: $Nt = No\,e^{rt}$

Nt = total population
No = initial population
r = growth rate
t = time

$Nt = 11{,}211{,}354e^{(-0.00195338)(16)}$

Nt = **10,866,372** million people

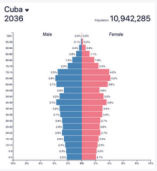


Fig 3. Age structure diagram (histogram) of Cuba's population in 2036

1. Cuba's population increased significantly since 1950.
2. It stopped growing during the 2000's and was relatively stable during that decade and the next one.
3. 2020 was their peak population size.
4. Now it is declining and will continue behaving this way.
5. Our prediction was not too far away from the one of the webpage (due to an approximate intrinsic growth rate used for the calculation).

Scan the QR code or click here to see Cuba's population from 1961 to 2021

Fertility rate in Cuba

TFR is calculated by using this formula:

$$TFR = \frac{\text{No. of live births during the year}}{\text{Midyear female population aged } 15-49 \text{years in the same area \& year}} X\ 100$$

$$TFR = (55 \times 365/2.523.750) \times 100$$

$$TFR = 0.79$$

According to the process we did, the result is 0.79. But in reality 1.6 is the total fertility rate in Cuba since 2020 according to a reliable source. This means there is an error margen because of the data we used.
A TFR under 2.1 means the population is decreasing.

ITALIAN POPULATION

Juliana L & Daniela M

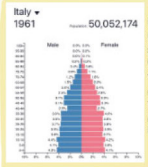
1. CURRENT POPULATION

60'263,602

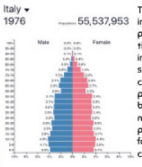
2. INTRINSIC GROWTH RATE

−0.000754

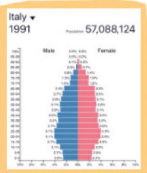
3. ANALYSIS



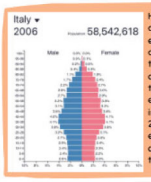
In this moment the Italian population shows somewhat of a bootom heavy pyramid, there is a slight bigger population of 10-14 than of babies, but the population seems to be increasing.



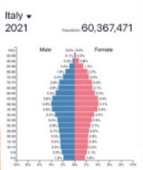
The population did in fact increase by 5 million people. This is the most the Italian population increases in the years we studied. Now we can currently see how the population of babies has begun to diminish, meaning that the population is not growing fast enough, but not completely stopped.



Given the fact that during the 70s, post-war Italian feminism is very strong, and women begin to speak up about equality issues such as abortions, wages and marriage age which affected directly the fertility rate. There were changes and women no longer had to follow sexist laws.This is refleed im the fact that now, the % of babies is nearly half compared to 1961.



Here is where the % of children begins being extremely lower comlared to the rest of the pyramid. This decline has to do with the standardization of electronic universities in Italy in the early 2000s, making higher education more attainable, decreasing the fertility rate.

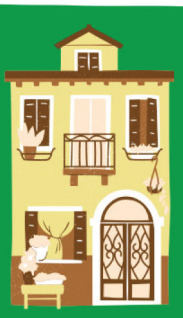


With the digitalization of our lives, came the trend that due to either climate change or laziness or lack of money having children is really impractical. This is not a worldwide feeling, however, it is extremely common to see young people having dogs instead of babies, given the facility of having one instead of a child.

4. 2036 PREDICTION

NT= Noe^rt
NT= 59'409,537e^0.000754(14)
NT= 58'409,537

Our prediction is fairly similar to the website's predictio. Since Italy was a negative/decaying intrinsic rate, the rule of 70 could not be applied because the population is no longer growing. Instead, we used the euler function for population trends, which showed a much more reasonable result which was very similar to the prediction of the websit. The numerically difference could be because different data was used to conduct the calculations .



5. TFR

Births per year= 81395
Amount of women 15-49= 12'001,139

81395/12'001,139=0.00678
0.00678*100= 0.678

The total fertility rate in Italy is 1.3 births per woman. With the calculations we got a result which is less than the actual rate. This probably happened because there is a margin of human error .

6. ENVIRONMENT

- Access to better food quality can increase life expectancy, which with technology is very simple to do nowadays.
- Industrialization can affect both the environment and the decrease fertility rate, because women can now have the opportunity to work equally with men

7. SUSTAINABILITY GOALS

This goal entails the reduction of inequalities in income as well as those based on age, sex, disability, race, ethnicity, origin, religion or economic or other status within a country. In Italy the main reason people don't have kids is because for most people childcare is our of budget. Strategies have been set by local governments to fully finance childcare for any families willing to have kids, which works perfectl, this way people are encouraged to have babies.

This goal counts on ensuring a sustainable consumption and production patterns, as we know Italy has a higher % of exportation to Europe and the rest of the world. As well as how the electronic waste is being managed and the amount of food waste this country creates. By thinking of ways to be able to control every year's electronic waste such as acidification of these electronic parts like it is done in India.

Population Growth USA

AP Environmental Science
Antonia Gómez and Gabriela Guzmán

Current Population of the U.S 2022

338,370,395

Intrinsic Growth Rate Obtained

0,034%

$$I = \frac{Births\ (t) - Deaths\ (t)}{Initial\ Population} \cdot 100$$

$$I = \frac{2041\ (365) - 1722\ (365)}{338\,370\,395} \cdot 100$$

Intrinsic Growth Rate according to Website

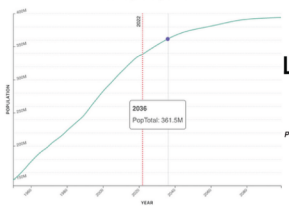
0,51%

$$I = \frac{(Births - Deaths) + (Inmigrations - Emigrations)}{Inital\ Population} \cdot 100$$

Population in 2036 (Rule of 70)

United States Population 2022 (Live)

338,370,395



Population in 2036 according to website

$$Nt = Noe^{rt}$$

$$2036 - 2022 = 14\ years$$

$$Nt = 338{,}370{,}395e^{(0.034 \cdot 14)}$$

$$Nt = 544{,}648{,}775$$

Population in 2036 obtained

Rule of 70

$$\frac{70}{r}$$

$$\frac{70}{0.034} = 2058.8$$

Year Population to Double: 2058

TFR over the years

Year	TFR
1960	3.5
1990	2.08
2000	2.06

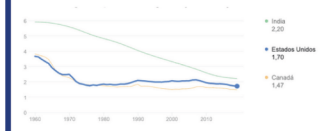
Fertility Rate

$$F = \frac{Births\ per\ day\ (t)}{Sum\ of\ \text{total}\ population\ women\ age\ groups\ 15-49} \cdot 100$$

$$F = \frac{2041(365)}{76111900} \cdot 100$$

$$F = 0.97$$

$$F = 1$$



Analysis Fertility Rate

The fertility rate of a population tells us the annual number of births per woman in their reproductive years, per 1000 women. In this case in the U.S, the fertility rate is 0.97 meaning that on average, there will be 1 birth per woman in 2022 between the ages of 15-49. However, there are a lot of factors and variables that need to be taken into account when analyzing these data. The fertility rate can change over time depending on many factors, such as culture since before it was prevalent for women to have multiple children something that could've affected the TFR in a significant way. Another factor that should be taken into account is abortion laws and the age of pregnancies since nowadays it is more likely for a teenager or young woman to decide to not give birth and instead have an abortion, something that wasn't available years ago and that could've made the TFR increase since more women would be giving birth. Education plays an essential role in this aspect since if more women are receiving proper sex education, they're less likely to get pregnant at young ages, the same happens with religion, if the religion states that it's wrong to have intercourse at young ages, there'll be fewer pregnancies in young age groups. To sum up, when analyzing TFR there are dependent and independent variables and the number of births is the dependent variable since it depends on multiple factors such as culture, education, religion, abortion laws...etc, which are independent factors.

Population over the years

In the pre-reproductive age groups, men have a larger population. The life expectancy in this year was not very high with 66.6 for men and 73.1 for women, something that can be seen in the pyramid. It can also be said that during these years, there was a baby boom because the U.S had just overcome The Great Depression and World War II which led many couples to start reproducing and marrying because of the delay these events produced. After these events, there was a peak in the economic aspect which also caused a surge in population.

During this year, the reproductive age groups were significantly higher than the rest of the population and there was a notable decrease in the population between the ages of 40 and 44 years for both genders. The life expectancy in this year was 72 years for men and 78 years for women, with this we can see that it increased taking into account previous years.

In this year, it can be seen that there are significantly more number of men and women in the age groups from 25 - 39 years. After these age groups, the pyramid "stabilizes" until the population of the age groups starts to decrease from both genders, however in the post reproductive age groups, women tend to have a larger population.

As in the previous pyramids, we can see that there is generally a greater population of women, this is mainly because women tend to have a longer life expectancy than men. The peak where we can find the largest population of men and women is between the ages of 45 to 49, after this the population has a tendency to decrease due to the age groups and the general life expectancy of this year.

We can see that compared to the other pyramids, this one does not vary so much in terms of the amount of population and doesn't have any noticeable peaks. In addition, there is no great difference between the population of women and men however, women have a higher population in the reproductive and post reproductive age groups.

