EUROMATH & EUROSCIENCE CONFERENCE 2024
&
EUROPEAN STEAME-ACADEMY SYMPOSIUM 2024

ABSTRACTS BOOKLET

12 – 16 MARCH 2024
ROME, ITALY

Local Host

EUROMATH & EUROSCIENCE 2024
and
EUROPEAN STEAME-Academy Symposium 2024

Opening Ceremony

11:45 – 13:15 (CET), Wednesday, 13 March 2024, Room: Aula Magna, and Streaming in AULA TL , Via Columbia 2, Rome

****

Welcoming address by the chair of the Organizing Committee

Prof. Gregory A. Makrides,
Chair of the Organizing Committee of the Conferences
President of Cyprus Math Society, President of the THALES Foundation
Chair of the Education Committee, European Mathematical Society

*

Greetings

Prof. Jan Philip Solovej (online)
President of the European Mathematical Society

*

Representatives of the host university
TOR-VERGATA University of Rome, Italy
Prof Bianca Sulpasso, Rector's Delegate for International Affairs

*

Prof Vito Introna, Rector's Delegate for Orientation, Tutoring and Placement

****

Invited Keynote Presentations

Keynote Speaker 1
Mathematics Competitions Around the World in 2024
Robert Geretschläger
President World Federation of National Mathematics Competitions (WFNMC), Austria

Keynote Speaker 2
STEAME EDUCATION: A CAREER CATALYST
Georgios Tzachristas
Student, National Technical University of Athens, Greece

FULL CONFERENCE PROGRAMME

Abstracts Booklet

Contents

WELCOMING ADDRESS BY THE CHAIR OF THE ORGANIZING COMMITTEE

Prof. Gregory A. Makrides,
Chair of the Organizing Committee of the Conferences
President of Cyprus Math Society, President of the THALES Foundation
Chair of the Education Committee, European Mathematical Society

Dear students, teachers, parents and colleagues, I would like to welcome you to the EUROMATH & EUROSCIENCE 2024 and the European STEAME-Academy Symposium 2024.
It is with great pleasure to welcome 500+ student participants and 100+ teachers from 21 countries. During this event we will celebrate the International Day of Mathematics during the "Mathematics and Science by Night" dinner dance on the 14th March.
The conference programme has 95 Math Presentations by school students, 63 Science Presentations by school students, 19 workshops delivered by teachers and researchers. Student participants have the opportunity to develop research and communication skills and at the same time to network and make new friends from many different countries.
I want to thank specially the Tor Vergata University of Rome in Italy for hosting the event, the university officers for their excellent support and the local colleagues for their volunteering contribution in supporting the event.
All participants will leave this event wiser and also with new friends.

*Gregory Makrides, Professor of Mathematics and STEAME Education at the University of National Education Commission in Krakow, Poland; President of the Cyprus Mathematical Society; President of the THALES Foundation; and Chair of the Education Committee of the European Mathematical Society

GREETINGS

Prof. Jan Philip Solovej (online)
President of the European Mathematical Society

It is a great pleasure for me as president of the European Mathematical Society to be given the opportunity to address you, the participants at the EUROMATH & EUROSCIENCE & EUROPEAN STEAME-ACADEMY SYMPOSIUM 2024 conference for school students. I am very sorry that I cannot be present in person and enjoy the conference with you. It is wonderful to see so many students participating from all over the world and that there are over 120 presentations. Mathematics as a field is unique in how it unites people across cultural and geographic barriers. No other topic is taught worldwide from first grade in all school systems everywhere. Some find the topic difficult. Others love it. I am sure you all are brought together here because you find mathematics interesting and enjoyable. I am immensely impressed with the breadth of the topics presented at the conference. I have never worried about the future of mathematics but it is nevertheless fantastic to see how mathematics keeps engaging new generation. I hope you will all benefit personally from participating in the conference, but I also hope that you will go home from the conference and act as ambassadors for mathematics and spread the word to all your friends and fellow students of how much fun it can be. For me personally mathematics has not only been a lot of fun but also always been a very social activity that I love to do with my collaborators. I hope you will all experience this at the conference and I wish you all some exciting days that will stimulate your interest in mathematics even more.

PLENARY TALKS

PL1. MATHEMATICS COMPETITIONS AROUND THE WORLD IN 2024

Robert Geretschläger
President World Federation of National Mathematics Competitions (WFNMC), Austria

The mathematical competition scene is booming internationally. There are many good reasons for this, as competitions are enjoyable in their own right, as well as providing opportunities for skill enhancement, networking with like-minded peers, and more. In my talk, I would like to take the opportunity to present some of the wonderful aspects of competition mathematics, as well as giving a brief overview of the expanding world of national and international mathematics competitions.

*Short bio
Robert Geretschläger is a teacher of mathematics and geometry, born in Toronto, Canada and living in Graz, Austria. He taught at Bundesrealgymnasium Keplerstraße in Graz for nearly 40 years, and is still active as a lecturer in teacher education. He is the editor and co-author of numerous books on popular mathematics, competition mathematics and the geometry of origami. For most of his career, he has been actively involved in the organisation of mathematics competitions. He has been leader of the Austrian team at the International Mathematical Olympiad since 2007 and the leading organizer of the Mathematical Kangaroo in Austria since its beginning in the mid-1990s. He is the current President of the World Federation of Mathematics Competitions.

PL2. STEAME EDUCATION: A CAREER CATALYST

Georgios Tzachristas,
Student, National Technical University of Athens, Greece

STEAME education is a crucial guiding factor for professional development. This approach combines science, technology, engineering, arts, mathematics and entrepreneurship in education, preparing students for modern jobs. Focused on developing skills such as creativity and collaborative work, STEAME education equips students for successful careers and addressing future challenges. I would be happy to serve as case study, since my personal STEAME trip has empowered many skills, a lot of confidence, new ideas and many important human contacts. My STEAME trip has involved travelling, teleconferencing, co-creating, posting problems, solving problems, developing digital skills, exchanging ideas, discussing, publishing articles, winning prizes, networking and interacting. In conclusion, STEAME education is a powerful building tool for a flexible innovative generation of people that are based on knowledge, ethics, collaboration and technology, in other words a CAREER CATALYST.

*Short bio
Georgios Tzachristas is a medalist at the Greek mathematical competitions and Olympiads, at the Mediterranean Mathematics Competition, at the European Mathematical Cup, at the Balkan Mathematical Olympiads and at the International Mathematical Olympiads. In July 2023, he became a GOLD IMO MEDALIST at the 64th IMO in Japan, with the best Greek score 35/42 at IMO ever! He has also got medals/awards at chess tournaments, physics and riddles competitions, HMS and EMS schools, E3SN committee as chair, articles and math solutions at the Euclides-B and the Plato magazines. Moreover, he is a pianist, athlete, dancer, English and German speaker and currently a freshman at the School of Electrical and Computer Engineering of the National Technical University of Athens.

STUDENT PRESENTATIONS IN MATHEMATICS

MP1. THE STABLE MATCHING PROBLEMA

Zois Pavlos, Karathanasis Panagiotis, Oikonomidis Iordanis, Mastoropoulos Emonas, Papanikolatos Gerasimos, Papaioannou Komninos, Papaioannou Vaggelis
Zanneio Model Lyceum of Piraeus, Greece

The stable marriage problem is a mathematical, economic, and computer science problem that involves finding a stable matching between two sets of elements with equal sizes. This problem has various real-world applications, such as assigning graduating medical students to their first hospital appointments or assigning users to servers in a distributed Internet service. In 1962, David Gale and Lloyd Shapley developed the Gale-Shapley algorithm, which provides a solution to the stable marriage problem. This algorithm works through a series of "rounds" and ensures that all marriages formed are stable.
This paper explains the concept of stable matching, discusses the necessary mathematical background and provides an analysis of the stable marriage problem focusing on the Gale-Shapley algorithm and its applications in real-world scenarios. Moreover, the paper includes a realization of the algorithm using python.

MP2. 4-2-3-1

Konstantinos Charalambous, Antonis Dianellos, Varnavas Hadjipanayis, Andreas Pantelides
The GC School of Careers, Nicosia, Cyprus

Football is considered to be the most popular sport in the world, with over 3.5 billion fans worldwide and 250 million players across 200 countries, regardless of age or gender. However, the mathematics behind football have not been fully unveiled yet to the majority of those.
Have you ever dreamed of participating in the most prestigious competitions worldwide, or scoring a goal against Manuel Neuer, or shooting like Lionel Messi and Cristiano Ronaldo? What if there was a way that you could? It is not that hard. You just have to be both a brilliant athlete, as well as good at maths. These people are tangible examples which divulge the secrets of the world of mathematics in football.
Based on the love of people for this sport, we dove further into analysing the shooting angles and were led to conclusions, which indicate the optimal position of a shot. Furthermore, we studied the perfect penalty. Trigonometry, logistic regression, probabilities, Shapley values, mechanics and statistics are just a few of the endless ingredients (mathematical models) that can be used in this delicious recipe of 4-2-3-1.
Overall, mathematics has a multifaceted role in football contributing to both the strategic and analytical aspects of the sport. In fact, it can easily be viewed through the eyes of mathematics just like everything else.

