RocheS²TEM

SUSTAINABILITY · SCIENCE · TECHNOLOGY · ENGINEERING · MATHEMATICS

Edición 7 · Abril de 2018
Chía, Cundinamarca

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Rochester School

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¿Cuál es la utilidad de las matemáticas?

En tu vida diaria usas las matemáticas para contar las horas, los días, los meses mientras valoras el tiempo que te queda para realizar una tarea. Calculas el costo de tu refrigerio y llevas un presupuesto de tus gastos para ahorrar lo que necesitas y poderte comprar el nuevo juego de video que tiene un descuento del 20% sobre el precio original.

Cuando llegas a una tienda, las puertas y el detector de metales que cruzas a la entrada están compuestos por sistemas electrónicos que no podrían haber sido diseñados sin las matemáticas, así como el código de barra que el cajero escanea con láser para que el precio aparezca en la pantalla de la registradora.

Cuando practicas un deporte, cuentas y memorizas el número de movimientos, valoras el peso que estás levantando o la distancia que estás recorriendo, creas un efecto o calculas un ángulo.
Cuando pintas o dibujas, calculas la mezcla de colores con cierta cantidad de pigmentos, manejas el espacio gráfico y proyectas la profundidad y dimensiones de tu obra.

Cuando viajas calculas la distancia y el tiempo para llegar a tu destino, así como la equivalencia de tu dinero con el del país que visitas.
Cuando estudias ciencias y biología, encuentras el número de moléculas producidas con una reacción química, comprendes los fenómenos climáticos y calculas los cambios a lo largo del tiempo.

Cuando nadas y buceas calculas la profundidad, mides la cantidad de aire restante en los tanques y evaluas el tiempo de espera antes de volver a sumergirte.

Cuando juegas ajedrez calculas el desplazamiento de tus fichas en el tablero, anticipas y proyectas jugadas, mides el tiempo de cada una y calculas el puntaje de las piezas de tu oponente.

Cuando practicas la danza, la música o el teatro, te sitúas en el espacio, prevees la duración de una escena o de un compás, calculas la intensidad de la luz o el sonido y mides su frecuencia.

Cuando cocinas mides las cantidades de los ingredientes, el tiempo de cocción y calculas el tamaño de las porciones, realizas conversiones de unidades de peso y temperatura.

Cuando usas tu computador, la tableta, el celular, el televisor, y todo tipo de tecnologías e inventos, haces uso indirecto de la matemáticas pues ninguno de ellos sería posible sin estas. Con los softwares de morphing o los programas de efectos especiales en 3D, las aplicaciones de matemáticas se utilizan en el diseño de los videojuegos y de las películas de animación.
Cuando caminas por el campo notas que las matemáticas son el lenguaje con que la naturaleza se expresa, se comunica y ordena el engranaje de cada una de sus partes, ya sea un átomo o una galaxia. Basta echar una ojeada a nuestro entorno para encontrarnos con el lenguaje armonioso de las matemáticas.

Adriana Biagi M.
Coordinadora Curricular de Matemáticas Pj - 4°

rocheSTEM

Science fiction in class,

because becoming a scientist is a matter of increasing your imagination.

Anything you dream is fiction, and anything you accomplish is science, the whole history of mankind is nothing but science fiction. Ray Bradbury

Manuela Venegas
Lower Elementary Science Teacher

The lost of future scientists

As a Science teacher in second grade I have the opportunity to encourage the natural curiosity of little children, they are eager to know new things, to see new animals and to get closer to strange and marvelous processes in the nature. On the contrary, as a science teacher of older children I discovered that sometimes they might lose that natural curiosity because they are deepen on essays, monographs or hard calculations. Encouraging teenager's curiosity is a hard work and that ability is the key for the creation of hypothesis and new discoveries in science.

The interest about scientific knowledge is getting lost in the educational process and what is even more concerning is that most of the graduates in Latin America, Europe or North America show little interest to choose scientific based professions as an option in the university.

In the Young People and Science study made for the European Commission (2008) they discovered that the 46% out of 25000 students in 27 countries of the European Union was not considering the science as a profession. Also the 52% said that they wouldn't study Biology or Medicine; the 54% wouldn't study Engineering or Natural Sciences, and the 57% wouldn't study neither Math nor natural science. When they asked why the half of them answered that they were not interested on sciences at all. (Eurobarometer, 2008).

The progressive decrease in the numbers of students enrolled in a scientific discipline and the alarming disinterest towards scientific professions that our society displays urges for teachers willing to explore new teaching techniques and approaches.

Science Fiction as a resource:

Recently many science teachers, including myself, are trying to transform the science subject into a trip inside the classroom, grasping students' attention with experiments and games, but as an elementary teacher, I have discovered the advantages of science fiction literature as a teaching resource for young readers. Covering two fronts at the same time; first by giving the students the opportunity to be amazed by the visual contexts showed by the books, which attracts them tremendously, supported by exotic planets, gigantic and extravagant monsters, imaginary worlds, galactic battles, etc. ..(Cavelos, 1999) secondly, by encouraging in those young readers the passion and discipline to read and taste the pleasure of traveling with their minds through literature.

There are many options inside the science fiction that you can choose to involve your students in different scientific topics. For elementary students is a joy to read the adventures of children their same age in the books of Angela Posada Swafford, a Colombian writer that is also an adventurer as a scientific journalists for National Geographic and the European Union of Science Journalists' Associations, among others. Her novels tell the adventures of a group of kids that have the chance to live scientific journeys thanks to the work of their scientific relatives, some examples of her books are: Un enemigo invisible, En el corazón de las ballenas and Detectives del ADN. Those books are optimal to teach difficult topics as adaptations of living things, genetics or virus and pandemics.

With my second grade students we had the chance to read some passages of the book "El corazón de las ballenas" to understand how the sea animals need to adapt to special conditions. They were amazed reading how the main characters save a mother whale and her calf from the attack of whale hunters, they also learnt the real size of the whale's hearts by going in a submarine. After reading the students create their own cover for the book and they designed the picture of a whale's heart.

However, if you are willing to explore the world of physics with the youngest leaners you can guide them through the comic books world searching for examples of physical laws. Children love superheroes and they are more than willing to know how plausible is to become one, or if the superheroes could actually have all sort of incredible superpowers in our real universe. Therefore, you can explore mechanics and forces by the hand of Superman, thermodynamics with the help of Flash, mass and energy conservation unleashing the Hulk and electromagnetism inviting the X men to your classroom.

During the first quarter the students had the chance to design their own superheroes focusing in the increase of an specific sense, and we use them later on the year to understand the forces of pushing and pulling, analyzing from a comic book how superman can affect the movement of things by applying forces in one specific direction. We also invited Superman to our classroom to solve problems involving changes of matter by using his heat vision or his freezing breath, and we debate about different techniques to rescue people in troubles or catching villains applying the changes of matter.