Evaluation Country & Population

- **Which environmental problems could've affected the behavior of the population through the years?**

- Wildfires is a a really big environmental problem in the USA. In 2020, the country experienced one of the largest wildfires in history, which lasted for the entire year, tearing through parts of California, Oregon, and Washington state. Smoke from large-scale wildfires causes significant air pollution in the affected area and is a threat to public health. Smoke is made up of a complex mixture of gases and fine particles, which can penetrate deep into the lungs and aggravate chronic heart and lung diseases. Smoke and poor air quality inhalation can lead to minor issues such as burning eyes and allergies or in a worst-case scenario, premature death. This can affect the population with life expectancy, because as already said, this contamination can generate more premature deaths and also cause the population to decrease.

- **In your opinion, which sustainability development goals can be improved in this country? Explain and suggest a possible strategy.**

-We think that the sustainable development goals that the USA should work on are responsible consumption and production since this country is one of the largest producers and consumers. Another of the sustainability development goals that the USA has to work on is affordable and clean energy. Low-income communities in the United States are disproportionately affected by climate change, but rarely have the resources to help fund solutions or beneficial change. Often located near power plants, low-income communities have higher rates of asthma and other health problems associated with air pollution. Renewable energy sources like solar power provide one of the most efficient ways to combat air quality problems and climate change but are often out of reach in underserved areas.

MADE BY: Daniel Granados & Sarah Jimenez

Understanding the topic of

HUMAN POPULATION IN GERMANY

POPULATION 2022

83,24 million

INTRINSIC GROWTH RATE

intrinsic growth rate

RNI=$BR - DR/10$

BR= 9.8
DR=11.46

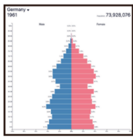
Therefore

RNI=$9.8 - 11.46/10$

RNI=-0,166%

FORMULA

$RNI = BR - DR \div 10$

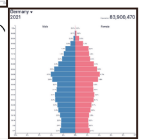


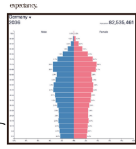
Population Pyramid 1961

Total population is 73.928.076. Shows pyramidal shape, referring to the biggest quantity of individuals concentrated in pre-reproductive and reproductive stages of the pyramid, between the ages of 0.4 and 20-24, which indicates high birth rate. More males than females. Quantity of people in post-reproductive years (46-100+) maintains stable numbers between 50-59 and then decreases, Suggests high death rate and low life expectancy.

Population Pyramid 2021

Total population is 83.900.470. It has a barrel shape, reference to the low birth rate and high life expectancy/low death rate. Biggest quantity of individuals is in the post-reproductive stage, between the ages of 50-59, showing a top heavy pyramid that reflects how there is a negative growth or declining in the population growth. In post-reproductive, there are significantly more females than males, having increased life expectancy.





Population Pyramid 2036

Total population is 82.535.461. The complete barrel shape shows that there is a significant decrease in birth rate, and exceeding life expectancy with a very low death rate. In post-reproductive ages, between 65-79, the population reaches most quantity of individuals. The pyramid is top heavy, having a decreasing growth rate in which there are more middle age people than babies being born. More middle age females than males.

PROJECTION 2036

By using the rule of 70, is possible to predict how is the population going to be by the year 2036, observing if the population is going to increase or decrease.

Rule of 70: Divide 70 with growth rate, predicting the doubling time, which is the amount of time for a population to double at a constant growth rate.

FORMULA

$\frac{70}{r} = \textit{Doubling time}$

With the rule of 70 formula, the population of Germany in 2022, and the growth rate in that year, it was possible to calculate what the population will be like in 2036:

Population 2036 Germany

$$\frac{70}{-0.05} = -1.400$$
$$2036 - 2022 = 14$$
$$\frac{1.400}{14} = 100 \to \frac{83.340.541}{100} = 833.405.1$$
$$83.340.541 - 833.405 = 82.507.144 \textit{ million}$$

In 1.400 years the population will be halved, so by dividing the 2022 population with 100 it was possible to know how much the population diminished. Finally, the quantity decreased minus the population in 2022 gave the final result of 82.507.144 million people in Germany by the year 2036.

ANALYSIS POPULATION PYRAMIDS

1976: Narrower base which points to falling birth rate, but still showing a stable proportion of pre-reproductive and reproductive individuals, most quantity being between the ages of 10-14 and 35-39. Decreasing death rate (barrel form), rising life expectancy. Reproductive phenomenons happening because of the development of the country. The bulges in the working class can also be due to the preceding baby boom in 1961.

1991: Falling birth rate and a rising life expectancy, wide apex of the pyramid showing high proportion of people living longer. Decreased death rate. Biggest number of people between reproductive and post-reproductive years (25-34 has most quantity of individuals). Proportional quantity of males and females, but in post-reproductive years there's a bigger life expectancy for females. Increased numbers in old-ages may be due to the maturity of the baby boom. cohorts.

2006: Progressing barrel form in the pyramid. Low birth rate and high life expectancy, alongside low death rate. Middle heavy, which shows stability (economically and socially). Biggest quantity of people between the ages of 40-44, but middle age class has the most quantity of people going from 30-50. Women and men have similar numbers of people., but women still live more. The decreasement in birth rate could be due to the increasement in education and decreasement in age of marriage, which slows population growth. Germany has a proportional carrying capacity comparing the size of the country and the quantity of people it has, demonstrating its exponential development.

The results given by the website are 82,535,461 by the year 2036, and the projection given by the rule of 70 is 82.507.144 by the year 2036. The quantity given is very similar, and the approximations both give a number of people in Germany coherent to its decreasing growth rate, easily explained and understood by looking at the pyramid and observing how middle aged individuals now have the biggest percentages.

REASONS FOR DECLINE IN GROWTH RATE

Women's education and equality in workforce, lower child mortality rate, major economical costs for raising children, increased life expectancies, marriage age, technological advancements (for example in medicine), etc.

TFR INFORMATION

The TFR (TOTAL FERTILITY RATE) is a formula used to calculate the births per women in a specific country. It is calculated by diving the number of births per year by the midyear female population aged 15-49 years in the same area & year times a thousand. There are several factors that may change this calculations such as education, politics, age of pregnancy, religion, nutrition, and economic factors. All of these factor may change this calculation; for example, education plays the role of giving women opportunity and tools to develop as young woman and not get pregnant at low ages, as well some religions do not allow baby's as well as some policies were they allow or do not allow abortions. Economic is such a key aspect since people with good economic income usually plan having kids at ages around 25-32 people or countrys with low economy's may have more non expected children than other countries

FORMULA

$$= \frac{\text{No. of live births during the year}}{\text{Midyear female population aged } 15-49\text{years in the same area \& year}} X\ 1000$$

$$\frac{152.205}{16.903.211} \times 1000 = 9$$

9 women every 1000 have a baby in Germany. The fertility rate in this country is incredibly low, showing development factors based on women's choice.

GLOBAL CITIZENSHIPS

In our country (Colombia) we are in progress of reaching the sustainability goals, but comparing us to Germany, a developed country, it is possible to understand that in order of reaching a bigger goal it is necessary for us to implement environmental policies in the production and exportation of goods, since both countries have a major influence in other countries that require their natural and industrial products.

RESPONSIBLE CONSUMPTION AND PRODUCTION

ENVIRONMENT AND POPULATION

Some environmental factors that affect the growth of populations that eventually are going to affect the population is the carrying capacity of the environment, which refers to the number of individuals the environment can provide resources to without exceeding its support. The problem with carrying capacity is that it is not only the number of individuals an ecosystem can host, it relates to how much resources the population consumes and at what rate they do so. Some environmental problems that are affecting the growth of population are physical space that humans need to continue to grow, and the need for natural resources (such as food, water, fuels, metals), since humans have consumed more resources in the past 50 years than all of the resources consumed by humans in the past.

SUSTAINABLE DEVELOPMENT GOALS

In 2020, Germany emitted 739 millions of tons of greenhouse gases, 8.7 less than in 2019, but there is still a long way to go in order of reaching 0 emissions, since this country is leading in the subject of sustainable goals and has the investment required to create cleaner technologies. For example, Germany manufactures multiple things from vehicles to industrial machinery, so if they work from the eco-design they could impact not only their production but the rest of the world that acts as a consumer.

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AP ENVIRONMENTAL SCIENCE

Maria Camila Benites
Mariana Vásquez

INDONESIA POPULATION GROWTH

Population pyramids

Population
275,591,549
Reference

Intrinsic growth rate
0.132%
Procedure | Analysis

1961	1976	1991	2006	2021
Population: 90.8M Growth rate: 2.75% Expanding	Population: 134.5M Growth rate: 2.52% Expanding	Population: 185.4M Growth rate: 1.76% Expanding	Population: 231.8M Growth rate: 1.31% Stationary	Population: 273.8M Growth rate: 0.70% Stationary

Expanding	Stationary	Contracting
Rapid growth	Slow growth	Cero growth
Underdeveloped nation	Developing nation	Developed nation
Youthful population	Ageing population	Aged population
High birth/death rate	Declining birth rate/High death rate	Low birth/death rate
Short life expectancy	Increasing life expectancy	Long life expectancy

The World Population Review gives a prediction for 2036 of **302.5M people**

Population predictions for 2036

280,731,830
70 rule procedure with 0.132% rate

309,117,008
70 rule procedure with 0.82% rate

Total Fertility Rate (TFR)

12,45 Children per 1000 woman Procedure

Marriage Law 1974

Parents can marry their daughter off as young as 16 years old

- 14% of young girls marry before their 18th birthday

Family planning 1974

Launch of a vigorous family planning program in the mid-1970s and from social and economic change

- Massive improvements through the 1970s and 1980s in basic education for girls.