MP3. BUFFON'S NEEDLE - FINDING A NEEDLE IN A HAYSTACK OR PI IN THE NEEDLES

Jingwen Fu
The GC School of Careers, Nicosia, Cyprus

The irrational number Pi is most commonly known as the ratio of the circumference to the diameter of a circle, it has a value of approximately 3.14 and is never ending. The fact that it is irrational is fascinating enough, but in addition to that, Pi also has a tendency to pop up in places that have nothing to do with circles. In this presentation we will dive into Buffon's needle problem, an example of Pi appearing from seemingly nowhere.
Buffon's needle problem involves dropping a needle onto a piece of paper with parallel lines drawn on it, where the distance between the lines is twice the length of the needle, and determining the probability of the needle intersecting a line. In this presentation, we will use mathematical proof to show how this probability is related to the value of Pi.
Further to this proof, we shall use the Monte Carlo method to estimate our own value of Pi. This involves computer simulations written in python, to demonstrate a clear and visual understanding. It is also more accurate and faster than manual experiments. Join us in this search of Pi in straight lines.

MP4. THE GOLDEN RATIO AND HUMAN BEAUTY - A CONTROVERSIAL CONNECTION

Angeliki Hadjigregoriou, Xenia Papandreou
The GC School of Careers, Nicosia, Cyprus

Amongst numerous mathematical concepts, few have stood the test of time as gracefully as the Golden Ratio has. Originating over 2,400 years ago in ancient Greece, this mathematical constant has travelled through time in both ancient and modern civilizations.
Thanks to humans' natural inclination towards beauty, the Golden Ratio has permeated in many fields of study. Despite it being a mathematical constant, many theories and models have been developed on the topic over time. Whether in architecture or psychology, individuals have experienced the same allure that once fascinated Euclid and Pythagoras.
To comprehend the Golden Ratio, one must first look at its mathematical properties. However, computing some calculations does not necessarily mean that the Golden Ratio should and can be applied to everything. This presentation examines the intriguing relationship between the Golden Ratio and human beauty, a relationship that is far from consolidated. Our aim is to clearly present an objective analysis of the existing research.
What is interesting is that we have found pictures that adhere to the Golden Ratio but it is quite evident that they are far from appealing. Our research led us to question whether beauty and the Golden Ratio have a direct correlation after all. No one can deny the accuracy of mathematical calculations. Is this enough, however, to accurately calculate beauty?

MP5. UNDERSTANDING WHY YOU ARE A LOSER IN THE STOCK MARKET

Peter Han FeiHong
The GC School of Careers, Nicosia, Cyprus

This presentation will explain with mathematical certainty how you will be a loser in the stock market. We will draw a connection between the Allias paradox and potential difficulties in the stock market and point out how human behavior is irrational. Through 2 simple questions, we can find out that reality is different from expectations and humans cannot maximize their utility. Behavioural economics determine how people are being influenced by factors such as income, family, peers and the environment.
Understanding the prospect theory is crucial as it provides insights into how people deviate from rational decision-making models when faced with risks and uncertainty. The aim will be to understand this and behave more rationally.
Minimizing risks is a key factor to being successful when entering the stock market. Planning out and facing the losses before thinking about gains is how to win the steady and exhausting battle to earning your first €1,000,000 with 100% certainty. Let's see if mathematics can help you achieve these goals.

MP6. MATHEMATICS DRIVING SHOTGUN

Antonia Kyriakou, Stavros Papacharalambous, Fotini Yiorkadji
The GC School of Careers, Nicosia, Cyprus

January 29, 1886. Arguably, one of the most significant days in human history and evolution. It was a turning point made by Carl Benz when he applied for a patent for his 'vehicle powered by a gas engine'. It was this patent which was later recognised as the birth certificate of the automobile. These vehicles have eased all our lives tremendously but
it also came with its downside. Sadly, approximately 1.19 million people die each year as a result of road traffic crashes. All these car crashes are caused by an amalgamation of reasons working together.
One car crash which undoubtedly shocked the whole planet, was that of princess Diana's. In our presentation we would like through this horrific accident to navigate people towards safe driving. Our aim was to investigate the role of mathematics in the accident scene and in the modern safety features of cars.
Mathematics provides the tools and the framework for engineers to model and analyse various aspects of vehicle safety, contributing to the development of effective safety features in modern automobiles. From adaptive driving to lane keeping assist and crumple zone airbags mathematics keep on making driving safer. So, every time we are driving mathematics is driving shotgun?

MP7. MATHS IN FORENSICS

Paris Kalorkotis, Mary Mina, Theodora Pamboridou, Omiros Trypatsas
The GC School of Careers, Nicosia, Cyprus

Although people often wonder, what the need is to study various fields of mathematics at school, there are indeed some fields that rely tremendously on mathematics. Is it, for example, possible to solve a crime without mathematics?

Mathematics plays a crucial role in the field of forensics, offering a wide range of tools and techniques that help in the analysis, interpretation, and presentation of evidence. It applies by employing a set of principles of trigonometry and statistics, giving a graphical representation and helping in the analysis of evidence in a crime scene investigation, ballistics, and fingerprinting.

A prime example when mathematics was highly involved in an investigation is no other than the assassination of John F. Kennedy. The cause of death of the former president of the United States involved bullet fragments into his cranium. Studies revealed what the probability was of the bullets being derived from the same source, which ultimately led to one main suspect. This was found mainly by using the chi-squared distribution. Furthermore, many models were created to find the amount of damage to his skull, as well as projectile methods were used and Newton's laws applied to reveal the track of the bullet.

Our project aims to reveal and analyse how mathematics is used in murder investigations and emphasise the growing significance of it in modern forensic science, in crime scene reconstruction and in the analysis of evidence to solve crimes.

MP8. NAVIGATING SKIES AND ROADS

Aris Americanos, Evelthon Glykys, Sotiris Theofanous
The GC School of Careers, Nicosia, Cyprus

Why does a high perfomance car outmaneuver a low performance car? Why are aeroplane wings so long? Both of these are because of aerodynamics. Through this presentation we aim to provide a detailed yet simple explanation of the basic principles of aerodynamics. These principles shape the design and performance of both cars and planes.

Aerodynamics, at its core, involves the study of how air interacts with objects in motion. We will introduce the key concepts of aerodynamics which are lift, drag and efficiency. From the sleek wings of airplanes slicing through the clouds to the streamlined bodies of cars driving along highways, we will illustrate the reasons behind their form and function.

In aviation aerodynamics play a significant role in achieving flight. We will explore how aircrafts use lift to defy gravity and the balance required to ensure a smooth and stable journey through the skies. On the ground, we will look into how cars navigate through air resistance, and we will uncover how aerodynamic design contributes to fuel efficiency and overall perfomance.

Join us in this journey as we bridge the gap between the complexities of aerodynamics and everyday understanding. Whether you are a novice or an enthusiast, this presentation promises an insightful and engaging exploration of the forces shaping our airborne and terrestrial travels.

MP9. MATHEMATICS BEHIND REFUSE CLASSIFICATION

Gong Zilin
The GC school of Careers, Nicosia, Cyprus

The growing world population has increased waste generation making its management an enormous global issue. Refuse classification offers numerous environmental benefits and it is a cost-effective process. It is a prerequisite for the scientific treatment of rubbish and lays the foundation for the reduction, recycling and harmless treatment of it. Nonetheless, the biggest challenge is changing people's habits and attitudes toward waste disposal.

This project aims to illustrate how to educate residents on this global issue and shed some light on how maths and statistics can be used in the collection and analysis of data relating to refuse classification. Artificial Intelligence plays a vital role in making the collection process more efficient. Although AI is a powerful tool, it is nowhere close to being perfect. Before applying AI, its findings need to be tested to avoid mistakes and not influence the validity of the research. Furthermore, to identify areas that need improvement we will run AI simulations, collect outcomes and analyse them.

Mathematics and statistics are integral to understanding, managing and optimizing the refuse classification processes. They provide the quantitative foundation necessary for informed decision-making and sustainable waste management practices.

MP10. SPACE MATHS

Stavros Georgiou, Michalis Florides
The GC School of Careers, Nicosia, Cyprus

For over 3000 years, humanity's fascination with the stars, with roots dating back to the Assyro-Babylonians in 1000 BCE, has evolved. Numerous discoveries have been made but we still have a lot to learn about astronomy. Astronomy relies on complex mathematical equations to reveal the universe's secrets.
Can we comprehend the complexity behind these equations, or are they beyond our understanding? Remarkably, mathematics play a vital role and has been essential in calculating planetary speed, gravity and distances, from the early days of astronomy. This is the main focus of our study since we find this combination intriguing.
Did you know that 1 tablespoon of neutron star weighs the same as the human population, or that the moon is lemon shaped and that one million earths could fit inside our sun? These are just a few examples of what astronomy can uncover using the power of mathematics.
Maths is everywhere! We encounter them on countless everyday things and astronomy is not an exception. Join us on a journey where mathematical equations help us understand the cosmos.