Moreover, I also like to read with them passages of Jules Verne's books, so we can rediscover

the mysteries of the Earth and the universe by traveling with his characters in books such as Journey to the center of the Earth or Form the Earth to the Moon. Finally to explore the advantages of computers science and biology mixed up to become into robotics we read Assimov's novels such as I Robot, Lucky Starr and the Pirates of the Asteroids or the Caves of Steel.

Nevertheless, it is vital to remind the fact that the science fiction is indeed fiction, so it is necessary that the teacher explores with the students the fictional part, and develop scientific skills to discover the truth and the fiction in each story. (Chapela, 2013). To make that difference more concrete I like to compare some novels that are fictional but use scientific facts, such as Posada's novels, with other more imaginative that bend the science on them to create new worlds, such as Verne's books or Star Wars stories. Along the process the students will become more analytic about the content they are reading and they will be able to recognize inaccuracies in the science part of a story, the options to resolve them or even to create their own stories based on scientific realities and laws.

Bringing down scientists to a human ground level, another advantage:

During a lot of time the science has been isolated and almost mystical, a discipline reserved to the most intelligent and unique humans on earth, or at least that is the perspective that most of the population in Latin America and United States, (Eurobarometer, 2008). Examples of this are Albert Einstein, Marie Curie or Stephen Hawking which are inspiring, but also distant from the common citizen that every student could be. But in real life the scientist are as common as a lawyer or a doctor, and if the students can learn that truth they could be identified with those people and subsequently eager to follow their steps. One problem in that decision is the amount of figures and concepts needed to learn a scientific discipline, that distort the reality of the profession and complicate the process for a student to identify with a scientists. (Palacios, 2007) Through the books we can reach more human and real scientists, failing more than succeeding and rising from those efforts with new perspectives to research. Angela Posada's books let the students to discover a Biologist aunt, an Oceanographer father or a Chemist uncle that live a normal life with their families whilst discovering and working with science everyday.

Besides, letting students to be involved in discussions and debates about daily news related with science or the books they are reading, applying all their acquired knowledge to solve real problems or to solve what could be wrong in science fiction literature, opens the opportunity for them to discover their own possibilities to think as a scientist, to organize thoughts and propose hypothesis they can test, keeping the curiosity door open meanwhile they grow and letting them be close to the science. ■

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The Rochester School vegetable garden

Juan Pablo Obregón
Natural Science teacher - Upper Elementary

Our kids nowadays live in an urban environment. Unfortunately, due to the increase of population, cities have become more and more dense which means more buildings and less time in open areas, like parks or green areas. Hopefully, at our schools we have a vegetable garden which allows children to explore and learn in a fun hands on activity while they learn the different skills need in science.

This garden is an opportunity to use our site as a book, students can explore how species interact in an ecosystem, how the weather and climate may have an impact on the food we decided to grow, and finally how can we use the scientific method to solve a problem. By having class at the garden, fourth grade students have learn the the difference between infer and hypothesis and have focus their efforts on how to write a hypothesis. "If I add fertilizer to the soil of some tomato seedlings but not others, then the seedlings that got fertilizer will grow taller and have more leaves then the non fertilizer ones." Once the hypothesis is ready, students conduct the experiment: they go to the garden and decide which planting beds are they going to use, taking into account that one would be fertilizer with the compost produced at the school, and the other one would not receive any compost, just water.

By using the scientific method students develop scientific skills such as ask and define

problems, plan and carry out an investigation and communicate information. Students also develop their understanding in cause and effect by testing different type of soils and the growth of plants ad most important, learn to grow healthy food.

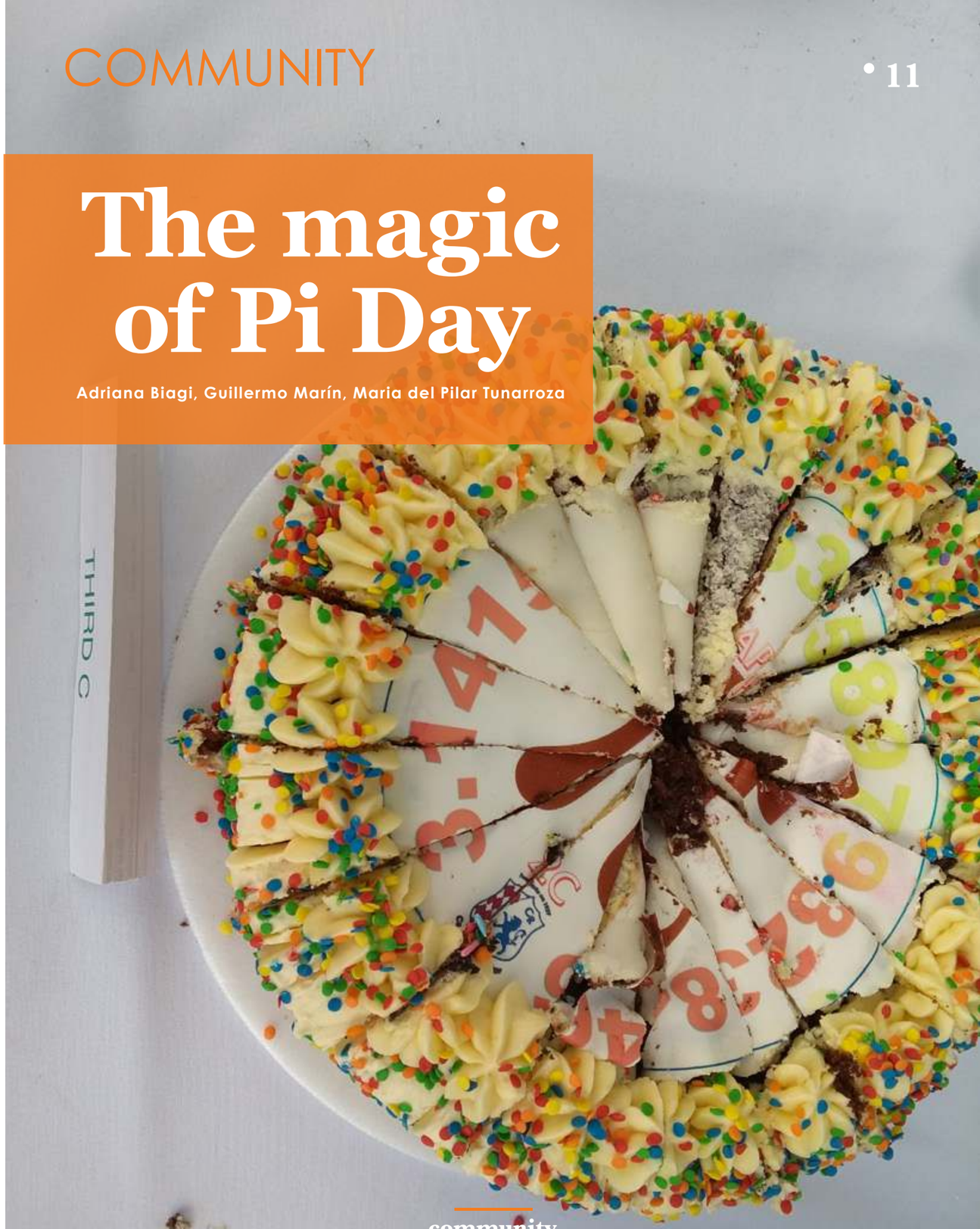
Students follow up their tomatoes seedlings once a week, every Friday. Students collect and record that data on their notebooks, organize data on a chart and come up with a conclusion that later on discuss with their classmates and refine with the help of the teacher.