Contraception

The world's fourth most-populous country is promoting later marriages

- 2.1 children per woman by 2025

Economy

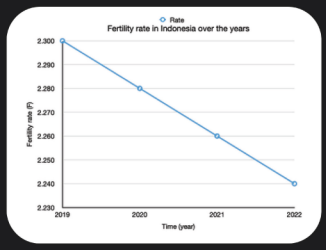
Aligns with broader strategies to move Indonesia up the industrial value chain

- A modestly higher-than-average fertility rate can balloon the numbers
- 2.3 children per woman, Indonesia will add 30 million people in the next decade

Sexual conflict

result of asymmetries in the minimum investment required for reproduction for males and females

- Men have higher ideal family sizes than women, but within reproducing couples, desire similar numbers of future offspring.
- Men have lower fertility intentions than women when husbands are significantly older than their wives.



RocheS²TEM
SUSTAINABILITY · SCIENCE · TECHNOLOGY · ENGINEERING · MATHEMATICS

PROTECTING US FROM THE SUN

Ana María Campos
AP Chemistry Teacher

In November, the AP-Chemistry and Chemistry & Conservation-2 students received the visit of Uli Osterwalder, a chemical engineer expert in the design of sun protection products. The students had the opportunity to enjoy a conference and a conversation about the importance of research in science and applied science.
The experience allowed students to connect with international professionals and create meaningful learning connections. Also, it allowed students to practice professionalism and critical thinking.
Before the lecture, the students spend time researching the speaker's experience and CV and the topic, and the chemical concepts needed to connect with the guest. Students understand the purpose of the guest speaker and create questions to discuss during the session.

Uli Osterwalder is a trained Chemical Engineer (ETH Zurich, Switzerland, and UH Houston, Texas). He joined the central process development of Ciba-Geigy in Basel, where he first developed a Phosgene Generator. Later he developed his leadership skills in Project Management and Process Analytics. At Ciba Specialty Chemicals Uli Osterwalder helped establish new business development in Fabric Care and Personal Care. At BASF SE in Ludwigshafen and Duesseldorf, he became Senior Marketing Manager and Scientific Adviser at Sun Care. He worked for DSM as a senior Scientific Adviser at Sun Care in Basel for two years.
In 2018 he started the consulting company Sun Protection Facilitator GmbH. He continues his commitment to contribute to further improvements in sun protection. Uli Osterwalder works for ISO on developing new UV protection assessment methods and is currently chairing the technical committee ISO TC/217 (Cosmetics). He is the author, co-author of numerous scientific articles, and editor of the papers CHALLENGES IN SUN PROTECTION, Karger, Basel (Osterwalder, 2022).

Below I present a short review of the most critical ideas that Uli Osterwalder shared with us at the Rochester School.

About the skin

The skin is the main interface between the body and the environment, being exposed to oxidants, including

solar radiation and environmental pollutants, such as internal combustion engine gasses, cigarette smoke, halogenated hydrocarbons, heavy metals and ozone, making it the first defense system against the external environment (Flavia Alvim Sant'anna Addor et al., 2022).

The solar spectrum contains ultraviolet radiation between 100 to 400 nm wavelengths. The solar ultraviolet (UV) radiation that reaches Earth is a combination of UVB (280-315 nm) and UVA (315-400 nm) wavelengths. UVC radiation (100-280 nm) is of no clinical significance, blocked by the ozone layer, and cannot reach the Earth's surface. On the skin, the acute effects of ultraviolet (UV) radiation include erythema, sunburns, and photo immunosuppression. In contrast, the chronic effects include photoaging and skin cancer ((Flavia Alvim Sant'anna Addor et al., 2022).

When ultraviolet sunlight hits our skin, it affects each of us differently. Depending on skin color, it'll take only minutes of exposure to turn one person beetroot-pink, while another requires hours to experience the slightest change.

What's to account for that difference, and how did our skin come to take on so many different hues to begin with? If you want to know more about it I recommend the TED video The science of skin color by Angela Koinehttps://www.ted.com/talks/angela_koine_flynn_the_science_of_skin_color.

With the rising number of skin cancer diagnosed annually, negative effects of ultraviolet (UV) radiation are now well recognized and significant public education programs have been undertaken on appropriate photoprotection, including the use of sunscreen. In daily life, UV exposure is unavoidable; therefore, sunscreens are recommended to be used regularly. There has been tremendous development in sunscreen and UV filter manufacturing over the last decade. Sunscreen active ingredients are now incorporated into cosmetics products to minimize the effect of early skin aging (photoaging). With the advances in technologies, many new UV filters with an improvement in their efficacy and safety have been developed over the last ten years (Marroquin N., et al, 2022).

Understanding sunscreens: How a sunscreen works.

Sunscreens were invented over seventy years ago to allow tanning without getting sunburnt. This requirement was achieved by simple UVB filters (290-320 nm). The need for UVA protection emerged over twenty years ago. Hence the major development in UV filters was in photo-stable UVA I (340-400 nm) and broad-spectrum UV filters. Ideally, a sunscreen should protect equally well against both UVB and UVA radiation (ideal sunscreen).

UV filters are the heart of sunscreen technology. Both organic and inorganic UV filters mainly work by absorbing UV radiation of a certain range of wavelengths. Mostly they are used in a dissolved state. Particulate UV filters additionally scatter and reflect UV radiation and light. The latter is not desired because of the whitening effect and is thus avoided by making the particles smaller. There has been a trend in UV filter development towards higher molecular weights above 500 Dalton.

One of the most recognized qualities of sunscreen is the SPF factor. The sun protection factor (SPF) is an international reference for expressing protection against UVB radiation, being in practice a primary measure of protection against UVB radiation and, to a lesser degree, against UVA radiation. According to the FDA (US Food and Drug Administration) the SPF is a measure of how much solar energy (UV radiation) is required to produce sunburn on protected skin (i.e., in the presence of sunscreen) relative to the amount of solar energy required to produce sunburn on unprotected skin. As the SPF value increases, sunburn protection increases (FDA, 2022).

There are a few common misunderstandings about sunscreens. A popular misconception is that SPF 60 is not twice as effective as SPF 30 (in preventing sunburn under laboratory conditions, to be precise). The argument is that an SPF 30 sunscreen absorbs 96.7% of the erythemogenic UV rays, whereas an SPF 60 sunscreen absorbs 98.3%; meaning only 1.6% more. Figure 1 shows the situation.

The argument is correct regarding how much is filtered out overall. But what matters more, the amount filtered out or the amount of UV rays transmitted onto the skin? The question is rhetorical.

The number of photons reaching the skin with an SPF 60 (labeled SPF 50+) is 50 % of the number of photons reaching the skin through a SPF 30 sunscreen; i.e. a difference of factor 2! This may also be illustrated by comparing an SPF 10 with an SPF 50 sunscreen. 10 photons end up in the skin compared to 2, i.e. a factor 5 difference as we would expect (Figure 1).

The second quality is the kind of UV-filters. Absorption of UV radiation by organic UV filters works by excitation of the electrons in the molecule: An electron is elevated from the highest occupied molecular orbital to the lowest unoccupied one. The most relevant electronic transitions in the UV absorbers are pp*-transitions. At present, all organic UV filters, which are used in sunscreens, contain aromatic groups in their chromophores. In many cases, a benzene moiety is linked to two substituents in para-position, one of which has the tendency to push the electrons towards the benzene ring, whereas the other substituent tends to suck the electrons off the ring, resulting in so-called push/pull-systems. In such molecules, the electrons are prone to be delocalized, giving rise to high absorption intensities when interacting with UV-light (Osterwalder, 2022).

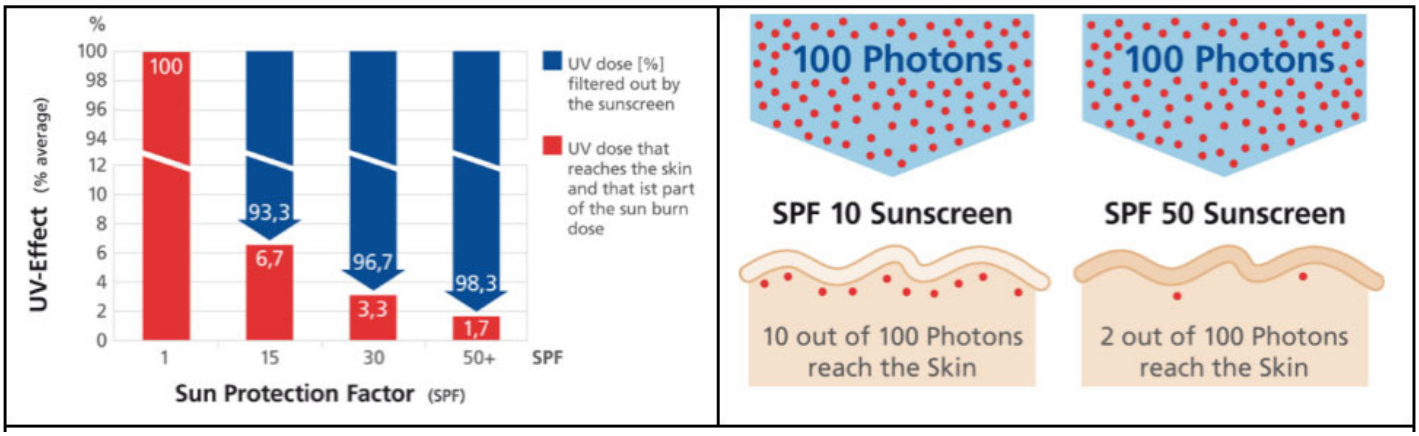


Figure 1. Illustration of the SPF. What is more important? Filtered UV radiation versus transmitted UV radiation? Image from: Uli Osterwalder, Overview of new UV filters, Intensive Course in Dermato-Cosmetic Science, Brussels, September 2018.