MP11. THE HIDDEN BEAUTY OF MATHS IN ART

Elena Potamiti
The English School, Nicosia, Cyprus

Art is the canvas, and mathematics is the brush; together, they craft the masterpiece of hidden beauty. Have you ever thought about the fascinating connection between mathematics and art? Throughout history, the integration of mathematical principles such as symmetry, geometry, and proportion in art has been prevalent, leading to the creation of incredible masterpieces. In my presentation, I will be presenting many famous artists, such as Leonardo da Vinci, Piet Mondrian, Wassily Kandinsky, Albrecht Durer, Maurits Cornelis Escher and Piero della Francesca, who are known for their exceptional works of art, which, upon closer inspection, reveal fascinating elements closely tied to mathematics. For instance, Leonardo da Vinci's Vitruvian Man is a classic example of applying mathematical theories in art, with the painting based on human body measurements. Now, imagine a world where numbers and colours combine in a symphony of precision and creativity to produce stunning works of art. This is what happens when math and art collaborate. It's like a particular language where math guides artists, helping them make their art more precise and imaginative. This unique combination not only enhances the beauty of art but also adds depth and meaning to it, making it even more captivating and thought-provoking.

MP12. MATH AND GENETICS

Marielena Neophytou
The English School, Nicosia, Cyprus

The focus of my presentation revolves around the influence of genetics on an individual's mathematical ability. Throughout my presentation, I aim to shed light on various aspects that may address unknown queries. Firstly, I aim to explore what exactly someone's math ability entails and whether it is primarily influenced by genetic factors or if everyone is born with an equal potential in mathematics, with variations arising solely due to differences in hard work rather than innate talent. Additionally, I will delve into the realm of genetics by discussing a specific gene present in our DNA that potentially correlates with mathematical ability, particularly during younger ages. It is intriguing to consider how different alleles of this gene might subtly affect an individual's aptitude in mathematics. Moreover, I will broaden the scope of the speech by examining non-genetic factors that can impact mathematical ability, such as education and disabilities. By exploring these external influences, we can gain a more comprehensive understanding of the complex interplay between genetics and various environmental factors in shaping mathematical prowess. Finally, I will conclude my presentation by summarizing the key points discussed and offering scientific advice to enhance mathematical ability. I will explore different strategies and approaches that can be employed to improve performance in this domain, providing practical guidance to those seeking to enhance their mathematical skills.

MP13. MATHS AND NATURE

Aigli Josephides Koufterou
The English School, Nicosia, Cyprus

Maths are everywhere, especially in nature. The universe, our universe, is a beautiful complex of shapes and patterns. Years ago, Alan Turing published a set of mathematical rules that can explain many of the patterns that we see in nature. Another one is the Fibonacci Sequence, also known as the Golden Ratio. The Fibonacci sequence is a simple yet profound pattern. It starts with zero and one and you can find the number that follows by adding the two previous numbers. This specific sequence is found in plants, for example the way leaves are arranged, seeds and the number of petals on a flower. The spiral patterns on shells, pinecones and pineapples show a specific angle known as the golden angle. Honeybee populations are found to follow Fibonacci-like growth patterns. In nature we find fractal patterns which remind geometric shapes. Another shape in nature is concentric circles. They are basically circles in different shapes and sizes but with the same centre, they are usually found inside trees. Beehives are a great example of symmetry, bees build their beehives in hexagons. Some people think that bees build it like that so there is no space between. Another example of symmetry in nature is the butterfly's wings. Their wings are built in that way, so they are symmetrical. Maths are an essential tool to humans in order to try and understand the way the world works.

MP14. MONEY MATHS

Anna Maria Menelaou, Irene Yianna
The English School, Nicosia, Cyprus

Everyone wants to enjoy financial independence, right? Have you ever wondered how successful investors manage to accumulate their wealth? The key to their success is none other than mathematics; let's call this MoneyMaths! Understanding mathematical concepts, such as compound interest, that can be used in the world of finance, and learning how to apply them in our everyday life can increase the balance of your bank account significantly. In fact, Albert Einstein has famously said that "Compound interest is the eighth wonder of the world. He who understands it, earns it… he who doesn't…pays it." Actually, what separates the people who understand the concept of compound interest from the ones who don't is that they don't interfere with it or interrupt it unnecessarily. Don't get it? Our presentation will help you understand this concept as well as other applications of mathematics in the areas of pensions & savings, investments, and insurance. For example, in insurance, mathematics is applied in the pricing of every product we buy; be it in healthcare, life insurance or motor insurance. Understanding the interplay between the final price we are asked to pay, and the probabilities of each outcome and their price is fundamental in this industry. Mathematics also has a key role in investments. Successful investors will calculate various ratios and examine series of data using mathematical techniques to be able to compare possible investments before deciding where to allocate their capital. The world of finance is complicated, but mathematics is key to financial success.

MP15. MATHEMATICS BEHIND MUSIC

Marilita Alkiviadi, Egli Michaelidou
The English School Nicosia, Cyprus

A music piece is divided into sections called measures just like mathematical divisions of time. Each measure has an equal number of beats, which is determined by a fraction called a time signature found at the start of a piece. The speed of the piece is called the tempo measured in beats per minute. The values of music are based on the time signature 4/4. For example, the value that lasts 1 beat is called a quarter because it's the quarter of a 4/4 measure. Just like algebra music has its own formulae in order to produce a certain sound, e.g. different scale formulae, chords formulae. Pythagoras discovered the string theory (the longer the string the lower the pitch and the shorter the string the higher the pitch), helping us tune our modern-day instruments. Music also has its own geometry. The 12 note Pythagorean system evolved to become the chromatic scale that we use today. Plotting those 12 notes as points equally spread on a circle and then joining them creates a dodecagon, which stands for the chromatic scale. Any other shape created inside that dodecagon stands for different musical sounds (e.g. heptagons for scales, triangles for chords). Lastly many mathematical concepts such as the Fibonacci sequence and the golden ratio are used in harmonies and musical pieces.

MP16. IS IT RANDOM OR IS IT AN ALGORITHM?

Gerasimos-Georgios Panayides, Chariton Charitonos, Garry Petrossian
The English School Nicosia, Cyprus

Most believe investing in stocks and cryptocurrencies is easy and requires no skill, however this is not the case. It is useful and enlightening to be able to present some current technology like cryptocurrencies where mathematics can be applied. In our presentation, we will explain how maths can be used to gain a better understanding of the Crypto and Stock markets, which in turn allows for an efficient and profitable investment! We will present a way to predict the mechanism of fluctuations in stock or crypto value precisely, using Mathematics. Statistical records related to real life examples, will also be demonstrated. You might be asking yourself, by now, if it is worth investing and possibly risking your money for such an investment...and for this reason, we will assess the different risks and dangers of investing and how MATHS allows you to avoid them. Through this presentation, as a result, you will learn how to use mathematical knowledge and logical reasoning to grasp the full potential of both Stock and Crypto investments!

MP17. IS IT RANDOM OR IS IT AN ALGORITHM?

Sylia Andreou, Anna Theodorou, Eleana Iacovou
The English School Nicosia, Cyprus

Have you realised social media is always one step ahead and hears what we say and knows what we see, or even THINK? Then, you are right, you're not losing your mind! It's not random it is an algorithm! This particular algorithm, manages to collect your personal data, aiming to build a specific news feed for each one of you, that provides what we are interested in, according to our preferences. For example, every day, Spotify creates your own personal playlist, which is based on your music taste at that period. When you search across any social media platform for a specific song, Spotify, is most likely to add it to one of your playlists. The algorithm is adjusted to gather information, such as your likes, shares, comments, or reposts, that indicate that you are fascinated by what is presented to you. Why do social media algorithms even exist? The main reason for the existence of these algorithms is marketing! The producers of big firms aim to advertise their products online to increase their profits. Our main goal as a team is to decipher social media algorithms, how they work, but mostly how they are also directly- correlated with mathematics!

MP18. LOVE AND MATH

Maria Christina Economides, Alexandra Georgiou
The English School Nicosia, Cyprus

Love and Math. The Complex Equation of the Heart. Love, the building block of humans. Mathematics, the fundamental language of the universe. They may seem like an unlikely pair; however, their relationship is deeper than one would expect. Mathematics might not be the initial spell someone would think to navigate the complexities of the heart, but it can provide invaluable solutions to this puzzle. From a young age, everyone experiences the touch of love, but until when? You cannot keep “loving” everyone and forever but at the same time you cannot settle for someone who does not truly fit your standards either. So, how do you know when is the right time to commit? And once you have, what lies ahead? How do you successfully guide your partner to the jewellery shop? And then, how do you plan the perfectest, dreamiest wedding? No need to worry. Mathematicians found a solution to that as well. You’ll find their answers in our presentation, like we did.

MP19. HOW MATHS IS USED IN COSMETOLOGY

Yiolanda Liveri, Nicole Tornaritis, Ellen Apeyitou
The English School Nicosia, Cyprus

You may think that there is no maths used in cosmetology, but in reality maths is everywhere, and our presentation will prove this to you. Maths plays a vital role in cosmetology, as it is used by hair dressers, makeup-artists, estheticians, and even masseuses. For starters, in hairdressing one primary application is in measurements and ratios for mixing hair dyes or styling products accurately. Precise calculations are essential to achieved the desired hair colour or chemical treatment results, ensuring the clients satisfaction. Geometry also plays a role in hairdressing, when determining the ideal angles and proportions for haircuts and facial contouring, helping cosmologists create flattering and symmetrical looks. Additionally, understanding percentages is crucial for properly diluting products when doing a client's hair, and especially for calculating prices, discounts or taxes in a salon setting. In continuation, on the business side of cosmetology math is fundamental for budgeting, expense management, pricing services and maintaining inventory in salons and spas. Time management is essential in this fast-paced industry, as it aids in efficient scheduling and appointment management. Cosmetologists need to manage their schedules efficiently, which involves calculating appointment times, break times and working hours. Those working in sales or commission-based roles use math to calculate earnings, bonuses and commissions. They have to use formulae to calculate each person's salary raise etc. In summary, math plays a fundamental role in ensuring accuracy, precision, mixtures, colouring and business management withing the field of cosmetology.