A vegetable garden gives you multiple opportunities to engage our students in hands on activities providing them with long lasting memories and learning. They have fun, develop scientific skills and develop the corporal dimension by managing garden tools such as shovels. They also satisfy all their basic needs (love and belonging, power and recognition, fun, survival and freedom) and learn to coexist in harmony with some insects they find disgusting at the beginning, and then, respect and even care for. All of this reasons, plus the smile on my students faces every time we go to the garden, gives me certainty that this project has personal and academic benefits for all.

You are welcome to visit our garden, eat the healthy tomatoes and have as much fun as we do. ■

The magic of Pi Day

Adriana Biagi, Guillermo Marín, Maria del Pilar Tunarroza



Pi day is a magic day. It all starts will dreams of how to celebrate such an important world date with respect, enthusiasm and that shows useful learning. It is a difficult event to plan, but that always ends up with satisfaction and pride, that's the magic and beauty of this celebration.

Preschool students made their presentations in their own blocks. They worked Math centers with different topics, such as: sorting, rods, patterns and numbers representations. Kinder students focused their presentations on showing how to measure using non-standard units and how to subtract in different ways. And first graders showed the three steps of Singapore Math Method: Concrete, Pictorial and Abstract.

This year, science projects were focused on the the usefulness of tools to solve certain scientific problems. Math projects appointed to the use of math in modeling real life situations that students can frequently find in their lives.

Students in lower elementary built compasses to understand magnets behavior, built scales to understand mass and used apps to understand the difference between mass and weight. They taught and played with older students who had a great time finding out how much will they weight in Jupiter.

Presentations In Lower Elementary focused on showing how to weight the mass of different candies using a gram and kilogram scale, explaining how to construct a scale, new ways to solve problems and tricks with times tables. Upper Elementary students created a QR code to share information about the plants of the school with videos they recorded around the campus; they also applied the scientific method to find a correlation between precipitation and fungi growth; they learned about solar radiation and used their virtues to share this information with the community asking them to use sun screen for preventing injuries in their skin showing them scientific data they collected using especial apps and the weather station at the school. In Math presentations they showed how to create TETRIS with squares and triangles using area and perimeter, and how to operate with decimals based on a Measurement Project, it was so much fun!

Learning to use the telescope.

Middle School students focused on new ideas for reinforcing the use of alternative energies, they were as creative as their imagination allowed and came up with very interesting proposals. Students also played scientists by extracting DNA and using scientific method to explain genetics and cell importance for our body, health and mind. In Math, students worked in several mini-projects from beauty to cooking to stock exchange transactions. Sixth grade students displayed the relationship between our perceptions of beauty and maths using ratios of rectangles sides to model features of many of the shapes that our brains consider beautiful. Seventh grade students displayed their knowledge on how to operate with rational numbers (fractions with negative and positive symbols) and the use of those numbers to create new recipes when cooking pizza for many people, and to model their ideal houses. Eighth grade students displayed different strategies to use when investing money and the proper use of information to make wise financial decisions.

High School students represented very well the 3 branches of science: chemistry, biology and physics. They invented mechanical arms to solve a problem of how to collect residues without using plastic bags; they used sensors to perfect the photo tickets used by the police, they analyzed for months all the chemical parameters of the water to propose a way to purify the water from the Waste Water Treatment Plant; used astronomy and chemistry to understand the gases of the universe and applied Choice Theory to potentiate our decisions and brain connections.

High school students also modeled their learning of math concepts using products of different kind. Ninth grade students displayed their knowledge by connecting algebraic expressions and operations with geometry through an Algebra Tiles workshop specially prepared for some Eighth grade students. They also showed the use

of geometry when making creative solids by folding paper. Tenth grade students showed their knowledge on Statistics and Probability by creating and displaying a Casino with many games to play and win candies when using Probability rules. Eleventh grade students modeled fractals to show concepts of Series and Limits, use jello to show how parabolic antenas work and teach Tenth grades on the use of Scientific Calculators. AP Calculus students showed 3-D models of bottles created by using Calculus.

Since most of the projects were showed in the auditorium, everybody got to see the evolution on scientific learning, usefulness and complexity of each subject, and understood how well connections are created within areas and how students grow in their life at Rochester in science and math.

One of the no-miss events in the Pi Day was the III STEM Olympics, which gathered 6 groups of students from different grades each, from Pre-school to 12th grade, to work as a team in solving problems related to Science, Math and Computer Science. It was an exciting time in which each member did the best for the group performance and success, supported by a enthusiastic group or parents and classmates who also enjoyed trying to solve the questions that posted increased difficulty as rounds passed.

We also ended the day thanking Stephen Hawking for leaving us with great teachings, not only about physics and universe phenomena, but about strength in life, constancy in searching for answers and the importance of science for everybody's life. He helped us see the universe in a different way, and we will honor his memory by teaching our students to have perspective.

However difficult life may seem, there is always something you can do and succeed at.

Stephen Hawking

Ministry of National Education Project: Aulas Sin Fronteras (ASF) Chocó

Mauricio Quintero
Coordinador de Sostenibilidad Social

In 2014 the Minister of Education Gina Parody and her team made a diagnosis based on the results of the Prueba Saber from 3rd, 5th, 9th, and 11th grade with the aim of improving the quality of education in Colombia. They identified some areas in which an improvement process was needed.

The diagnosis showed the most deficient results in the areas of Language, Mathematics and Sciences, core areas in the formation of students, were in Chocó. In 2015, the Ministry of National Education (MEN) and the Union of International Schools (UNCOLI) began a project called "Aulas Sin Fronteras," whose objective is improving the quality of education in this Department.

Among the UNCOLI schools that joined this project is Rochester School, who joined in 2016 with the teacher Juan Francisco Gómez in the area of Language. Rochester's participation has continued from 2017 with me, Mauricio Quintero, in the area of Natural Science.

Planning

For the Ministry, the challenge was how to carry out the project, therefore,
it defined four key points through which UNCOLI schools would support this initiative:

1. The design of student and teacher guides with activities framed in the methodology of the "Flipped Classroom," and with the planning structure of "Teaching for Understanding."
2. The creation of videoclips as supporting material for the guides.
3. Teacher training in the methodology and the implementation of ASF lessons.
4. The design of the curriculum for ninth grade in the areas of Language, Math, Natural Science and Social Science.

Nowadays

In this academic year (2017-2018) when I started to be part of this project I could observe two realities; on one side, the teachers' desire to have better practices and to implement new teaching-learning strategies; on the other side, I noticed the difficult social situation of the Department and the lack of infrastructure and resources in many schools, which haven't allowed the implementation of new proposals in recent years.