The inorganic oxides TiO2, ZnO, or CeO2 and more recently TiO2 modified with manganese ions, protect mainly by absorption of UV radiation, although some scattering superimposes this main effect. Being small particulate crystals, these materials are semiconductors with high band gap energy between the valence and conduction band. The band gap of the bulk crystals is in the range of an energy corresponding to wavelengths between 370 and 390 nm, but this may alter with the size of the primary particles (the smaller the primary particles, the higher the band gap energy). UV light is absorbed by elevating an electron from the valence to the conduction band.

Sunscreen manufacturers have four basic requirements on sunscreen actives, which existing and new ingredients must fulfill before they can be incorporated in a final product: Efficacy, Safety, Registration, Patent Freedom.

1. Efficacy: Sunscreen actives (UV Filters) must absorb UV radiation somewhere between wavelengths of 290 and 400 nm. The specific Extinction E1,1 is a measure of maximum absorption by weight (extrapolated for 1% concentration and 1 cm path length). The value of a UV filter is determined by its contribution to the SPF and UVA-PF.

2. Safety: Sunscreen actives should have no adverse effect on humans and the environment. Although direct comparison with a new pharmaceutical drug is not appropriate, the development of a new sunscreen active for global use is highly demanding.

3. Registration: In order to exploit the full economic potential of a UV filter, UV absorber manufacturers are aiming for global registration. In Europe, South America, Asia and Africa, where sunscreens are considered as cosmetics, approval is possible within 1-2 years of filing. In Australia, Japan and especially the USA it takes longer.

4. Patent freedom: Patent freedom means the free use of sunscreen actives by any sunscreen manufacturer, i.e. without any uncertainty about whether any third party patent rights are infringed by the use of a particular ingredient.

When looking at the packaging of sunscreen for dermatological use, the comparison between products tends to be impossible for the health professional and is even more misleading for the common consumer. The SPF is the information most commonly related to the effectiveness of sunscreens and the easiest to see on the sunscreen label. However, its interpretation should not be based only on the numerical value itself, as it should also consider the adequate way to use the product in terms of applied quantity and regularity of reapplications. In this case, it is very important to critically review the labels and learn about the products we are buying.

Figure 2. gives an overview of the requirements on sunscreen products.

New Technology.

Despite all these activities around conventional UV Absorbers, there is still a need to find and develop new UV absorbers. The requirements in terms of efficacy and safety are comparable with the development of a

Figure 2. Important requirements for sunscreen indication.

new drug, and the research and development takes several years until a substance can finally be approved in Europe. In Australia and USA, UV absorbers are indeed regulated as drugs, and registration takes considerably longer.

There is a comprehensive patent literature describing many new structures and substances that can in principle be used as sunscreen actives. Most substances that were once identified will however never make it to a commercial product. Three UVB, three UVA and three Broad-Spectrum UV Filters have been developed in Europe over the last 15 years. Their names, COLIPA-number and major characteristics are given gy organizations like the Cosmetic Europe. Cosmetics Europe is the European trade association for the cosmetics and personal care industry. Their members include cosmetics and personal care manufacturers, and also associations representing our industry at the national level, right across Europe (https://cosmeticseurope.eu/about-us/).

The latest UV filter added to the positive list is Tris Biphenyl Triazine (nano), TBPT covering the UVB/UVA II rang. Yet another new microfine organic UV filter called HAA299 or C1332, covering the UVAI/short visible range, received a positive safety evaluation, but it can only be commercially available after EU approval. One of the most innovative tools has been the use of nanotechnology to create new absorbents (Shi L., et al. 2012).

With the increasing awareness of the importance of using sunscreens to prevent sunburns, skin cancer, hyperpigmentation disorders and skin aging, demand for sunscreen formulations has increased, creating an opportunity for manufacturers of dermo-cosmetics to develop good-quality skincare products that are effective, environmentally safe and aesthetically appealing to meet the consumer requirements. The science of photo-protection has also developed better scientific knowledge and technologies (Osterwalder, 2016). The regulations for sunscreens vary between countries and, in a globalized world where patients have access to sunscreens from all over the world, and it is important that dermatologists and also for the consumers know the main regulatory differences.

Are you ready to buy your sunscreen lotion?

Scan to watch the interview with Uli Osterwalder.

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RocheS²TEM

SUSTAINABILITY · SCIENCE · TECHNOLOGY · ENGINEERING · MATHEMATICS

SPORT AND SCIENCE

Authors: Diego Sierra, Martina Hernández, Maria Camila Gómez, Amy Mejía, Karla Varela

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SUSTAINABILITY · SCIENCE · TECHNOLOGY · ENGINEERING · MATHEMATICS

Introduction

Circular and parabolic motion are two examples of motion in two dimensions. Circular motion for a particle moving around a rotational axis in a circular path, a path where the distance between the particle and the axis remains constant. Parabolic motion for a particle which motion is a combination of a uniform motion along the x (horizontal) axis and a uniform accelerated motion along the y (vertical) axis.

Students used the online application Tracker Physlet or Playground Physics to analyze the main quantities used to describe the motion of a particle, quantities such as distance, displacement, velocity, and acceleration.
They studied the importance of physics in their daily lives and the relevance of physics and science in design of technologies, sports elements, improvement plans, and sport courts designs for high-performance athletes. Moreover, they analyzed the fun of learning physics while analyzing circular motion when playing with cups filled with water.

Here you find an analysis of the motion of a ball in volleyball, and basketball. It shows how the ball follows a linear path with a constant velocity on the horizontal axis while following a parabolic path under the action of the gravitational force on the y-axis. Moreover, it presents elements to understand how air resistance should be included as a factor in the analysis. Finally, the movement of an array of water-filled up cups on trays is analyzed, explaining how circular motion is related to centripetal force.

If you are keen to know more about this research, you are invited to watch this 1 minutes trailer. Follow the QR

Theoretical background

Gravity: Force that pulls masses towards each other. Field of attraction.

Displacement: Total change on the position, based on the initial and final points and not in the path. Vector quantity.

Velocity: Change of position in a given time interval. Vector quantity.

Acceleration: Rate of change of the velocity. Vector quantity.

Heart rate: Number of beats per minute of the heart.

In the link of QR code, there is a detailed explanation of the equations and concepts required for this research. You learn about distance, displacement, speed, velocity, acceleration, and vector. You will also get an introduction to the angular quantities that are the main factors to be analyzed in a circular motion.

Equations:

Position in x: i. Stand for initial, f for final and t for time.

$$\textbf{Eq. 1: } x_f = x_i + v_{ix} \cdot t$$

Position in y:

$$\textbf{Eq. 2: } y_f = y_i + v_{iy} \cdot t - \frac{1}{2} \cdot g \cdot t^2$$

Velocity in y: where g stand for gravitational acceleration.

$$\textbf{Eq. 3: } v_{y,f} = v_{y,i} - g \cdot t$$

Velocity in y: where $\Delta y = y_f - y_i$.

$$\textbf{Eq. 4: } v_{y,f}^2 = v_{y,i}^2 - 2 \cdot g \cdot \Delta y$$

Data Collection and processing

1. Throwing a ball.
2. Recording the path
3. Taking a reference measurement
4. Use Tracker Physlet app or Playground Physics to analyze the data
5. Register the videos, tables, and graphs.
6. Analyze and compare with theoretical expectations.

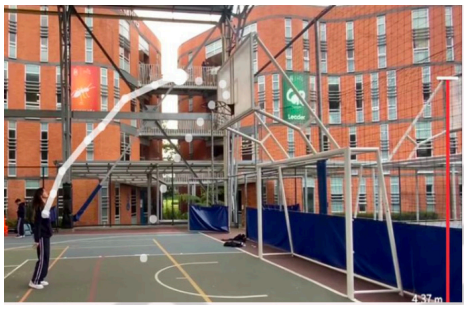
For further information on how to use the app and how to record the videos, please follow the QR codes 3 and 4, respectively.

QR code 3: Videos of the experiments

QR code 4: Videos of the experiments

Basketball: Students took data while playing basketball and trying to score after a shoe of the ball.

Playground Physics:



Picture 1: Student playing basketball. Analyzed with Playground physics

Tracker:

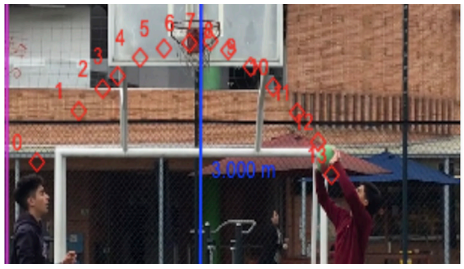
Picture 2: Student playing basketball. Analyzed with Tracker Physlet App.

Volleyball: Students tracking the motion of a volleyball ball while playing trying to control the ball and the touches.

Playground Physics:

Picture 3: Student playing volleyball. Analyzed with Playground physics

Tracker:



Analyzed with Tracker Physlet App.