MP20. FROM EQUATIONS TO COURTROOMS

Lina Constantinou, Filaretos Ierotheou, Alexandros Tseriotis
The English School Nicosia, Cyprus

Have you ever wondered how maths corelates to law? In our presentation, we are going to discuss maths' impact to law and the judging system. Specifically, we will refer to different formulae and rules, regarding both maths and law, using a variety of diagrams and equations to obtain a deeper understanding. The three main focuses of our presentation will be
investigating financial law, criminal law in combination with forensic analysis as well as legal research and data analysis. Financial law relies on mathematical concepts, implementing a range of different formulas, which lawyers use to advise their clients, especially for financial regulations. Additionally, even though law and science are rarely connected to each other, criminal law and forensic analysis form an exception. Forensics examine and analyse evidence from crime scenes to develop findings which can be crucial in the criminal investigations. Furthermore, law captivates the interest of many mathematicians through legal research and data analysis. This is the process of combining data into decision making on topics affecting lawyers. They usually use statistical thinking to calculate the probability of an event occurring. In conclusion, in our presentation we are going to explore different mathematical techniques that lawyers use when assisting a client. Imagine the advantage you would have if you ever found yourself blamed for a crime you didn't commit and you were able to use maths to predict the harshness of the judge and figure out ways to avoid punishment…

MP21. PICTURE PROOFS

Ismini Gavrielidou, Lia Petrou
The English School Nicosia, Cyprus

We all agree that maths might be challenging for some people. So, we found a way to make maths fun and easy. Picture proofs in mathematics provide a direct and visual approach to understanding complex concepts. In our presentation we focused on four major proofs to showcase the power of this method. Firstly, we explore the proof that the sum of angles in a triangle always add up to 180 degrees. Secondly, we will show how Pythagoras theorem can be proved using pictures rather than algebra. Also, we will tell you about the fantastic mobius strip and lastly, we dig into the series of odd numbers, demonstrating that the sum of consecutive odd numbers forms perfect squares. The visual representation of these proofs aids in comprehending the hidden patterns and emphasizes mathematical reasoning. Picture proofs are helpful for high school students.They bridge the gap between abstract symbols and thorough understanding, making mathematical concepts more relatable and engaging. Through these proofs, students not only gain a deeper appreciation for the subject but also develop problem-solving skills and critical thinking abilities that extend beyond the classroom.
In conclusion, picture proofs in mathematics are a powerful educational tool, elucidating complex principles through visual aids and fostering a lasting appreciation for the subject. High school students benefit immensely from this approach as it enhances their mathematical literacy and equips them with a solid foundation for future learning.

MP22. THE MATH BEHIND AI MAGIC

Aglaia Patsalides
The English School Nicosia, Cyprus

AI or Artificial Intelligence, is the development of advanced computer systems that mimic human intelligence, enabling machines to reason, and perform tasks like problem-solving and language understanding. AI is the world's future, and most people don't quite understand how powerful or valuable it is. We use machine intelligence in our everyday lives and all of us come across it extremely often, even without knowing it. What are the formulas behind it? How are AI programmed? How does it answer questions so quickly? What can AI not answer? Most students have certainly previously used an AI chat bot such as Chat GPT, in order to complete their homework or help with any other research. ChatGPT is an artificial conversational entity created by OpenAI. After its release in November 2022, its usage has skyrocketed, reaching over 180 million users who are benefiting from its capabilities in applications like chatbots and virtual assistants, transforming how people interact with AI-powered systems. If you have ever used an AI chat bot or AI in general, you might have realised, that it works like magic. It can generate any kind of request you have within seconds or even milliseconds. But, it isn't quite magic,It's all math!

MP23. THE MATHS BEHIND DOBBLE

Anna Rouva, Maria Michael
The English School Nicosia, Cyprus

Dobble is a fascinating card game which is easy to play, but has quite an interesting algorithm behind it. The main goal of this game is to get rid of your cards. In order to do this, you have to find the one common symbol between your card and the middle card. For this game to work, there are some requirements that the cards must follow. Each card is unique with all cards having an equal number of symbols on them. There is no symbol appearing more than once on a card and two cards only have one symbol in common. Obviously, for the game to work, there shouldn't be the same symbol common in all cards. The algorithm is based on the number of symbols on each card, the number of cards and the total number of symbols. The original game of Dobble has 55 cards, 8 symbols on each card and 57 symbols in total. This game also works with fewer cards, symbols and symbols per card. The algorithm is $n^2-n+1=s$, where n is the number of symbols in each card and s the maximum number of cards possible, which is equal to the number of symbols needed. The algorithm behind this game, will be explained in this presentation.

MP24. THE NATURE OF MATHEMATICS

Artemis Demetriade, Nefeli Diaouri, Despoina Markidou
The English School Nicosia, Cyprus

How many of you have ever said, or even thought, that maths are useless? That they were invented by ancient people and they are based on theories trying to explain facts? In our topic, we will prove to you that maths existed in nature since the very beginning. How do we know that? It's everywhere around us. From the tiniest raindrop to the largest star in the centre of our solar system, math is the secret key of nature. We will present to you multiple different aspects of mathematics, as well as how those tend to exist in our universe explaining many of our everyday observations. With detailed examples and live demonstrations, we will substantiate that nature has designed everything in such a way, so that very specific ratios and proportions appear. Looking into how rainbows are formed, we will see how different angles, laws of mathematics and geometric principles affect the colour reaching the human eye. Even the smallest creatures such as bees, spiders and ants use algorithms and create patterns and tessellations to survive. All of our surroundings have a mathematical proof behind them and we don't even know it…so why not discover.

MP25. THE SCIENCE OF EATING

Antrea Iacovou, Stephanie Kremmou
The English School Nicosia, Cyprus

Did you ever think about how maths plays a big part in our daily nutrition? The key to healthier everyday life is simply maths. It is important to determine the nutrition program for boys and girls according to their age group and their daily fitness activities. We will present ways you can improve your daily diet using modernised methods. You will learn how to control your food portions and consume meals rich in nutrients whilst having a reasonable budget. Incorporating more inexpensive yet nutrient-rich foods into your daily routine will help you save money and eat well. Not every diet is necessarily right for you, for example males and females have different necessities when it comes to nutrients and calories. Foods are scaled proportionaly, and combined in a certain order, to achieve desired outcomes.In addition, Ingredients must be measured and scaled accurately, food production quantities are calculated, and recipes are increased or decreased to scale based on demand. Math is used for portion control, to maintain consistency in production, and to compute food costs.It is incredible how much maths can help you achieve your everyday goals to be healthier and it can even solve anything! Follow our journey to be nutrition wealthy and healthy!

MP26. THE UNIVERSAL EQUATION

Margarita Mita, Sophia Anastasi
The English School Nicosia, Cyprus

The vast expanse of the universe has always captivated human imagination, with its countless galaxies, celestial bodies, and mesmerizing phenomena. But what if there is an unread chapter, an overrated discovery, waiting to be explored deeper. Welcome, to the Mathematical Universe Hypothesis by Max Tegmark. A theory that connects the elegance of mathematics with the fabric of our reality. We delve into the idea that our entire universe isn't just described by mathematics but is fundamentally build upon it. Join us on a journey into this extraordinary concept, where equations and formulas hold the key to unlocking the mysteries of our existence, challenging our understanding of the cosmos, and forever changing our perception of the world around us. In this presentation we are going to analyze electrons and how maths is related to them but also about planets and their properties which is what our cosmos is made of. Fibonacci patterns, gravity, parabolas, numbers, shapes, graphs. All these mathematical terms are found and used in our everyday lives without us even realizing. So, if we take seriously the idea that both space itself and everything in it has no properties except mathematical ones, it starts to sound a little bit less insane that maybe everything is indeed mathematics. We are going to do our part and try our best to prove to you that all this time we were underestimating our own ability to figure things out but are you willing to do yours? Are you willing to think big?

MP27. WHICH IS THE BEST TEAM IN THE PREMIER LEAGUE?

Andreas Anastasi
The English School Nicosia, Cyprus

Football in England is a national addiction and a way of living. Many English people work and live for that moment every week when they will get to see their team playing. Premier League[England's top flight division] attracts interest from all over the world being the most worldwide league. Many people follow premier league games in a weekly base supporting a club passionately. Among the premier league fans there has been always the debate which is the best team in the premier league. But what makes the best team in the premier league? Is it the success it has seen? The biggest or the most loyal fanbase? Well in this presentation with the help of statistics and mathematics we will find an answer to one of the biggest questions in the whole football community. For that we will have to compare the top 6 teams of England in different areas. Top 6 teams will be the teams that were among the top 6 places the most times in the last decade starting from 2013-2014 season.