However, since 2015 MEN and UNCOLI have been working tirelessly, and as a result, the acceptance and implementation by the principals, coordinators and teachers of these proposals have been demonstrated.

This year, Rochester has been collaborating with the Natural Science group where Abraham Lincoln, Gimnasio Campestre, Santa María and Helvetia Schools have been working on developing the Natural Science curriculum for ninth grade and designing video clips and materials for teachers and students.

Likewise, we had two visits to Rochester School form Chocó personnel, one in October 2017, with all the Principals and Coordinators who exchanged experiences in the academic areas and administrative management affairs with our Principal Alethia Bogoya and coordinators in order to support them in the execution of the project. Another visit took place in November 2017, where teachers from Chocó observed different teaching practices through the class visits.

Additionally, we held two teacher training sessions:
The first at Reyes Católicos school in Bogotá, so that the teachers from Chocó knew the frame of the "Aulas Sin Fronteras" project, the content and structure of the teacher and student guides; that way they could plan classes using the project's resources.
The second training session was in April of this year, in Quibdó, at the "Universidad Tecnológica del Chocó" where we worked on the different models of Science education and focused on the use of guides and on the planning and execution of teaching units by Chocó teachers.

Thus, our purpose was to help more than 9,500 students in grades 7, 8 and 9 with these materials, train 480 teachers and make several visits to accompany teachers and managers of these institutions in the implementation of teaching strategies.

As Uncoli teachers, we will expect to continue giving support to Chocó teachers in this year.
Finally, this experience has allowed me to grow personally and professionally through helping communities that really need it.

Thanks Rochester School for giving me the opportunity of getting involved in this experience.

Lanzamiento de la cartilla para la conservación del oso Andino

Andrea Polanco Pinzón
Docente Biología

Green School

El pasado 2 de Marzo se realizó el Green Apple Day of Service en el colegio Rochester. Este es un día muy especial en donde los colegios al rededor del mundo celebran la sostenibilidad y presentan los proyectos estudiantiles que transformaran al mundo. Por ese motivo aprovechamos este momento tan especial para hacer oficial el lanzamiento de la cartilla para la conservación del oso andino (Tremarctos ornatus), una especie única del área andina, protectora del páramo y del agua y en peligro de extinción en nuestro país.

Hace un año las estudiantes Gabriela Rodríguez y Valentina Rincón decidieron realizar como proyecto de grado una cartilla para niños donde explicaran por medio de cuentos y actividades la importancia del oso, del páramo y de las especies asociadas al oso. Cuando le preguntan a Valentina por qué decidió trabajar con el oso ella explica: “Hace varios años estaba viendo las noticias y vi que unos campesinos habían matado a un oso de anteojos. Como era un animal del que el colegio nos hablaba tanto y como ya habíamos ido al Páramo de Chingaza, me sentí identificada con el tema y pensé que todos deberíamos de conocer y entender la importancia del medio ambiente y de los seres vivos.” Ellas decidieron por medio de este creativo material explicar la situación del oso Andino y cómo los niños pueden cuidarlo, mediante dibujos, gráficas e infografías realizados por ellas mismas, acompañadas de cuentos cortos, también de su autoría, con un lenguaje sencillo y divertido. Se busca, por medio de la cartilla, que no solo los niños del colegio Rochester sino niños de escuelas cercanas al paramo descubran la importancia de cuidar al oso y al páramo y como ellos mismos desde su comunidad pueden hacer un cambio sistémico y comenzar a ser sostenibles.

Durante el green apple day los niños del colegio rochester pudieron leer de primera mano la novedosa cartilla. Se sentaron en grupos pequeños y las autoras de la cartilla leyeron algunos cuentos cortos para ellos. Realizaron actividades divertidas como sopas de letras, colorearon y dibujaron su imagen de calidad del páramo y de sus habitantes. También, se tomaron fotos con el oso y realizaron posters con leyendas como: “si hay oso hay agua”. Esta cartilla se imprimirá y se llevará a las comunidades del páramo donde también se realizarán actividades como la del Green Apple Day of Service; algunos ejemplares se quedarán en el colegio para su uso académico. Los dejamos con el link de descarga de la cartilla, esperamos lo disfruten.

Descarga la Cartilla

Expositores como **Juan Diego Quintero**, estudiante de escuela media nos enseñó la problemática ambiental relacionada con los RAES; ex alumnas como **Gabriela Rodríguez** y **Valentina Rincón** (Prom.2017) lanzaron su cartilla de proyecto de grado, la cual hoy se convierte en un texto curricular como guía para la conservación del Oso Andino; padres de familia como **César Bernal**, quien nos muestra como su empresa Everest Printed Solutions trabaja estrategias de sostenibilidad en torno a etiquetas, empaques y y demás materias primas; vecinos, proveedores y docentes mostraron igual, como su trabajo, ayuda a esta temática de conservación y responsabilidad sostenible.

Estudiantes de décimo, realizaron una jornada de limpieza en el canal de Fenoco. La siembra de 200 árboles en la cantera vecina, fue el cierre de esta gran jornada donde muchos de nuestra comunidad dejaron su huella sembrando un árbol que crecerá llevando en su tallo el mejor de los mensajes, el interés y el amor por nuestro planeta.

"Este es un día que hemos visto que la comunidatd lo ha ido apreciando, ha sido una experiencia muy bonita. El colegio no solo se preocupa por tener una infraestructura sostenible sino que se preocupa por enseñar sobre qué es sostenibilidad a la comunidad, abrir sus puertas y compartir todas estas experiencias."

Jorge Quintero
Director de Sostenibilidad del Colegio Rochester.

VIERNES
2 DE MARZO

SÁBADO
3 DE MARZO

GREEN APPLE DAY OF SERVICE 2018

La comunidad de la Vereda Fusca, en Cundinamarca, de la que hacen parte el **Colegio Rochester**, la escuela de la vereda y la Junta de Acción Comunal, con el apoyo de la Secretaría Ambiental de Chía, realizó la limpieza y recolección de 129 kg. de residuos en el Canal Fenoco y la siembra de árboles en zonas afectadas por la actividad humana, en el marco del **Green Apple Day** of Service, una iniciativa internacional en la que colegios de todo el planeta y su comunidad aledaña realizan una jornada anual de servicio voluntario en pro del medio ambiente.

Fundado en 1959
Colegio Rochester

Orgullosamente tenemos una cultura que nos enmarca y que cada vez nos volvemos pioneros de esta iniciativa de vida que no es más que una iniciativa de supervivencia.

¡Felicitaciones Rochester!

Laplace y sus descubrimientos sistémicos

César Clemente Rueda
Profesor Matemáticas Primaria Alta 3º

A través de la historia del mundo han pasado hombres que han dedicado su vida entera a describir y descifrar mediante modelos matemáticos; desde los fenómenos físicos sucedidos en la tierra y en el espacio, hasta los hechos más cotidianos del día a día, todo con números bien ordenados en ecuaciones. Estas ecuaciones pueden tener formas sencillas y fáciles de resolver que nos entretienen y divierten, hasta formas muy complejas, que por generaciones han sabido dar trabajo y "dolores de cabeza" incluso hasta a las mentes más brillantes de la ciencia universal, tomando no solo horas y días, sino años y hasta centurias descifrar y dar solución a tales ecuaciones.