Trial	$\Delta\vec{x}$ $[m]$	$\Delta\vec{y}$ $[m]$	y_{max} $[m]$	y_{min} $[m]$	$\vec{v}_{x,avg}$ $[m/s]$	$\vec{v}_{y,0}$ $[m/s]$	$\vec{v}_{y,f}$ $[m/s]$	$\vec{a}_{x,exp}$ $[m/s^2]$	$\vec{a}_{y,exp}$ $[m/s^2]$	% error $\vec{a}$
1	8.5	3.3	4.4	1.1	8.8	6.9	-6.2	0.3	9.4	5
2	3.5	1.4	2.9	1.5	4.2	5.0	-2.3	~ 0	9.2	6

Table 1. Experimental data of the motion of a ball in a shot in basketball. Ymax and Ymin refers to the maximum and minimum height reached by the ball, respectively.

Trial	$\Delta\vec{x}$ $[m]$	$\Delta\vec{y}$ $[m]$	y_{max} $[m]$	y_{min} $[m]$	$\vec{v}_{x,avg}$ $[m/s]$	$\vec{v}_{y,0}$ $[m/s]$	$\vec{v}_{y,f}$ $[m/s]$	$\vec{a}_{x,exp}$ $[m/s^2]$	$\vec{a}_{y,exp}$ $[m/s^2]$	% error $\vec{a}$
3	7.1	3.9	4.8	0.8	1.9	10.8	5.9	0.1	10.4	6
4										

Table 1. Experimental data of the motion of a ball in a shot in volleyball. Ymax and Ymin refers to the maximum and minimum height reached by the ball, respectively.

Analysis

Parabolic Motion

The data is analyzed using Playground physics (trials 1, 3) and Tracker Physlet online app (trial s2, 4). The results are consistent with the expected motion of a ball acting upon the force of gravity while moving forward. Table 1 shows the data gathered in each trial for basketball, and Table 2 shows the collected data for volleyball. The analysis focuses on displacement, velocity, and acceleration in both axis: x and y. See graphs 1 and 2.

Displacement: The path along the horizontal axis, $\Delta\vec{x}$, as a function of time, is described by a straight line with a positive-constant slope. It implies an average constant velocity and acceleration close to zero. On the vertical axis, $\Delta\vec{y}$ the path as function of time, is described by a parabola. This behavior implies a change in the velocity (slope) with an acceleration different from zero. For the first few seconds the vertical path looks like a straight line because the ball was just about to leave our hands, and the parabolic motion has not yet started.

These equations are equivalent to eq. 2 in the background. In trials 2 and 4 there is a negative starting position since tracker extrapolates the parabola in distance till it finds the y-axis intercept.

Trial 1 - Basketball: $y_f = 1.1 + 6.9 \cdot t - 4.7 \cdot t^2$
Trial 2 - Basketball: $y_f = -8.7 + 6.5 \cdot t - 4.1 \cdot t^2$
Trial 3 - Volleyball: $y_f = 0.8 + 10.8 \cdot t - 5.2 \cdot t^2$

Trial 4 - Volleyball: $_f = -8.9 + 3.4 \cdot t - 4.2 \cdot t$

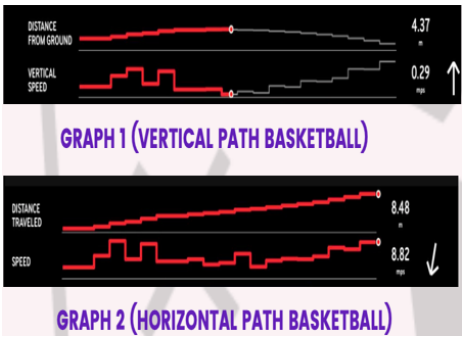
Velocity: The velocity along the horizontal axis has a constant value. A few oscillations in the horizontal velocity magnitude are present because of the interaction of the ball with the air. However, the oscillations' magnitude is negligible compared to the actual velocity. The velocity in the y-axis decreases constantly until it reaches a value of zero. It has a constant increase in magnitude, with the same rate of change, slope, for the decrease and the increasing intervals. The magnitude of the vertical velocity is zero when the ball reaches its maximum height, and there is a turning point in the parabola, vertex, and in the velocity magnitude. See graphs 1 to 4.

Acceleration: The acceleration in the x-axis should to be zero. Both trials have an average acceleration in x close to zero. For the vertical axis, the acceleration is supposed to be $g = 9.81 m/s^2$ i.e. the acceleration due to the gravitational field. The collected data and the curve fitting show that the acceleration is actually close to , with an experimental error of about 5%.

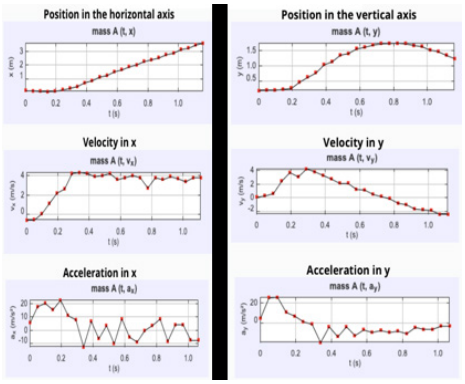
This uncertainty results from the combination of data analysis systematic uncertainty due to data manipulation and human error, and due to random uncertainty factors such as the air resistance. Even though air resistance has a small contribution, it is important to take it into account.

Basketball: Students took data while playing basketball and trying to score after a shot of the ball.

Playground Physics:

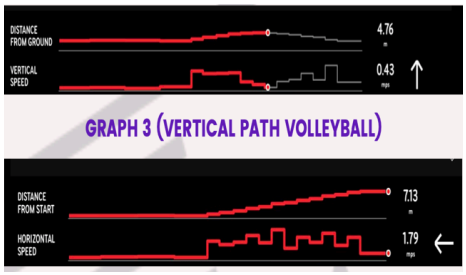


Graph 1: Basketball. Analyzed with Tracker Physlet App. Top: Displacement vs time and velocity vs time in x. Bottom: Displacement vs time and velocity vs time in y.

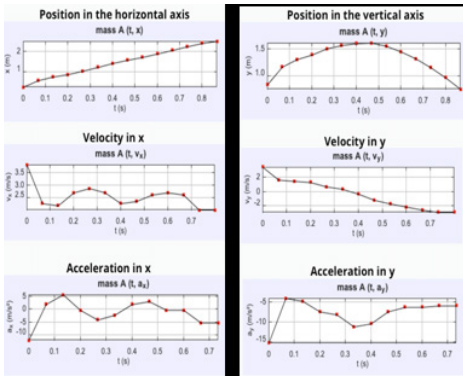


Graph 2: Basketball. Analyzed with Tracker Physlet App. Top: Displacement vs time in x and y. Middle: Velocity vs time in x and y. Bottom: Acceleration vs t in x and y.

Volleyball: Students took data while playing Volleyball and trying to control the touches.



Graph 3: Volleyball. Analyzed with Tracker Physlet App. Top: Displacement vs time and velocity vs time in x. Bottom: Displacement vs time and velocity vs time in y.

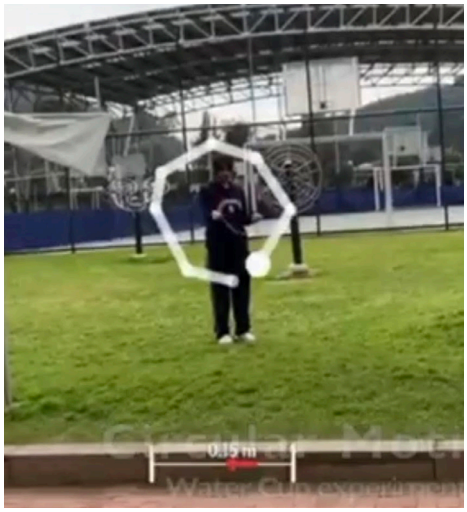


Graph 4: Volleyball. Analyzed with Tracker Physlet App. Top: Displacement vs time in x and y. Middle: Velocity vs time in x and y. Bottom: Acceleration vs t in x and y.

Circular motion

In this experiment, two plastic cups are tied by a string, and then filled with water to its half. The experiment where the cups are spun around to prove that the water wouldn't spill because of inertia, Newton's first law of motion: Objects either remain still or move in straight lines. This property is called inertia. To make something move in a circle, you have to use force (a push or a pull). As proved in the experiment the water didn't spill when it spun around.

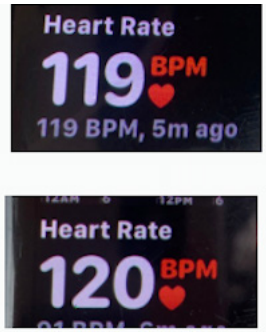
This vertical circle had a centripetal force, tension, which kept it spinning. These types of circles are divided into what can be called four sections, as seen in picture 5: Ta,Tb, Tc and Td, which are just the opposite or upper parts of a circle, each of these owns a different equation. Per se, the lowest part of a circle would be its start (Ta) and its highest (Tc), both Tb and Td share the same equations given that they're the opposite sides of the circle. When the two cups were spun around it reached a maximum speed of 4.98 m/s and traveled in vertical circle a total distance of 2.29 m. The circle was 1.90 m at its highest point, it took 2.04 m/s to reach, and had 0.47 m of width. Given the revolutions per second or the cup's mass it would've been able to find things like its period (T),its frequency (f) or force.