MP28. CAN MATHEMATICS WIN AT MAFIA?

Riana Georgiadi, Theodora Constantinou
The English School Nicosia, Cyprus

Mafia, also called Werewolf, is a party game. The participants are divided into two competing groups: citizens and mafia members. The objective is to eliminate the opponent group. The game consists of two consecutive phases, day and night, and a certain set of actions, e.g. eliminating a player by voting during the day. The mafia members have additional powers such as knowing who the other mafia members are and collectively choosing to kill a citizen during the night. Here, we will present a simple mathematical model of the game to help increase your skills in Mafia. We find the closed-form solutions for the mafia winning-chance w(n, m). Moreover, probability helps assess the likelihood of different events occurring in the game. It aids in making informed decisions by calculating probabilities associated with actions or outcomes. It turns out that a relatively small number of the mafia members, i.e., proportional to the square root of the total number of players, gives equal winning-chance for both groups. Mafia is a game of strategy and deception, and mathematics just so happens to help you secure your victory.

MP29. FOOTBALL AND ITS MATHEMATICS

Maximos Yiasemides, Andreas Chimarides, Iacovos Malekkos
The English School Nicosia, Cyprus

Football, a sport cherished worldwide, is intricately linked to mathematics, revealing a hidden layer of precision and strategy beneath its dynamic surface. From calculating player statistics to optimizing team performance, mathematics permeates every facet of the game. Analyzing player movements, passing accuracy, and goal-scoring patterns employs statistical methods, showcasing the power of data-driven insights. Coaches leverage mathematical models to devise strategic game plans, considering variables like player positioning, opponent tendencies, and even environmental factors.

Moreover, the geometry of the field itself becomes a canvas for mathematical principles. Players strategically position themselves to form triangles, exploiting spatial relationships to control the flow of the game. Probability theory comes into play during penalty shootouts, with goalkeepers relying on mathematical calculations to anticipate the trajectory of the ball.

Financial mathematics plays a crucial role in the business side of football, influencing player transfers, contract negotiations, and club valuation. The burgeoning field of sports analytics, rooted in mathematical methodologies, has revolutionized the way teams approach training, performance analysis, and injury prevention.

In essence, the marriage of football and mathematics extends beyond the pitch, enriching the sport with quantitative insights that enhance both its spectacle and strategic depth.

MP30. PURRPLEXING ENCLOSURE – THE STORY OF A HIDING CAT

Constantinos Michaelas, Leonidas Thanh Ikossi Le, Raphael Son Ikossi Le
The Senior School, Nicosia, Cyprus

I have I problem with my cat, not Schrodinger's. My cat is hiding in a box, but I don't know which box. He is somewhere in a set of boxes ranging from 1 to n. He is totally nocturnal, shifting to one box to the left or right every single night. I hope you can help me solve this logic problem. Each morning we can choose a single box to open, in the hope of reuniting me with my elusive furball. The real challenge is outsmarting the cat's sly moves. This has turned into a game of strategy, reason and deduction. Let's rise to the challenge to uncover the cat's secret spot before the next sunset! You should know that this cat is not your typical animal as it is figurative and symbolic, impervious to hunger and thirst, and, as it is not real, it cannot die. It is like cracking a code where each night presents the challenge as to which box to choose to outwit the crafty feline. This puzzle has the perfect mix of strategy, suspense, and fun making it a brainteaser that I believe is beyond the standard scavenger hunt.x

MP31. WHY ARE KNOTS MORE THAN JUST KNOTS?

Ekaterina Frolova
The Senior School, Nicosia, Cyprus

I have decided to do a project about “Knot theory”, to find out what knots are in mathematics and how we can use them. Knots first found their use in Chemistry in the 19th century, when different chemists were trying to systemize the atoms and the vortex theory of the atom was suggested, which said that an atom is just a tiny knot. Later, the theory proved to be wrong, but this was how scientists started studying knots. Nowadays, Knot theory is widely used in quantum physics, genetic engineering, and medicine – to better understand the processes that take place in the DNA, to make new materials and medicine. Today, over 159 billion knots are known, and, theoretically, we could make over 159 billion new materials from a single molecule. Moreover, Knot theory is used to cure cancer and explain properties of chiral molecules, such as thalidomide. In mathematics a knot is a knotted loop of string, which we can represent as a 2D projection. We can say that two knots are different if one cannot be changed into another. However, to prove that two knots are not the same, we cannot just do the Reidemeister moves – the three types of modifications you can do to a knot – but need to use other methods such as colorability and polynomials. Overall, Knot theory is an extremely fascinating field of mathematics. It is new but it is now rapidly developing.

MP32. SUMMATION, NUMBERS AND SHAPES IN GEOMETRY

Viktoria Branimirova Nacheva, Valentin Georgiev Gadzhelov, Simeon Nedyalkov Nikolov, Tzveta Georgieva Dzhevelekova
125th Secondary School "Boyan Penev", Sofia, Bulgaria

The historical development of geometric models is presented - from the geometric skills of builders, surveyors and astronomers in ancient civilizations to the challenges of modern discoveries to appropriate models for their unraveling. Emphasis in the project is the concept of parallelism Euclidean geometry is considered and the necessity of the existence of other geometries is shown.
Hyperbolic and spherical geometry and their similarities and differences with Euclidean geometry are discussed through various visualizations. The main difference between geometric models is their idea of the nature of space. Dynamic geometric interpretations developed by our team are shown. The Dutch artist Moritz Escher, unique in his style, is presented, who at the beginning of the last century introduced his highly intuitive visual sense of mathematics through impossible constructions. On this basis, original interpretations of his graphs are shown Topological objects and planar representations of objects impossible in three-dimensional space are demonstrated.
Many geometries exist, but only Euclidean geometry is being taught in schools today. The more the sciences progress there is, the greater the need to create new geometries by interpreting other basic geometric concepts – point, distance, etc. A challenge for all young people is the discovery of new geometric patterns.
To increase audience interest, we will create a Cheshar polyhedron and a spidron together using unfolding patterns. The project will also be presented through an interactive poster, including additional information, graphic images, encoded through QR codes.

MP33. JUNG’S THEOREM IN THE PLANE AND THE 3-D SPACE

Boris Stanislavov Kostadinov
125th Secondary School "Boyan Penev", Sofia, Bulgaria

The following project discusses Jung’s Theorem in two private cases – the plane and 3-D space and explores some interesting problems related to it. Imagine a finite set of dots scattered across the plane. Connect the two most distant points with a segment and let its length be d. According to Jung’s Theorem, there exists a circle with a radius equal to d3 that contains all these scattered points. Similarly, imagine a finite set of points scattered across the 3-D space. Connect the two most distant points with a segment, and let its length be d. In this case, there exists a sphere with a radius equal to d38 that contains all these scattered points. The theorem is named after Heinrich Jung who first discovered this property in 1901.
The presentation covers the proof of the theorem in these cases and the dynamic geometric interpretation of the proofs in the plane and the 3-D space. We will explore a couple of interesting problems and their simple solutions, that wouldn’t have been as easy without the knowledge of Jung’s Theorem. These problems will demonstrate the usefulness of the theorem and its potential applications in real-life situation
The presentation will be accompanied by an interactive poster that includes specific information and the process of constructing the different coverings, that can be reached through a QR code.
Keywords: Jung’s Theorem, points, plane, 3-D space, covering (circle, sphere), construction
Scientific consultant – Ivayla Radkova, a teacher in 125th Secondary School “Boyan Penev”, Sofia, Bulgaria.

MP34. MATHCHESS

Borislav Stefanov Fidanov, Maxim Plamenov Marinov
125th Secondary School "Boyan Penev", Sofia, Bulgaria

The project aims to combine an educational element with entertainment through demonstrations and audience participation in the mathchess combinatorial game. The rules for moving the pieces are identical to those in chess. What is common to all of the examined problems is the search for optimality about the number of pieces (most often of the same type) and/or the number of moves (walking the board). In mathematics, these problems are known as "covering" problems and are related to the knowledge and application of various strategies that are a part of the field of combinatorics Different methods (strategies) for solving the set sketches are presented - invariance, coloring and others.
Some generalizations are made for the analysis and selection of strategies and the size of the chess field (the playing area). Several sketches are organized as real-time games with the audience. This interactive part of the presentation not only enriches knowledge but also provides entertainment, as the participants are actively engaged in the process of learning mathematical competences and game strategies and improving chess skills.
The project will also be presented through an interactive poster, including additional information, and a series of study tasks encoded through QR codes (audio and video files, interactive applications).
The consultant of the project is Madlen Christova, a teacher at 125th Secondary School “Boyan Penev”, Sofia, Bulgaria.
Keywords: chess piece; combinatorial game, covering, optimality, invariance, coloring

MP35. THROW AND HOLD

Hristo Kostadinov Kostadinov
125th Secondary School "Boyan Penev", Sofia, Bulgaria