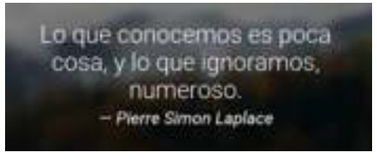
El astrónomo, físico y matemático francés Pierre-Simon Laplace fue sin duda una de esas grandes mentes matemáticas que descifró con sencillez inigualable modelos matemáticos anteriormente propuestos por eminentes matemáticos como: Leonard Euler y Joseph Fourier, entre otros.

Pierre-Simon Laplace nació en Beaumont-en-Auge, Normandia, Francia, el 28 de marzo de 1749.

Una de los gigantes desafíos matemáticos de la historia ha sido darle solución a algunas de las "Ecuaciones Diferenciales" propuestas. Comencemos a familiarizarnos con ese nombre.

Las "Ecuaciones Diferenciales" son modelos matemáticos que describen el comportamiento real del mundo físico tal como lo conocemos. Las ecuaciones diferenciales juegan un rol muy importante en el modelado virtual de cualquier proceso físico, técnico, o biológico, por ejemplo, tanto el movimiento celeste, como el diseño de un puente, o la interacción entre neuronas.

Las ecuaciones diferenciales que se plantean para resolver problemas de la vida real, no necesariamente son resolubles directamente, es decir, sus soluciones no tienen una expresión en forma cerrada. Cuando sucede esto, las soluciones se pueden aproximar usando "métodos numéricos", es decir, se deben diseñar algoritmos para, a través de números y reglas matemáticas simples, simular procesos matemáticos más complejos aplicados a procesos del mundo real.



Los computadores han podido superar las barreras numéricas humanas gracias a su capacidad de manejar grandes cantidades de números con el uso de algoritmos y se han podido utilizar para darle solución a las ecuaciones diferenciales más complejas, sin embargo, no hemos podido llegar a la resolución definitiva de algunas de éstas y es por éste motivo que se utiliza el modelo de resolución parcial o por aproximaciones. ¡Complejo! ¿Cierto?.

Laplace desarrolló una manera más sencilla de resolver una ecuación diferencial compleja, ésta idea fue publicada como "La Transformada de Laplace"

Leonard Euler había investigado un conjunto de "ecuaciones integrales" para dar solución a su vez a un conjunto de "ecuaciones diferenciales", pero no profundizó en ellas y pronto abandonó su investigación.

Joseph Louis Lagrange, admirador de Euler, también investigó ese tipo de integrales, y las ligó a la teoría de la probabilidad en un trabajo sobre funciones de densidad de probabilidad.


TRAITÉ
DE
MÉCANIQUE CÉLESTE,
PAR M. LAPLACE,
TOME PREMIER.

Este tipo de integrales atrajeron la atención de Laplace cuando, en 1782, siguiendo la idea de Euler, trató de emplear estas integrales como soluciones de ecuaciones diferenciales. Parece ser que en 1785 dio un paso más allá, y reenfocó el problema para en vez de usar las integrales como soluciones, aplicarlas a las ecuaciones dando lugar a las transformadas de Laplace, tal y como hoy en día se entienden.

Laplace usó una integral análoga a la Transformada de Mellin (versión multiplicativa de la transformada de Laplace) con la que transformó una ecuación diferencial en una ecuación algebraica de la que buscó su solución. Planteó alguna de las principales propiedades de su transformada, y de alguna forma reconoció que el método de Joseph Fourier para resolver, por medio de series de Fourier, la ecuación de difusión (ecuaciones que

desarrolló Joseph Fourier para describir la transferencia de calor de partícula a partícula en los cuerpos físicos) podría relacionarse con su transformada integral para un espacio finito con soluciones periódicas.

Hacia principios del siglo XX, la transformada de Laplace se convirtió en una herramienta común de la teoría de vibraciones y de la teoría de circuitos, dos de los campos donde ha sido aplicada con más éxito. En general, la transformada es adecuada para resolver sistemas de ecuaciones diferenciales lineales con condiciones iniciales en el origen. Una de sus ventajas más significativas radica en que la integración y derivación se convierten en multiplicación y división. Esto transforma las ecuaciones diferenciales e integrales en ecuaciones polinómicas, mucho más fáciles de resolver.

En fin, éste artículo no pretende explicar los descubrimientos de Laplace mostrando fórmulas matemáticas incomprensibles para muchos lectores, pero se puede decir que Pierre-Simon Laplace, mediante sus descubrimientos matemáticos, facilitó la resolución de las ecuaciones diferenciales y este conocimiento, igualmente, simplificó la vida de los científicos venideros.

Además de estos destellos de brillantez intelectual, Laplace, atento a los descubrimientos de nebulosas realizados por William Herschel en Inglaterra, pensó que el colapso gravitatorio de una nebulosa podría haber dado origen a la formación del Sol y que el material orbitando en torno al Sol podría condensarse para formar una familia de planetas. Esta teoría explicaba de manera natural que todos los planetas orbiten en torno al Sol en el mismo sentido (de oeste a este) y que sus órbitas estén en un mismo plano.

Esta hipótesis nebular, la cual ya había sido perfilada anteriormente por Inmanuel Kant, con mucho mayor detalle y múltiples refinamientos, permanece en nuestros días como el fundamento básico de toda la teoría de la formación estelar. Por otra parte, demostró también la estabilidad del sistema solar, sentó las bases científicas de la teoría matemática de probabilidades (en su obra Théorie analytique des probabilités, donde, entre otros logros, formuló el método de los mínimos cuadrados, que es fundamental para la teoría de errores) y formuló de manera muy firme e influyente la imagen de un mundo completamente determinista.

Laplace es recordado como uno de los máximos científicos de todos los tiempos, a veces referido como "el Isaac Newton de Francia", con unas fenomenales facultades matemáticas no poseídas por ninguno de sus contemporáneos.

Pierre-Simon Laplace murió en Paris el 5 de marzo de 1827, dejándonos conocimiento útil para el análisis y la comprensión tanto de las matemáticas como de la mecánica del universo.

En la actualidad contamos con hombres y mujeres que tienen esa chispa de genialidad que se necesita para seguir desvelando los misterios de las ciencias. Tal como lo dijo Albert Einstein: "No tengo talentos especiales, pero sí soy profundamente curioso". Y en esto nos enfocamos en el Colegio Rochester: en incentivar la curiosidad y no dejar de hacerse preguntas, lo cual es la puerta de entrada a los descubrimientos más asombrosos del género humano. Así mismo, nos apoyamos en otra idea de Albert Einstein íntimamente ligada a la Teoría de la Elección: "La palabra progreso no tiene ningún sentido mientras hayan niños infelices"

Can our artificial reservoir support life?