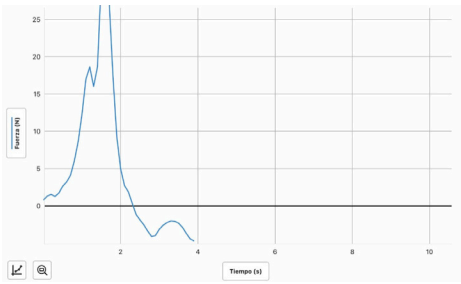
Picture 5: Student working on the experiment of circular motion.

Health data

An analysis of the heart rate (see picture 6), the force of the diaphragm (see picture 7), and respiration rate is included. It is evident that when we throw the ball, the force by the diaphragm changes, it increases as the lungs are contracting and collapsing. The same happens with the heartbeats that increase with time while playing any sport. Finally, the respiration rate remains constant, above 90%, as it is expected.



Picture 6: Student's heart rate while playing sports.



Picture 7: Student's diaphragm force while playing sports.

Conclusions

Physics and science:

We saw that physics is always there. Even though we don't see it we are constantly depending on it for real-life situations. Sports are a great way to demonstrate this.

We demonstrated the theory with this lab practice. We were able to see a parabola for the displacement in the vertical axis and demonstrate that the velocity in the y-axis at the highest point is 0.

It was shown that the velocity in the x-axis remains constant as the acceleration in x is zero.

The acceleration in the y-axis is close to g within an error bar of 5%, demonstrating that the air resistance can be negligible in broad studies.

The science in sports is important for improving performance and skills while lessening any risk of injuries, this especially applies to high-performance sports and the ones that require the most physical stability. Having science in sports will ensure more security, that's why practitioners go to a deporthologist now and then.

Its relation with physics is its components since they are needed and calculated throughout the project. In the basketball case, it has a type of physics called projectile motion (parabolic motion). Players calculate the force, direction, angle, etc, needed to shoot the ball and for it to enter the hoop. They jump when it is the right moment and when the other factors are also correct, then they throw the ball before they rebound for more accuracy and precision.

Another example of a sport with parabolic motion is volleyball, here the practitioners hit the ball into the air with their arms so that it creates a parabola form and crosses the mesh. In the water case, the gravitational force and the constant velocity with which the cup is moving make the water stay in place, instead of falling and splashing everywhere.

Virtues - Schickel:

Integral Health: we concluded that just throwing a basketball won't affect your body's measurements and data, it takes a few minutes of practicing the sport to see the effects on the body.

Dr. Glasser describes the quality world as a "personal picture album" of all the people, things, ideas, and ideals that we have discovered to increase the quality of our lives. For a lot of us, sports form part of our quality world. Understanding our sport using the sciences will help us be even better.

THISREAL

The topic is completely linked with virtues, life competencies, and science. Rochester School philosophy is based on the development of life competencies (THISREAL) about which students learn to make decisions that solve problems that take into consideration the best interest of the context, environment, community, and themselves. For this lab in specific the competencies that were applied the most were Analysis & Assessment of self and systems thinking & solving issues

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INSULATING MATERIALS FOR LUNCHBOX PROJECT

By: Zharim De San Vicente - Natural and Environmental Science Upper Elementary

As many of you know, the lunch boxes used by students on a daily basis have to be able to store heat and cold successfully for them to enjoy their favorite foods. Likewise, valuable members of our educational institution such as directors, teachers and other personnel drink coffee or other hot drinks in thermos, which are designed to retain the heat of the drink. But how are these elements designed to perform their function successfully? Fourth grade students designed a lunch box capable of thermally insulating high and low temperatures. They were able to use 3 materials within their lunchbox that can perform the insulating effect, so they had to be able to choose the correct material based on physical properties of matter. Through the project, students explained that thermal insulators do not conduct thermal energy well, so the heat and cold within the materials lose their energy slower than thermal conductors. In class, the students put their lunch boxes to the test by storing a bottle of cold water and another bottle of hot water properly separated inside their lunch boxes. They measured the temperature from their bottles every 10 minutes for a total of 40 minutes, and recorded their results in their notebooks. After looking at the results students analyzed if the materials chosen were able to insulate the cold and the heat based on the temperature gained or lost inside the time-lapse. Students trained several skills throughout the project that helped them to achieve what was expected. These skills were asking and defining problems, and developing and using models to justify their results and their designs. Additionally, the students used system thinking to solve issues and relate well with others to get the desired results. Kids put into practice several virtues which we always manage to work with in school projects as cooperation, leadership and self-evaluation. As a result, students were happy to see how something they designed and tested for several days worked properly and performed well within the established parameters. They were also content about how all the designs, drawings and stickers placed in their lunchbox were highly appreciated and taken into account. With this project, students demonstrated their learning about the physical properties of matter and how they affect all the materials and objects surrounding them. It was an enriching experience for them and for me as a teacher.

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DEVELOPING SKILLS THROUGH COMPUTER SCIENCE AND STEM

By: Miguel Salek Rodríguez
Computer Science Curriculum Coordinator

The computer science area of Rochester School is more than a classroom, it is a space where students learn from mistakes, where regardless of age they never stop being surprised, where they work from curiosity, where the values of companionship, collaborative work, respect for ideas are promoted. All of these outcome take place inside the classroom spaces with digital and tools, manual tools and from the using STEM methodology.

As an area, we have sought that students stop visualizing the computer as a whole; and rather that they understand it as a tool that facilitates the processes, but at the same time that this acquired knowledge is put into practice to develop cognitive, methodological, and technological skills.

On the other hand, the computer science program and the education and technology planning team, together with the sustainability area, strengthen the STEM project and the application of the skills developed in each of the subjects of the students from preschool to high school. This type of work generates spaces for collaboration, problem-solving, and meaningful learning, motivating the student to be in the constant desire to learn to generate solutions for sustainable development and automation of processes by solving real problems of everyday life.

"They told me and I forgot it; I saw it and I understood it; I did it and I learned it."

Confucio (551 BC - 478 BC)


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CAMPUS SOSTENIBLE, UNA VISIÓN QUE SE MATERIALIZÓ EN NUESTRO CAMPUS LEED PLATINO EN OPERACIÓN Y MANTENIMIENTO.

Liliana Medina Campos MSc. LEED AP BD+C

Escanea para conocer todas las acciones que implementamos para ser un Colegio Sostenible

En algún instante del tiempo, hace más de 10 años, el deseo de crecer en la planta física del colegio, y en la visión de las necesidades futuras de ciudadanos que afrontarán los impactos del cambio climático por nuestro actuar como civilización, nuestro Presidente, Juan Pablo Aljure, proyectó un mapa mental (Imagen 1), de lo que en su experiencia formativa, pero sobre todo en su apuesta por la sostenibilidad, requería un campus que fuera una herramienta viva de aprendizaje para la implementación de un currículo de sostenibilidad. La decisión de certificar LEED (Leadership in Energy and Environmental Design) el campus, significó el punto de partida para la realidad que vivimos, disfrutamos y aprendemos desde 2012.

El sistema de certificación LEED, es un Etiquetado Ambiental Tipo I que fue creado en 1993 por el Consejo de Construcción Sostenible de los Estados Unidos (USGBC por sus siglas en inglés), que para los diferentes tipos de edificación o áreas interiores, los evalúa como edificaciones nuevas o existentes y que actualmente ya incluye mecanismo de certificación para ciudades y comunidades y su ruta de actuar busca edificaciones Neto Cero.

La estructura de certificación como edificación nueva, difiere de la certificación en operación y mantenimiento, en los enfoques y cumplimientos obligatorios para cada una, pero su áreas de aplicación o categorías son las mismas (Imagen 2).

Imagen 2. Categorías de Certificación LEED

De igual forma, el sistema de certificación LEED, contempla un puntaje de desempeño que acorde al valor, confiere los niveles de certificación (Imagen 3), considerándose el nivel platino el de mejor desempeño.

Imagen 3. Niveles y Puntajes de Certificación LEED

El camino que inició en 2011 para el logro de la primera certificación LEED Oro v3 (64 Puntos), como edificación nueva en 2014, primer colegio en Colombia y en América Latina en obtener este estatus, y se tuvo que sortear varios obstáculos de orden técnico como para la época no contar con incentivos económicos para la construcción sostenible; el cumplimiento de normatividad internacional, que para la fecha e incluso aún, en muchos de los aspectos está por encima de normas nacionales,

Escanea para ampliar el mapa mental.