The project introduces an original board game with dice. It's called "Throw and Hold." The main rules are: (1) Points can be earned when rolling the dice, which can later be lost. (2) The goal of the game is to reach 100 points by accumulating and making appropriate choices in each turn – the first to reach this sum is the winner. (3) After reaching 50 points, a second "bonus" dice is obtained, which can be advantageous or useless.
The game explores the realms of entertainment, critical thinking, and strategy, making it suitable for all ages. Several strategies for winning the game are described.
The ultimate product of the project is the creation of an engaging and fun educational game. In the presentation to the audience, the focus will be on demonstrating how to play "Roll and Hold" and providing an example of a typical game session.
Keywords: game, strategy, dice, probabilities, luck, possibilities

MP36. STEINER-LEMUS THEOREM

Ivan Valentinov Filipov
125th Secondary School "Boyan Penev", Sofia, Bulgaria

The main focus of the presentation is the Steiner-Lemus Theorem, which states that "Any triangle with two equal angle bisectors is isosceles" – an obvious statement accepted in schools without proof. The interest in the problem arises from the fact that almost all its solutions are reached by assuming the opposite. There are very few direct proofs of the theorem. Its brief history is also traced.
The development utilizes only basic geometric knowledge. For each discussed problem, there is a drawing processed with Geogebra and a link to its proof. The geometric variations of the statements are animated depending on the change in parameters. Several proofs by assuming the opposite of the theorem and one of the few direct proofs are included. Two other problems related to the theorem are also examined. One is its extended version, and the other is an analogue. The proof of the extended version of the Steiner-Lemus Theorem included in the presentation is without assuming the opposite. The way this version is formulated turns its proof into a second direct solution to the main problem.
The project is illustrated with original drawings. The scientific consultant for the project is Madlen Christova, a teacher at 125th Secondary School in Sofia, Bulgaria.
Keywords: Steiner-Lemus Theorem, angle bisector in a triangle, direct and indirect proof

MP37. THE JOKES OF INFINITY

Ivaylo Antonov Dragovski
125th Secondary School "Boyan Penev", Sofia, Bulgaria

In this project, we will take a look and discuss a couple of problems, connected to the term infinity. Some of the most popular so-called paradoxes connected to infinity are “The Hilbert Hotel” by David Hilbert and “The Infinite Monkey Theorem” formulated by Emil Borel.
The huge and always friendly hotel with an infinite number of rooms, thought of by the German mathematician David Hilbert, demonstrates infinity in the way that it can accommodate new and new people despite it already being “full”. We will exhibit this paradoxical idea engagingly and entertainingly. This paradox connected to infinity, is one of “the easiest” because it only uses natural numbers. “The lowest” level of infinity is the one of countably infinite sets, connected to the set of natural numbers.
Moving on, we will show how the hotel can accommodate as many people as there already are inside. We will also play with the different conditions and will show the entertaining part of infinity through a fun animation.
Furthermore, we are going to accent on the infinity of time, which will help us understand another analogical, at a first glance paradoxical statement – The infinite monkey theorem.
These two paradoxes illustrate the properties of infinity and how they contradict human thinking. It is hard for our limited minds to understand such an unlimited concept as infinity.
The presentation will be accompanied by an interactive poster, containing audio and video files, and interactive interfaces, that can be reached through QR codes.
Keywords: infinity, paradox, interactive poster
Scientific consultant – Ivayla Radkova,
a Mathematics teacher in 125th Secondary School “Boyan Penev”; Sofia, Bulgaria.

MP38. QUICK MINDSET

Kaloyan Danielov Geshev
125th Secondary School "Boyan Penev", Sofia, Bulgaria

I calculate quickly in my mind, without intermediate notes, numerical expressions ranging from the simplest arithmetic operations (addition, multiplication, division) to extracting approximate square roots with accuracy up to 8 digits and exact 18-digit cubic numbers. I can represent numbers as the sum of squares of four numbers, determine calendar dates within 1 minute, and more. These are just some of the areas I work on and compete in.
What makes it interesting is that I don't use visualization in these calculations. Instead, I train my mental abilities using mathematical formulas and methods that minimize the calculation processes. The human brain can memorize up to 8 digits at most, but with my method, I can handle a minimum of 10 digits. The speed of calculation in the human brain can be compared to that of a computer processor – around 60 bits/second. In the case of human computers, it can reach up to 80 bits/second depending on the operations performed.
I am a human calculator and one of the fastest individuals (I am a world champion in rapid mental calculations), but this makes me very different and often misunderstood. I am a smart and thoughtful boy who is learning how to use his mental advantages to be successful.
An interactive poster has been created, including specific information, training processes, and challenges, encoded through QR codes. The scientific consultants for the project are Madlen Christova, teacher at 125th Secondary School in Sofia, and Georgi Georgiev, personal coach.
Keywords: rapid mental calculation, human-computer

MP39. DIDO'S PROBLEM

Nikola Stanislav Vasilev
125th Secondary School "Boyan Penev", Sofia, Bulgaria

Dido‘s problem and the myth surrounding it are analyzed. The question of how to arrange already cut flexible fabric to enclose as large an area as possible is answered. It is proved that the shape that the fabric will form is a circle using 3 steps.
An experimental computer graphic is presented that can be used to simulate these steps and shows how the area increases after each one.
This approach not only finds an answer but also gives a problem but also provides a mathematical solution for the placement choice. Applications of this problem and others like it (called isoperimetric problems) are shown. Then some fun and practical challenges are presented. Finally, an interactive poster is displayed with a QR code that directs people to another document that has even more useful information and more ways to use newly acquired knowledge.
The consultant of the project is Teodora Vasileva, a student at UACEG, Sofia
Keywords: Dido's problem, isoperimetric problem, computer graphics, area of a shape

MP40. POLYHEDRA

Tsvetina Tsvetislavova Antova, Selina Alper Aleytin
125 SU "Boyan Penev", Sofia, Bulgaria

The project explores several polyhedra – the Cheshire polyhedra (1924) the Silasi polyhedra (1942), and the spidron (1956). Polyhedra are three-dimensional figures with straight edges, whose faces are polygons. The first two polyhedra are dual to each other and are topologically equivalent to a torus – they have a hole. Their exceptionally interesting construction not only makes them objects of mathematical curiosity but also reveals intriguing applications in various scientific and applied fields. The presentation traces the similarities and differences between them and the well-known tetrahedra. The spidron is a spiral triangular structure. Its specific features and construction conditions are examined, and the construction process itself is animated. Sectioning each of the three tetrahedra with a plane is demonstrated and analyzed.
The final product of the project is the creation of an interactive poster, containing specific information, the process of constructing geometric shapes, and 3D models encoded through QR codes (audio and video files, interactive applications). To emphasize the presentation to the audience, we will collectively structure a Cheshire polyhedron and a spidron using unfold models.
The scientific consultants for the project are Madlen Christova and Jasena Christova, teachers at 125th Secondary School “Boyan Penev”, Sofia.

MP41. MATHEMATICS AND AIRPLANE CRASHES

Petra Bušljeta, Gabrijela Kozelički, Anika Lučić, Nika Tomljanović,
Prva Rijecka Hrvatska Gimnazija, Croatia

Have you ever been on a plane? If so, you must have thought at times that the plane might fall. You know what they say, planes are safer than cars. Even though airplane accidents are not as common, their consequences can be serious, so it is important to raise awareness of the reasons they happen.
Before the plane takes of, it is crucial to make risk assessment and system reliability. Plane accidents can happen because of mathematical errors in the system. These errors can be huge, but even the smallest ones can cause a plane to crash. Accurate mathematical calculations can help keep airplane travelling safe.
In our presentation, we will present the statistics and probability of airplane crashes, calculate the angle of a falling plane and show real life examples where errors in mathematical calculations caused tragedies in plane travel.
Come with us on a mathematical journey filled with airplanes, flying and, unfortunately, falling. But don't worry, this one has no accidents!

MP43. UNRAVELING THE COASTLINE MYSTERY: A JOURNEY INTO FRACTAL GEOMETRY

Tsianakas Dimitrios Romanos, Pavlos Emmanouil Kontrafouris, Angelos Kosmas Lialios, Masouras Georgios, Mazonakis Georgios, Ioannis Georgios Papandreou
I.M.Panagiotopoulos School, Greece

In this paper we explore the Coastline Paradox, where mathematics, mystery, puzzles, innovation, and surprise converge in a harmonious blend. The exploration starts by following the historical route of paradoxes, tracing our steps back to Zeno, the pioneer in playing with paradoxes. The geographical backdrop of Italy serves as the contextual canvas, wherein we utilize the map of this nation to measure coastlines, each of us employing distinct units. Through that engaging hands-on activity, we unravel the complexities of coastline measurement and we discover the fascinating world of Fractal Geometry. We draw inspiration from Lewis Fry Richardson's invaluable clues. His insights into self-similarity, fractal geometry, dimensionality, and iterative processes have greatly influenced the mathematical framework we used in order to try and comprehend the paradox. The conclusion drawn is that the conventional methods of measuring geographical features, such as coastlines, may not provide a straightforward or consistent result. The Coastline paradox emphasizes the sensitivity of measurements to the chosen scale or unit of measurement, revealing that traditional Euclidean geometry is insufficient for accurately representing the irregular and intricate nature of natural features.

MP44. TRUTH OR DARE?