Erika Díaz[1]
Sofía Palomino, Luis Carlos Pardo, Alejandro Torres[2]

Abstract

Small reservoirs are prevalent landscape features that affect the physical, chemical, and biological characteristics of headwater streams and land around them. Rochester School's artificial reservoir was characterized for four months. The site was sampled weekly for water quality parameters (pH, dissolved oxygen, turbidity, alkalinity, total phosphates and total nitrate; with the use of protocols proposed by GLOBE and the analysis kit for water La Motte). The most fluctuated parameters were the concentration of nitrates and dissolved oxygen. Procedures for cultivating and characterizing bacteria and their metabolism were made, finding 23 isolates with both fermentative and oxidative metabolic capacities, low motility and great capacity to reduce nitrates, possibly as an adaptive measure to changes in chemical conditions of water and nutrient availability. All of this in order to first know the properties of the sample site and in a future evaluate whether or not it was possible to have complex animals. The present article was accepted for the virtual GLOBE simposium that will take place on October (www.globe.gov).

Introduction

The purpose is to characterize the physico-chemical parameters and the metabolism of the microorganism that live at the reservoir to guide future studies to the evaluation of the possibility of having superior organisms, either plants or fish, living there. The properties analyzed were the following: alkalinity, which is defined as the capacity of the water buffer or its ability to receive protons and to resist changes in pH (hydrogen ions concentration) that would make water more acidic and affect organisms than life in water, the type of soil and dissolved particles in water bodies, such as hydrogen ions and salts affect pH and conductivity, we can estimate through Turbidity, which is an indirect measure of the suspension of solids. Dissolved oxygen, the measurement of dissolved oxygen is the most important parameter for the determination of water quality, since it is crucial for the survival of aerobic organisms and aquatic fauna in bodies of water, it also indicates if there is pollution, determines the type of microorganisms and its metabolism (aerobic or anaerobic), if we know its levels we can predict if the aerobic biological process can take place to transform the biodegradable organic pollutants discharged into the water (Ibanez, J. G, el al. 2008). Phosphates, in which phosphorus is one of the elements that plants require in relatively large quantities, which are essential because they are a part of the energy carrying

[1] Laboratory assistant
[2] 11th grade students

phosphates, phospholipids, nucleic acids and several essential coenzymes. Nitrates, which are an inorganic form of nitrogen plays an important role in an ecosystem as their properties come to serve as nutrients for plants, microorganisms and other living beings that can be found in water. The development of these studies are very important since we believe that they contribute to the sustainable development of the area by: preserving a high biodiversity in wild flora and fauna (even migratory species), offering protection against erosion, mitigating the floods, favoring the recharge of underground water, the purification the of water and stabilizing the the local temperature and rain conditions (Pérez-Castillo, et al. 2008). Having in consideration that our school promotes the conservation of the native biodiversity, we can say that is also of dire importance to the school.Once the research and analysis are finished, our goal is to be able to answer what type of organisms are ideal to live in the experimented location and why. This would be helpful because then we would be able to conduct a future research where we can conclude why those species are the best suited and then change the conditions in which these organisms live under. Other than investigation contributions, later on we could see into expanding this region's wildlife and modifying its parameters so more developed animals such as fish or frogs can make this artificial reservoir their new living environment

Methodology

The measurements were carried out during 4 months, samples of water were taken from the reservoir of the school, at Chía Colombia and taken to the laboratory for analysis.

Figure 1. Location of the reservoir where the samples were taken

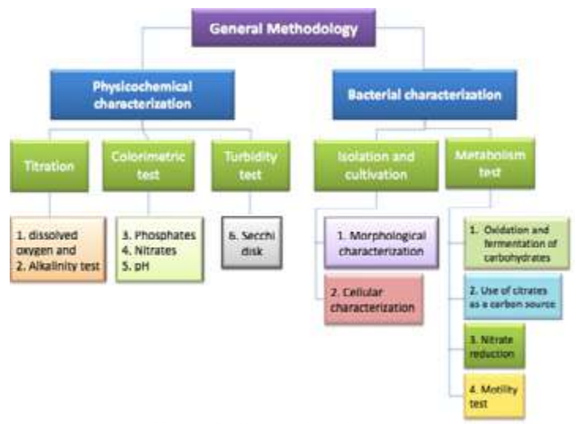


Figure 2. General methodology

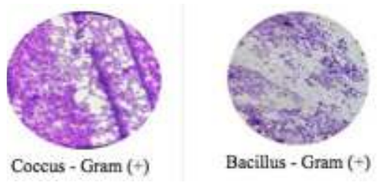


Figure 3: a) Glucose oxidation b) motility test c) nitrate reduction capacity d) use of citrate as the only carbon source e) glucose, lactose and sucrose fermentation

Results and Discussion

In the characterization of the culturable bacteria of the reservoir, 23 bacterial strains were isolated whose macroscopic morphology oscillated between the punctiform, circular, irregular and filamentous forms. The elevations were convex, umbilicated and elevated, regarding the margins, there were found the following types: whole, lobed and filamentous. Regarding the Gram stain, it was evidenced that the majority (20 out of 23) were Gram positive and 3 were Gram negative (Figure 4).

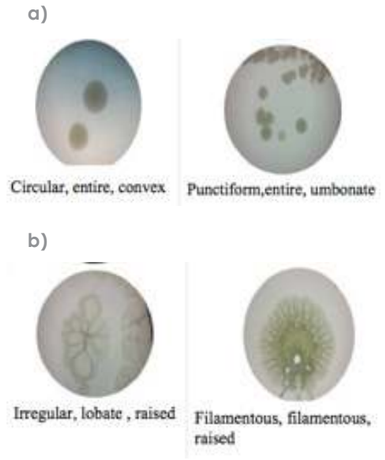
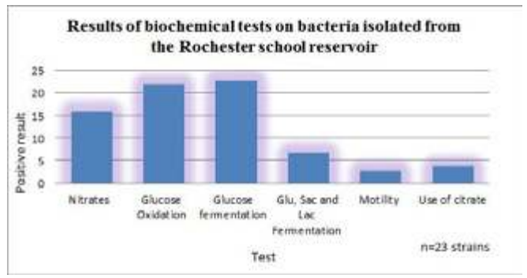


Figure 4. a) Main macroscopic features of bacterial Culture, whole colony, edge and elevation and B) Gram staining and cell morphology of 23 bacterial isolations in the reservoir

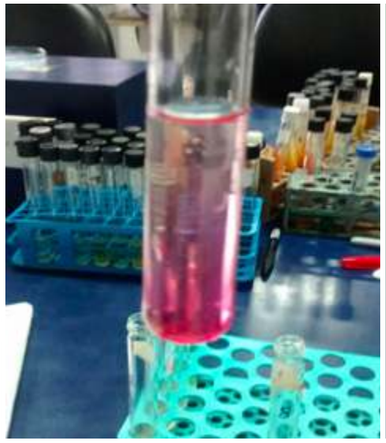
In the Figure 3, it can be observed the reading of the biochemical samples, which relied on the preparation of a specific method of cultivation. For the test, it was used a positive control and one negative, in most cases the change of coloring indicated a positive result and in the case of motility samples, the turbidity of the sample tube was evidenced. The results of the metabolic analysis aspects such as nitrates reduction, the use of citrates as the only source of carbon, sugar fermentation (glucose, sucrose and lactose) were evaluated as well as the use of glucose as carbon for fermentative ways as for oxidative, as observed on the Graph 1, most bacteria use some as carbon sources, such as lactose, sucrose and glucose not only for oxidative but also fermentative methods, demonstrating the versatility and adaptive capacities concerning the fluctuations in quantities of substrates in the reservoir.