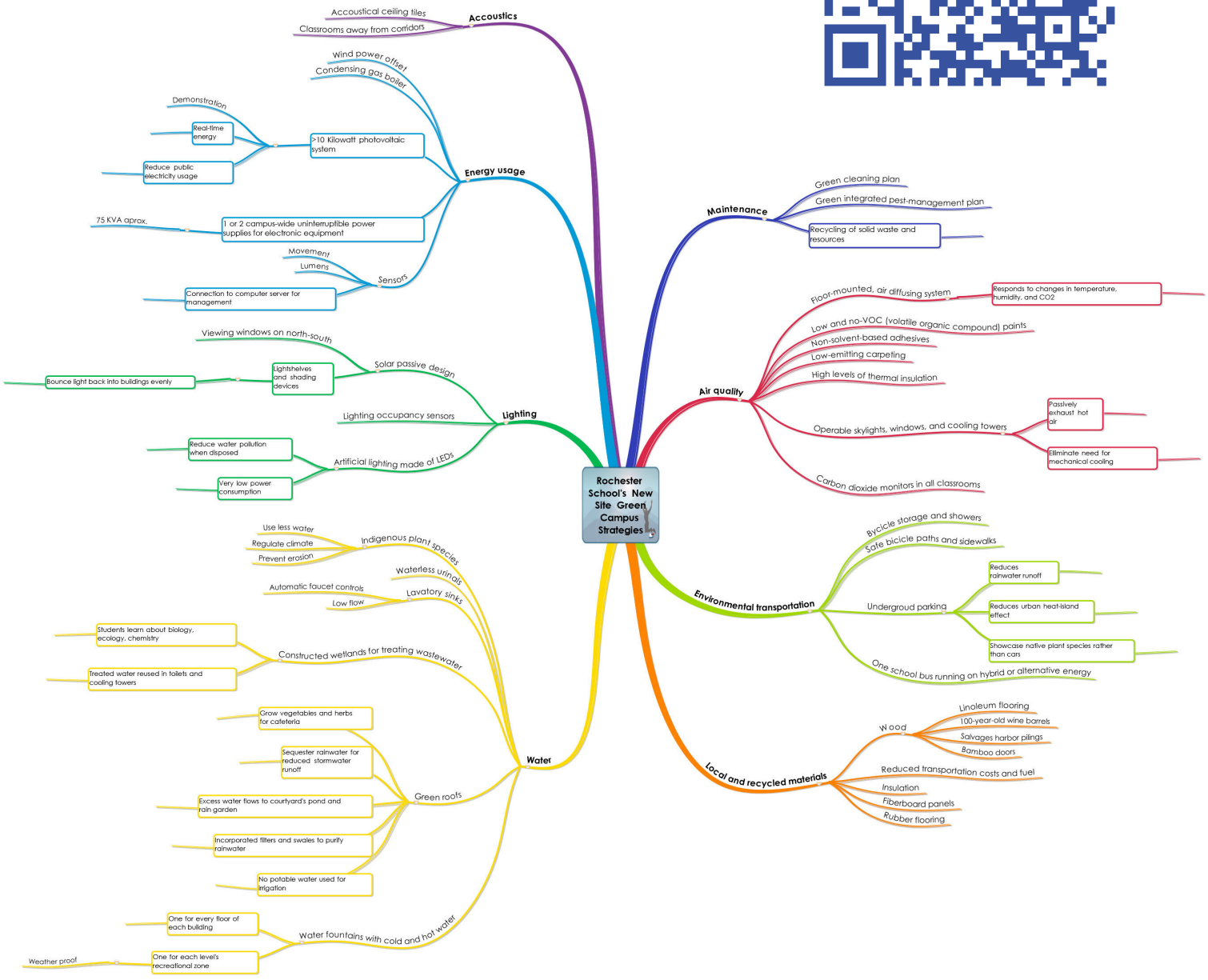

Imagen 1. Mapa de Estrategias para Colegio Verde. Juan Pablo Aljure, 2011

pero que retó a todo el equipo de proyecto a cumplir con los requerimientos colombianos e ir más allá; cambiar las prácticas y paradigmas que los profesionales del sector de diseño y construcción para que todas las estrategias se integraran, pero proyectadas a la operación y mantenimiento; articular las estrategias para el aprendizaje de nuestros estudiantes y de esta forma empezar a transformar la sociedad.

Iniciar la operación de nuestro campus en septiembre de 2012, requirió un cambio organizacional, con la creación de roles específicos para que la operación y el mantenimiento, permitieran los alcances requeridos para la obtención en 2014 de nuestra primera certificación. Pero más allá, permitió que se generara una transformación en la forma de administrar, operar y mantener nuestro campus, con la formulación de políticas específicas, actuares específicos y más aún, la consolidación de información que validaran todo aquello que referimos ante el USGBC, en el compromiso que asumimos de informar por cinco (5) años, el desempeño en la operación.

Al momento de buscar la recertificación, nuestro desempeño permitió en 2019, ser el primer colegio, primer proyecto en ser recertificado LEED Oro v4.1 (78 puntos), pero sobre todo, validar que nuestros indicadores sobrepasaban lo que se había referido en el diseño que íbamos a lograr. Para el año 2019, la estructura organizacional, el currículo de sostenibilidad, el fortalecimiento de las políticas y sí el permanente actuar de toda nuestra comunidad, nos demostraron que la apuesta por ir más allá de lo que es el normal de las edificaciones, sigue posicionando a nuestro colegio en el liderazgo, y que asumir retos fue puesto a prueba en 2020 por la pandemia del COVID-19. Tener un campus que en la operación facilitara asegurar espacios saludables, nuevamente en cabeza de nuestro presidente, retó a todo el equipo asignado, para identificar las necesidades para retornar pronto a la presencialidad y generar las acciones requeridas de bioseguridad, facilitando que en septiembre del 2020 regresáramos a nuestro campus, como el primer colegio en Colombia en retornar de forma segura.

Nuestro liderazgo, compromiso con la sostenibilidad, pero sobre todo nuestra misión con todos nuestros estudiantes, colaboradores y quienes nos visitan, han sido altamente reconocidos por diferentes instancias, pero en 2021, recibir el reconocimiento del USGBC en Liderazgo, nos sigue demostrando que la apuesta es lograble con la responsabilidad de cada día asegurar el desempeño sostenible.

Pero los retos deben invitar a ser cada día mejores y así, nuestro compromiso de recertificarnos cada 3 años, nos llevó a todos a la búsqueda de un nivel mayor en LEED. Así, en septiembre de 2022, somos el primer colegio en América Latina en ser recertificado LEED OM v4.1 Platino (82 Puntos). Y es aquí donde debemos empezar a resaltar y felicitar no solo a toda la familia Aljure y Juan Pablo como Presidente, sino a aquellos que cada día logran que el campus opere, todo el personal de infraestructura en cabeza del Ing. Jaime Medina, nuestro Director de Infraestructura, todo el personal administrativo en cabeza de Diana Alba Directora Administrativa y el Equipo de Sostenibilidad en cabeza de Jorge Quintero, ahora fortalecidos con nuestro CEO Juan Carlos Franco, pero sobre todo, nuestra comunidad, todas las direcciones, coordinaciones que día a día aportan con su labor para nuestro desempeño y a nuestro equipo docente en cabeza de Alethia Bogoya, pero antes en el compromiso de Sonia Muñóz, en la iniciativa de Pilar Tunarroza, quien formuló el currículo de sostenibilidad y finalmente en nuestros estudiantes, que no solo disfrutan un campus vivo de aprendizaje para la sostenibilidad, sino que viven las 3 dimensiones de la sostenibilidad de forma sistémica.

En el año 2011 cuando tuve mi primera conversación con Juan Pablo Aljure sobre su visión de tener un campus LEED, me uní al reto y al camino de esa visión de diseñar, construir, operar y mantener un campus sostenible. Seguimos asumiendo retos, no por aquellos que ya hemos cruzado cierta edad, los asumimos por aquellos que se están formando en nuestro colegio, por aquellos que vendrán a ser parte de la Comunidad Rochesteriana y que como ciudadanos sistémicos lideren la resiliencia que nuestro planeta y nuestra sociedad requieren.

GREEN APPLE DAY OF SERVICE: STUDENTS TEACHING STUDENTS

By: Matthew Reis
Sustainability Curriculum Coordinator

The past Green Apple Day of Service provided an opportunity for students to volunteer their time to improve the community. One activity involved students from 11th and 12th grade teaching pre-kindergarten (PreK), kindergarten (Kinder), and lower primary about energy. There were two objectives which included teaching students about forms of renewable energy and energy transformations. In PreK and Kinder, high school students taught and supported primary students in the construction of a Rubber Band Guitar. The high school students worked with the class teacher to support the students gluing, cutting, decorating their guitars (Image 1). At the end of the class the students played their guitars together like a rock band (Image 2)! It was totally awesome!

In lower primary, the students participated in an Energy Circus. The children rotated between stations and explored models of solar, water, wind, and chemical energy (Images 3, 4, 5 & 6). They used their senses of observation: touch, smell, vision, and hearing to formulate their concept of how energy is transformed and generated (Image 7). I still remember the wind energy station. The children formed a line as the high schoolers lifted them up so the children could spin the wind energy model to make a bulb light-up (Image 8).

I was struck by the generosity of the students and their focus and dedication supporting our little members of school. All of the students in PreK and Kinder were able to produce a final product that they took home and shared with their parents. It is truly a tribute to Rochester's robust virtues and competencies development and dedication to a well defined strategic intent. We are very proud of our students who volunteered their time to improve the learning experiences of our younger promotion.

There are several ways to create opportunities where students can teach other students:

1) Weave student teaching into the curriculum. For example, students can co-create and co-teach one lesson. Providing clear instructions and powerpoint templates helps student success.
2) Support student clubs and afterschool organizations that promote leadership and peer teaching. For example, students can stay after school or come early to school to tutor other students. Green apple was an excellent opportunity for members of the Sustainable Development Club to teach students in primary about renewable

energy sources.