Ioannis Vogiatzis, Chara Pantazopoulou, Christina Logotheti, Michalis Ligkas Kaplanis, Kontantinos Kallergis, Pantelis Stefanou
I.M.Panagiotopoulos School, Greece

Imagine being in ancient Egypt and playing lucky games. Would you be able to win a Pharaoh? In this paper we will explore the mysteries of lucky games in ancient civilizations and we will reach out for the mathematics hidden in them. Have you ever wondered what the connection between dice and probability is? If someone asked you to bet in red after ten red numbers in a row would you do it? Before answering let us guide you through the law of large numbers. In our research we investigate the three courses of uncertainty in game. A player wins through some combination of chance, logic and bluff and most of times games of chance can be analyzed with the help of Probability Theory or Game Theory. Where would you bet? Truth or Dare?

MP45. ARE YOU A CHESS MASTER?

Ioannis Patelis, Kallirroi Politou, Polyxeni Nikolakopoulou, Nikolaos Kanellopoulos, Vasileios Foteineas
I.M.Panagiotopoulos School, Greece

When did humans first start playing chess? Have you ever tried to play Chess in a 2x2 or even 8X8 chess board? In this paper we will try to unravel the secrets of chess and the beauty of mathematics hidden behind them. We have analyzed the combinations and permutations someone might use in order to become a chess master. We came across a Retrograde problem (or retro, as it is more commonly called) where the solver's main challenge lies in reverse engineering the position he is given. Finally we have attempted to solve a mysterious chess problem where only knight take part. In other words in this paper we will prove that what Godfrey Harold Hardy said is completely true "A chess problem is an exercise in Pure Mathematics".

MP46. IS SUBTRACTION A LIE? LET'S DIVE INTO IT!

Alkinoos Alexopoulos, Michail Kallergis, Marilia Kazalaki, Alexandros Koutroumpis, Anastasia Bintza, Theodora Bintza, Georgia Tsatsaroni
I.M.Panagiotopoulos School, Greece

Our exploration aims to provide an answer to the intriguing question, "Is subtraction a lie?". Our idea is to consider negative numbers as partners in addition, making subtraction less confusing and more relatable. This new perspective showcases a unique approach to integers, operations, and their applications by diving into the depths of the sea and soaring into the sky. We utilize hands-on materials to create our own deep-sea landscapes, counting depths below the sea and heights in the sky. By extending this exploration into the sea and the sky, we aim to make mathematical concepts like positive and negative numbers more tangible. Additionally, we incorporate the coordinate plane to bring these mathematical concepts to life in a comfortable and engaging way. By reframing subtraction as a collaborative partner to addition, we aim to make negative numbers less complex. So, this exploration not only questions the nature of subtraction but also redefines it as an extension of addition.

MP47. ALL ROADS LEAD TO ROME: HOW MUCH MATH IS REQUIRED TO NAVIGATE US FROM ATHENS TO ROME?

Alkinoos Alexopoulos, Michail Kallergis, Marilia Kazalaki, Alexandros Koutroumpis,Anastasia Bintza, Theodora Bintza, Georgia Tsatsaroni
I.M.Panagiotopoulos School, Greece

This presentation explores the application of mathematical principles in travel planning, addressing the question: "How much math is required to navigate us from Athens to Rome?". We focus on geographical coordinates, graph theory, statistics, economics, and environmental impact. We will calculate Earth distances using simple geometry, map road networks with graph theory, and evaluate diverse travel routes. Economic considerations, including airplane fuel costs, are be detailed, and statistical methodologies leads us the most efficient route. Practical elements like currency conversions and time zone adjustments are incorporated. Accommodation costs are computed and environmental impact assessment, including airplane emissions and carbon footprint reduction tips, is highlighted. The model we are exploring extends to time management, encompassing flight hours and accommodation scheduling. Our conclusion emphasizes the eco-friendly, time-efficient, and cost-effective attributes of this mathematical approach, inspiring us, young minds, to view math as an invaluable tool for real-world navigation.

MP48. MEASURE WITHOUT A RULER: A HISTORICAL OVERVIEW AND COMPARATIVE STUDY

Maria Mixalakea, Aggeliki Mixalakea, Panagiota Mpasanou, Eleni Veroniki Gavriil, Alkmini Alexopoulou, Loukas Nikas
I.M.Panagiotopoulos Primary School, Greece

This paper explores various methods for measurements without a ruler, utilizing both the human body and everyday objects. A brief historical retrospective is presented, tracing the origins that led to the necessity for measurements without a ruler. Drawing inspiration from the works of Leonardo da Vinci and Vitruvius, we incorporate their contributions into our study. We conduct measurements both with and without a ruler and we introduce a hands-on approach to measurements, supported by numerical computation methods using hands. This is grounded in a study advocating that learning through hands-on activities and gestures is more effective. Finally, we explore non-ruler measurement methods in sports and architecture. This approach enhances the understanding of non-traditional measurement techniques and their viability in practical scenarios, contributing to a broader perspective on measurement methodologies.

MP49. EXPLORING PATTERNS TO UNDERSTAND NUMBERS: A MULTIFACETED APPROACH

Alkmini Alexopoulou, Loukas Nikas, Aggeliki Mixalakea, Maria Mixalakea, Panagiota Mpasanou, Eleni Veroniki Gavriil
I.M.Panagiotopoulos Primary School, Greece

This paper delves into the study of the properties of natural numbers, aiming to gain a deeper understanding through the exploration of patterns. By representing natural numbers in a articulate manner, we focus on the fundamental nature of prime numbers, considering them as the foundations of the natural numbers. To deepen our understanding of the properties of natural numbers, we embark on a historical journey through the realm of mathematics, drawing inspiration from Pythagorean numerical concepts. Throughout this research, we systematically seek patterns within the structure of natural numbers through original and multiple representations. This method allows us to delve into the intricacies of their structure and comprehend the ways in which they are formed. Ultimately, the discovered patterns aid in a more profound understanding of the structural characteristics of natural numbers, bridging the gap between mathematical concepts and real-world applications. Furthermore, the representation of these patterns leads to the creation of original works of art, showcasing the potential for mathematical concepts to influence and be expressed creatively across various domains. This paper presents a comprehensive approach that combines mathematical analysis of numerical structures with expressive representation, fostering a unique perspective for a deeper understanding of natural numbers and mathematics as a whole.

MP50. THE PROBLEM OF THE WORLD HUNGER

Nikolina Markovic* and Svetlana Rsumovic
High School “Sveti Sava”, Serbia

The problem of the world hunger is one of the biggest and one of the most dangerous problems in today’s world. Each day, 25.000 people, including more than 10.000 children, die from hunger and related causes. There is also the problem of thirst. More than a billion people do not have access to safe drinking water. More than half the population do not have access to adequate sanitation. At least 3-4 million people die every year of water related diseases.
During this presentation we will try to answer the question concerning what is the actual problem of the world hunger and the world thirst, what are some things that we can do to stop this.
These problems can be presented as one of the worst mathematical equations. We will show you that mathematics hides all the answers even the answers of the biggest problems that we all face.

MP51. JOURNEY THROUGH THE HISTORY OF CROATIAN SCIENCE

Laura Sabljak, Lea Tomak, Larisa Žeželj
Prva Rijecka Hrvatska Gimnazija, Croatia

Croatia is a small country with just 4 million residents but despite the size, you can often hear about numerous Croatian scientists who managed to leave their mark in the world of science. Through our presentation, we are going to talk about the most famous ones with a focus on their lives and important achievements in different scientific fields, such as mathematics, physics, chemistry, engineering, and more. First, we will place these scientists in a geographical network of Croatia with the display of the coordinates of the latitude and longitude of their birthplaces and also in the coordinate grid with the origin in the capital city Zagreb. The presentation will be composed as a journey through time and space. We also put. By starting in the hometown of the oldest scientist and then traveling chronologically through the birthplaces of other scientists, we will explore how long science has been a part of Croatian history. We will also calculate the air distance between the cities. Using the average driving speed, we will determine the time needed to complete the tour of Croatian science.
In this way, through mathematics, we aim to reveal valuable insights, demonstrating the importance of Croatian scientific inventions in a new and interactive way. Presenting these scientists will emphasize their impact and contribution to the development of science in Croatia, but also in the whole world.life.

MP52. A PLANNED SUMMER

Sirya D'errico, Davide Rota
ISIS "Europa", Italy

Mathematics is the science that allows you to analyze data, read graphs and make predictions. Who among us doesn't think about a summer holiday even when it's winter? It's still school time but this makes us dream even more because with mathematics we can plan our holidays in a safe way, with the certainty, or rather, with the greater probability, that we will find the ideal period for the well-deserved diving in the sea. With mathematics there is no "Medicane" that holds, the citizen who knows how to grasp the public services offered by the institutions and who appreciates the help of the models can reduce the margin of error and enjoy the good weather during holidays. The activity combines mathematics with civic education.

MP53. MATHEMATICS IN ANCIENT EGYPT: UNVEILING THE GEOMETRIC ELEGANCE OF THE NILE CIVILIZATION

Eleni Antoniou, Augoustina Theodoridou, Aggelos Kleanthous, Paris Zamboglou, Ermini Demou, Christina Christodoulou
PASCAL Secondary School, Lemesos Cyprus

Our project delves into the profound mathematical achievements of ancient Egypt, a civilization that thrived along the banks of the Nile River for millennia. The mathematical prowess of the ancient Egyptians was not only instrumental in the practical aspects of daily life, such as surveying and construction, but also played a significant role in the realms of religious symbolism and celestial observations.