Graph 1. Results of biochemical tests on bacteria isolated from the Rochester school reservoir

As for the physico-chemical samples of the reservoir's water observed in the Graph 2. we can see that the average amount of nitrates found in the reservoir was approximately 6 ppm, 10 ppm being the highest value and 1 ppm the lowest. We can see that after the fourth data recollection, that is to say since mid December, the concentration has been increasing, though not constantly. Usually this parameter is very fluctuant in water bodies, the contribution of different forms of nitrogen in water bodies, for the best part of it are of anthropogenic type, whether it is for domestic wastes, the use of fertilizers and so on. In our case, the land where the school has been built counts with an inclination that allows all superficial water and rain to get to the reservoir, which could drag substance rich in nitrogen, which can be converted in simpler forms such as nitrates and nitrites by bacteria actions, which collaborates with the evidence in the analysis of the bacterial metabolism (Graph 1). Another factor to keep in mind and that we have observed is that with the decrease of rain and water levels in the reservoir, this compounds tend to increase in the water body (Graph 2) (Pacheco Ávila, et Al. 2002). The high concentrations of nitrates create an anoxygenic environment, the concentrations over 0,9 ppm tend to stimulate the growth of seaweeds and indicate eutrophication, values higher than 20 ppm indicate a high contamination rate in the water body. (Pérez-Castillo, et al. 2008),(Peña, O.S et al. 2006).

Graph 2. Results of the physico-chemical Parameters in units of ppm



Dissolved oxygen like nitrates are considered to be an indication of contamination by organic matter due to the residual flushes, either domestic or industrial, in water bodies. The low concentrations of dissolved oxygen can be located where the organic matter is decomposing, which means that bacterias use the oxygen to decompose waste, they are also low in warm water of slow movement. The waters with dissolved oxygen concentrations above 4,1 mg/L are considered to be of good quay, in our study, the levels of diluted oxygen were between 3 and 4,9 mg/L the which affects the life of aquatic organisms that require it to live (Peña, O.S et al. 2006). In the year of 2017, a Rochester School student did a project of the evaluated parameters between her own work and the Fúneque Lagoon, place where a fish species in danger of extinction, Capitán Sabana lives. Once observed that there wasn't a significant difference between these two evaluated places, it was concluded that those type of fish could live in our reservoir. (Rodríguez, P.V . 2017)
We observed that the decrease in the amount of dissolved oxygen is connected to the increase of the nitrate concentration in the reservoir (Graph 2 and table 1), this goes also to a microbiological level, where the bacteria cultivated showed having both metabolisms (oxidative and fermentative) (Graph 1). Although the levels shown in the reservoir aren't alarming, it is necessary to keep monitoring and studying ways to improve said parameters since it has been documented that the decrease of dissolved oxygen not only affects the nitrates but also the concentrations of manganese hydroxide, iron and sulfates. The fact of propitiating the reducing conditions in the environment can be toxic for fish and superior organisms, in addition these reduced compounds maintain the anoxic sediment-water interface and prevent the accumulation of layers of iron hydroxide. With the loss of iron in the water that covers it, the capacity of retention of phosphorus of the sediment decrease. The previously mentioned can also explain the results we obtained. The results given for phosphates were considerably constant throughout the data recollection (They had a range of 0-0,2 and its average was 0,2 ppm) (Friedl, G., & Wüest, A. 2002)

As shown in the results, the levels of transparency varied between 22 cm to 30cm. The average transparency was of 24.6 cm. We used a handmade secchi disk to make this measurements. The average alkalinity levels found were of 56 ppm, the highest value being 78 ppm and 20 ppm being the lowest. We can probably infer that the lowest value (20ppm) may be an outlier given its difference from the other data. Alkalinity is a measure that has a direct relationship with pH as both measure the changes of acids in water, extreme changes in Alkalinity have a direct impact towards the pH levels; as a higher alkalinity level in water will help prevent mayor impacts changes in pH levels, and as consequence help the propagation of life as it helps protect the environment from these great changes. Alkalinity is also determined by the soil and terrain that surrounds the body of water as its components can alter the water's chemicals when diluted. (Mr. Brian Oram, P. 2018)

The pH of reservoir showed to have a range between 6.0-7.5, though the average pH levels were of approximately 6.7. are almost neutral and could indicate that it is fit for holding life of other organisms in the reservoir, since the pH is considered as an indicator of the water quality in general, how much it is being affected by external agents. The changes in pH can indicate the insertion of fertilizers, particularly when continuous measures are registered along the conductivity of the water body and, eutrophication processes, if associated with the photosynthesis process and algae respiration. Furthermore, the pH affects the toxicity of some compounds such as the amoniac when controlling its ionization, like the biological availability of certain contaminants, as the heavy metals. Values higher than 9.0 and lower than 5.8 produce limitations in development and physiology of the aquatic organisms. (Pérez-Castillo, et al. 2008).

Conclusions

• During the measurement time the amount of dissolved oxygen decreased progressively while the nitrate concentration was increased, this tendency was also observed that was linked to increased temperature, which is crucial for the retention of oxygen in water and although oxygen levels did not drop drastically their levels at the moment are in the upper limit for any organism can live in our reservoir.

• Parameters such as phosphates, pH and alkalinity showed no significant variations with time and changing weather conditions, both pH and the alkalinity showed no dependence on the other parameters analyzed, and showed that the reservoir is feasible to support life other organisms. The low concentration of the phosphates as mentioned above may be related to the presence of nitrates although further studies to determine why the low phosphate concentrations.

• Bacteria isolated and characterized shown to be in its large majority Gram positive , both oxidative metabolic capacities and fermentative, and preferential use of carbohydrates against substrates such as citrate, also showed a high capacity to reduce nitrates to nitrites, and this could show how the excesses of available organic matter is utilized by microorganisms and why this parameter is so fluctuating. ■

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The compass and the scientific skills

developed by second graders during the Science Show and Tell.

Nathali Coral
Lower elementary Science teacher

As part of the students scientific learning at Rochester school, we celebrated the Pi Day last March 14th, the day that commemorates the birthday of German physicist Albert Einstein, and in which science is celebrated in the world. An opportunity for students to show their work and develop new scientific skills.

For second graders, the days prior to the event were dedicated to the preparation and real comprehension of the topics they were going to share during their presentations on Pi Day. The compass was selected as the central element for the group to analyze. The learning expectation around the compass was "how to differentiate the concepts of attraction and repulsion by manipulating magnets". In order to develop this competency, students manipulated magnets to understand how polarity attracts or repels certain materials. Then, they studied the compass and its different components and understood how it indicates direction on earth according to the planet's magnetic field.