3) Build in-class opportunities for students to learn from each other. For example, the class is split into half. One half of the class participates in an informative talk in another classroom. The other half stays and completes a guided reading of the topic. When the class reunites, they share the information they learn. A great resource is The Teacher Toolkit by Paul Ginnis. You can find it for free at this link: https://www.crownhouse.co.uk/assets/look-inside/9781899836765.pdf

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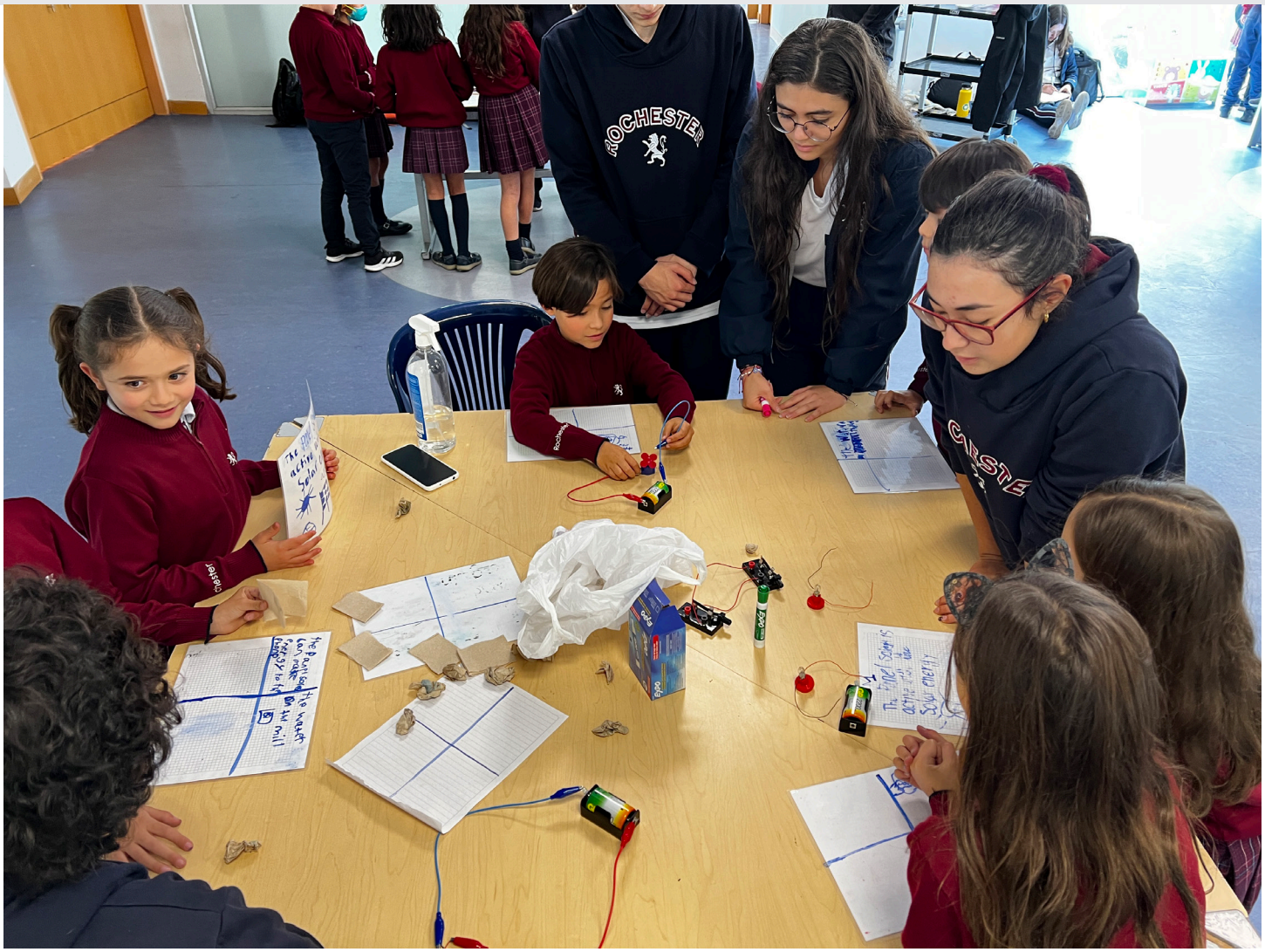

GREEN APPLE DAY OF SERVICE- A STUDENT REFLECTION

By: Laura Pardo, Emilio Martinez, and Juan Daza
11th grade students

During Green Apple Day, some students from Eleventh-grade were asked to perform a teaching moment for small children to learn about different energy sources. This special moment was performed to increase the relationships between older and younger students, as well as for the small children to learn about some of the basics of sustainability in the world they currently live in. For this day, three groups of children were brought to participate, and then they were all divided into four different groups that taught various types of energy sources and, in the end, showed what they had learned.

This workshop aims to teach children about the different sources of renewable and sustainable energy. For this, various elements were used, such as a wind turbine, hydroelectric source, and solar panels. The eleventh-grade students were divided into different groups to organize these elements by groups and carry out the workshop in a more organized way. At the beginning of the workshop, a brief explanation of what would be done was given, and then groups of four to five children were formed to rotate through the different stations. At each station, they taught about some a type of energy, such as wind energy, hydraulic energy, or solar energy. The elements were used to interact with the children, and in this way, they could learn in a more fun way. At the end of the explanation at each station, each child drew what he thought was the most interesting in each station.

The experience lived during this project was quite remarkable since the eleventh-grade students could connect with those children with whom they usually do not have contact, knowing more about what they are like and how they learn. All the participants felt it was good to give information on a topic they had learned in Environmental Sustainability. The children were curious about the subject by participating and constantly talking about it, asking anything that came to their head, and allowing us to explain the topic more thoroughly so that they understood it without problems. The eleventh-grade students agreed to do the project to have an experience of what it is like to teach children and to be able to give them new exciting information. Above all, it was a fun and engaging lesson because everything was not monotonous.

Opportunities to participate in projects like this can help us a lot in life, such as our communication skills and dissemination of information, and thus have better communication tools with everyone, but mainly with children like those we had in public, being able to help more in the learning process of people who cover that age range or others, since more than anything we obtained ways to express our clear ideas to people, whether to explain and teach or communicate.

To sum everything up, we saw how teens and children improved their communication skills through this activity and how teens improved their teaching skills while the small children learned new things that will help them later in life on this short but fun day.

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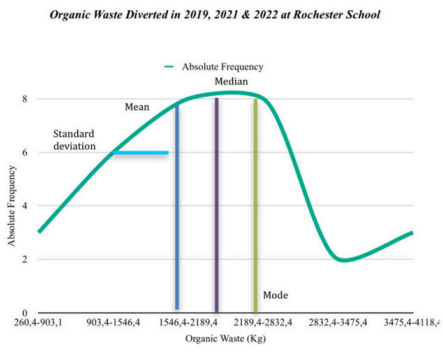

Peter Drucker once said "The best way to predict future is to create it. "Sustainability and maintaining a healthy environment for all while inspiring and educating students to take charge of their lives is the main purpose of Rochester School's institution. In the sustainability project, skills were demonstrated to ensure the virtue of systemic citizenship, taking into account me, others and context. In the Total Organic Waste Project, the comprehension of descriptive statistics to understand real-world context situation was shown with final proposals that aimed to innovate new ways of reducing the production of Organic Waste based on its harmful effects towards world problems.

Based on the analysis of the production of organic waste for the years of 2019, 2021 & 2022 solutions and proposals to comprehend, the comparison of Colombian product int waste and to an average American school to understand that statistics of Rochester's School production could be improved with the following proposals.

The president of the facility, Juan Pablo Aljure aims for zero waste in the future. Meanwhile, organic waste is being reduced and recycled, small actions can still contribute to the world's problems that affect everyone. For instance, a School in Colombia "Café Madrid" was selected as a role model because of the contribution to their

compost project. This project involves science, chemistry, and mathematics, creating a soil fertilizer, Rochester has implemented the compost project by recycling the food and turning it into soil fertilizer for the school green area, however, Café Madrid created and designed a "Paca Biodigestora" which consists of technology for the integral management of organic waste, this process permits biological degradation of the organic matter until soil fertilizer is made. Thus, this option to avoid the presence of oxygen work by thinking through the organic residues in a 1 meter cubic cube. In this manner, the growth of microorganisms and insects that obtain energy through the residues and generate the process of decomposition.

A study made by the WRAP shows that the age group that wastes more food corresponds to children and young adults, thus a proposal that can be implemented is to educate students as a great manner of reduction, students shall understand why food waste is important specially the effects the issue contributes to. and the main causes of it, therefore a campaign for food waste could be implemented. Additionally, portion control should be established, at Rochester School, posters are implemented yet students and facilities should order what they will eat. If food is not eaten or even touched it can be recovered and used to donate it.

Another great proposal is to comprehend the process of biomass gasification. Sustainability can be combined with the generation of energy via, biomass gasification. A process called fluidization is very efficient at converting food waste in sources of energy-rich gas to generate heat and power. This proposal would implement and use the tons of food waste to convert into reusable and sustainable forms of helping the planet and producing renewable sources of energy. The purpose of this proposal is to break down food into an anaerobic digester, where later on the methane can be captured to produce electricity. Biomass gasification allows the conversion of organic waste for fuel, heat and electricity. This process has a cost of 2,80 USD per kg with an average of COP 25 mill.

This process represents an important way of being sustainable. Rochester School's Sustainability project demonstrated the importance of maintaining a sustainable environment for other by implementing and analyzing real numbers, to be innovative and make a difference.

This is to help different global problems that can be analyzed. The Total Organic Waste Diverted demonstrated the importance of food waste and its connection to real problems. It quantified the problem to comprehend a real picture of the problem with real-life comparisons.

The skills used in the project showed competencies toward being a systemic citizen.

Scan to watch the student presentation.


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