For the development of the model, the children investigated and consulted with their parents about a compass, its parts, and mechanism. They became familiar with and used terms such as magnetic field and orientation. Finally, they developed the functional model of the compass using homemade materials such as a needle, some cork, and a magnet. Prior to the show and tell presentation, they double checked their models to verify their functionality and strengthen the ideas they wanted to share, ideas such as who invented the compass, how it works, and in the case of some animals like sea turtles, which do not have compasses, how newborns are oriented to find the sea.

For their presentation to preschool children, second grade students read a story they had written in collaboration with Luisa Noguera, a story writer for children, and their science teacher Nathali Coral. This story was about two children, who imagined they were two pirates who wanted to find a treasure in the Northern Islands. They were two intrepid pirates who knew they could reach the North by watching the stars. However, the sky was cloudy and could not orient themselves. At that moment, a sympathetic Chinese man, Toy Lim Pio, came down from a cloud, and offered them a compass, an invention created hundreds of years before by his ancestors. Using the compass, the pirates could find their destination by dawn. Right there and then, they observed the treasure in front of their eyes: sea shells as bright and beautiful as precious jewels shone in the light of the sun marching and guided by the Earth's magnetic field, they could find the ocean. The children also managed to find their way back home with the help of the compass.

Each of the elements that involved this activity is fostering different skills that our children develop while participating in this type of events organized for the entire community, a space designed for both learning and developing one of the pillars in our school: useful learning for life. As children start to create an idea, they research a topic, use scientific vocabulary, build a useful model, communicate their learning through exposure, teach others and work as a team. They demonstrate they are acquiring tools that allow them to succeed in life. At the end of the day, the children expressed their satisfaction in meeting the basic needs of survival, love and belonging, power, freedom and fun.

Math, math, we love Math!

Mathematics may not teach us how to add love or subtract hate but it gives us every reason to hope that every problem has a solution.

Natalia Chinchilla García
Pre Kinder C- Family Coordinator, English and Math teacher.

On the day of the passing of Stephen Hawking, we celebrated our 2018 Pi Day at Rochester School, it was a day full of learning and fun! We will be for ever grateful for the parents, students and teachers that took part of this amazing moment. As a new teacher at Rochester School, I can proudly say that the students enjoyed showing off their learnings.

In regards with, basically, preschoolers do math all the time, even if it is not sitting at desks with worksheets or playing with counters. Preschool math helps them understand the world around them and teaches them to reason and to find explanations to what surrounds them. Us, teachers of preschool math, take into account firstly the children´s prior knowledge and prioritize their lovely and spontaneous discoveries to go further into their mathematical learning.

During this quarter, I have outlined the following as important parts of preschool math learning, and which were protagonists in the Pi Day.

First, children learn about numbers by counting objects and discussing the results they see, they count days until their birthdays and recite nursery rhymes with numbers. Then, they practice constructing shapes and discussing what composes them. Continuing, they compare height when constructing block towers, they measure each other and the distance from their favorite place to another. They also learn that they need to kneel lower to reach something, because the space is smaller and so on. Preschool math teachers like me, strengthen children´s findings by asking questions and making observations when found. Games using numbers, geometry, patterns and measurement are super important during these years of education, as well as the way how these little people are taught math. Further, children are all ears and eyes of patterns in their clothes, uniforms, they start to recognize colors and sizes in everything that surrounds them. To finally start analyzing data were children start sorting objects by color, size and shape, counting and recording data in charts.

Fortunately, the beauty if early childhood mathematics is a sentiment that changed my perspective after the last Pi day, march 14th. This whole day described math learning experiences that are meaningful and enjoyable for children and teachers. All of us could be part of a playful math experience which will always inspire others to try some of these ideas. I engaged in the enjoyable mathematics instruction and will continue to see children´s understanding grow.

Hands on Science

Learning about renewable energies

María Claudia Martínez Velasco
Life Science Teacher for Middle School

Introduction

The way we use energy and how we produce it, is of vital importance to society.

Studying about real world problems can make sustainability issues more meaningful to students, since they become capable of taking what was learned in one situation and apply it to a new situation. Students develop expertise in a particular subject area, understanding when, why and how to apply what they know using their skills to propose solutions.

Hands-on activities enhance learning significantly at all levels, allowing a physical understanding of scientific concepts that directly involve them in the learning process.

I want to share an experience working with a group of 7th graders during Life Science class.

Learning about Renewable energy

For this activity, students have been learning about fossil fuels and how humans have been using them as energy supplies, the potential consequences of our need for
energy, and the resultant impact on climate change.

Students were also introduced to the different types of renewable energy resources by engaging in various activities like reading articles, watching videos and doing research to help them understand the transformation of energy (solar, water and wind) into electricity.

Students explored the different roles engineers who work in renewable energy fields have in creating a sustainable environment.

Working on the project

The goal of this project was for students to collect information about alternative sources of energy that can power our daily appliances, and propose solutions to real world problems like mitigating climate change while promoting the use of clean energy.

The students selected the way they wanted to approach their learning by choosing the particular problem they wanted to address, and how they would teach it to their classmates, either by building a model or carrying out an experiment.

The results were amazing!

Proposals

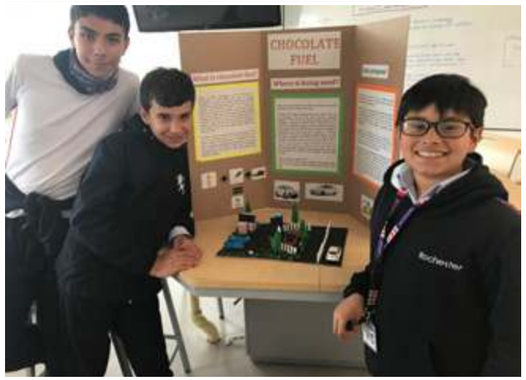
Some of their proposals included:

- Doing their own solar charger to avoid the use of electricity to charge their phones, and taught other students how to build it using mini solar panels.

- Proposing an alliance between Chocolates Jet and Bayer laboratory to use chocolate fat and E. coli to produce hydrogen and use it as fuel for cars instead of fossil fuels, to protect the ozone layer.

- Using electrons from photosynthesis in plants as a source of energy to provide electricity to Vigía del Fuerte, the only village in Antioquia without this service.

- Generating body heat to convert it into electric energy and charge mobile devices.



Thoughts and Reflections

Giving students the power of choice by including them in the decision on what real life situation they felt interested on working to propose solutions, and how they would present it to other students, offered them insight into their own learning and helped them become responsible for their process.

Hands-on projects certainly engage students and benefit all types of learners by providing opportunities to observe as well as perform, validate their understanding through teaching others, and help their peers to build and expand their critical thinking skills.

When students learn about sustainability and how to protect their environment, they are given the opportunity to strengthen values such as responsibility, thrift , caring for them, others and their context, developing their character. They feel empowered and motivated for action. ■

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