One of the most remarkable features of ancient Egyptian mathematics lies in its pragmatic applications. The Egyptians developed a sophisticated system of measurement, using cubit rods and plumb bobs, which facilitated the construction of monumental structures like the pyramids and temples. Additionally, their advancements in geometry were evident in the precise layout of cities and agricultural fields along the fertile Nile floodplains.

Beyond practical applications, mathematics held a sacred significance in ancient Egyptian culture. Numerical symbolism was deeply integrated into religious practices, with certain numbers believed to possess mystical properties. The proportions and dimensions of sacred structures were often governed by mathematical principles, reflecting the Egyptians' spiritual connection with the divine.

Furthermore, the ancient Egyptians demonstrated a keen understanding of astronomy, employing mathematical concepts to predict celestial events and create calendars. The alignment of architectural elements with celestial bodies underscored the Egyptians' belief in the interconnectedness of the earthly and cosmic realms.

The legacy of ancient Egyptian mathematics endures as a testament to the intellectual ingenuity of a civilization that laid the foundations for subsequent mathematical developments in the ancient world.

MP55. WHY ARE MUSICIANS GOOD AT MATHEMATICS?

Nicoletta Vaki
The Grammar School, Nicosia, Cyprus

A sound is a vibration that propagates through a medium, such as a gas, liquid or solid. There are three types of sounds. Infrasounds which are below 20 Hz, audible sounds which are between 20-20000Hz and ultrasounds which are above 20000Hz. Humans can hear only audible sounds. Each sound has its own 5 characteristics: wavelength, amplitude, frequency, time period and velocity. These characteristics enable us to distinguish between different sounds. We can observe these differences by playing different notes in various musical instruments such as the piano, which also has a correlation with mathematics. The piano is one of the most popular musical instruments. It is claimed that is enhances students' mathematical performance by 40% and many believe that all pianists are good at mathematics. But why is this true? This is because it develops something called "practical intelligence", so the students learn how to recognize easier different patterns and therefore solve mathematical problems more effortlessly. In addition to that, listening to music can also help students achieve better grades in mathematics. This is due to the fact that both the left and right hemisphere is affected when listening to music and solving a mathematical problem, so the connection between them increases. This increases the chances for a correct result. In fact, this was the method that Einstein used when he couldn't solve a mathematical problem.

MP56. LIFE IN A BILLIONTH OF A NUTSHELL

Antonis Tymvios
The Grammar School Nicosia, Cyprus

Humans are amongst the most complicated organisms on this planet. With four functioning limbs, almost 80 organs and 206 bones, it is miraculous how all these abstract pieces seem to come together to form this masterpiece of a living thing. What drives this construction of our bodies? What brings together trillions of molecules to form a human capable of unfathomable actions? It would have to be something unbelievably complex, hidden well within our very bodies. However, something so crucial and complicated would surely not fit within a tiny body, right? Not quite. What if I told you that all the information needed to build all the cells that make up a human is compacted into a space so infinitely tiny it is just 1/20millionth of a grain of sand. Such, is the remarkability of the DNA molecule, and it is all made possible thanks to one of the most mathematically efficient structures of all time: the DNA double-helix. Helices are everywhere, simply as they permit us to store as much material as possible in a restricted space. Consequently, in the essential issue of storing genetic material in something as small as a cell nucleus, it is only logical that this space saving shape has been employed. By considering the size of genes and nitrogenous bases found along the length of DNA strand, it is possible to prove through volume analysis the true contribution of this shape to the human organism, and the shocking consequences thatcould emerge from a lack of it.

MP57. CAN YOU SPIN FOREVER? THE ART OF BALLET AND MATHEMATICS

Ourania Niki Shiaka, Laura More Charalampous
The Grammar School, Nicosia, Cyprus

“Leg higher, shoulders down, hold your core, straighten your back, spot!” This is the voice in every dancer’s head as they prepare to pirouette, again and again and again. But what is so significant about this misleadingly simple looking little dance move? Consider car wheels, airplane turbines, helicopter blades - what do they all have in common with a pirouette? They spin. Much less gracefully than a ballerina of course, but still; they spin. Engineers and inventors have taken inspiration from the capabilities of the human form since time immemorial, so imagine if a ballerina managed to spin forever. The implications would be endless. But is it even possible? If yes, how? As we try to answer this question, delve with us into the enchanting realm of ballet where science meets artistry, discovering that the perfect pirouette is a combination of many scientific principles which have to be tuned to perfection in the fraction of a second for it to work. There’s the intricate interplay of forces and moments, the conversion of energies as the ballerina plies, the angular momentum conserved in her leg and the center of gravity governing her posture. And these are only some of the factors a dancer hopes they can control to turn mere rotation to a mesmerizing spectacle. Other things like friction are at play too, which us mere mortals have no power over. So only maths, the unseen choreographer behind every swirl, will tell us; Can you spin forever?

MP58. CUDDLY KILLERS; CAN THE POPULATION OF STRAY CATS INFLUENCE THE ENTIRE ECOSYSTEM?

Mary Isabelle Tanousis
The Grammar School, Nicosia, Cyprus

That is the stray cat population in Cyprus. We have an estimate however, which places the stray cat population at about 1.5 million according to the island's largest newspaper, Cyprus Mail, but that is a rough estimate due to cats' ability to reproduce incredibly efficiently, meaning the population is probably larger than this number and will keep growing exponentially. However, we can use this estimate to visualise the impacts that cats have on the bird populations of different species on the island. By graphing the populations of barn owls, barn swallows and wood pigeons in France, England, Ireland, Scotland and Cyprus, and then overlay a graph of each country’s cat population we can clearly see the correlation of an inversely proportional population of cats to population of bird species per country respectively. Furthermore, we can create a food web for each of these bird species in Cyprus to see the roles that each of them plays in the island’s ecosystem. This shows us how important birds are in the island's biodiversity, but also for human wellbeing. For example, birds are seed distributors, pollinators and predators of agricultural pests and mosquitos; and in a country where desertification is its biggest threat in the next decade, mosquito-born disease is becoming more prevalent and agricultural yield is decreasing yearly, the decrease in bird populations isn’t just an animal crisis. No.
Now it’s a human one.

MP59. THE CLEVER OLD MAN AND THE RIVER

Qiyue Angel Wang
The Grammar School, Nicosia, Cyprus

All roads lead to Rome.
Nevertheless, different choices do matter with efficiency: more unnecessary efforts may be involved if the longer way is chosen with more time consummation. That is why everyone is trying to approach the shortest possible path to one's destination. Without any of the recent technology, can we still determine our best way to any destination by only mathematics? Do we need to try a mouthful of times to test every possible combination formed by the existing roads to decide if we must leave our house earlier?
Certainly NO – the concept of optimization can be applied. Remember the game we all tried in our childhood where you need to draw a house without lifting the pen (one-stroke puzzle)? Here also utilizes the same concept of Euler path: if any other way is chosen to be repeated, the perfect Euler path cannot be achieved. Multiple modifications and additions are discussed to be arranged into a specific pattern in the optimum position according to the concept of Heron's Shortest Path and the Chinese Postman Problem. By giving evidence to build up the proof for the shortest path, real life planning appears to be much simpler with an array of roads in front; By considering multiple factors, optimization helps to work efficiently instead of hard.

MP60. THE P-ADICS NUMBERS: A MATHEMATICAL JOURNEY

Titouan Roger
Lycée Français Charles Lepierre, Portugal

P-adic numbers, a fascinating branch of mathematics, diverge from classical real numbers, introducing a new field of research and discoveries. These figures, which appear as numbers with an infinity of digits after the decimal point, have a lot of hidden applications. In this presentation, I am going to present these how the P-adics give us an insight into another side of the mathematical world. What are the p-adics and what are they used for?
The goal of this presentation is to explain, in a simple way, the complexity of the p-adics. My presentation will be divided in four parts, each one delving a little further into the depths of mathematical concepts. The first one will be dedicated to defining useful terms and ideas required to follow the flow of the explanation. In the second part I will present the P-adics and their arithmetical properties, including basic operations. Next, I will use a practical example to show the applications of this issue. Finally, I will propose a little theorical course to close this talk.

MP61. COLOUR THEORY AND MATHS

Marina Mavros
Med High Private English School, Larnaka, Cyprus

Everyone likes art, whether they're an artist or not, art is always fascinating to look at for anybody. But making art is not as easy as the way you look at it. To create artwork an artist must consider what they will draw, why they will draw, what materials they will use, but the most important of all; what colours shall they use? No artwork is complete without the right palette after all.
About 40,000 years ago, people could witness shades of colours in the wild but people could not yet capture them, so a combination of chalk, soil, animal fat and burnt charcoal were mixed together with certain pigments that created the first colours for artists. Those colours included; black, white, yellow, red and brown. Up until today, people are still mixing together colour to create an endless list of a multitude of colourful shades.
In my presentation; Colour Theory and Maths, I will explain using mathematics how artists mix colours to get the right shades, using mainly fractions and ratios, and to do this I will most likely make my own equation to explain my theory.
In order to help my explanation I will also give a brief description on the basic primary colours; red, yellow and blue. The final part of my presentation will also include one or two paintings from any artists (not decided yet) and I will break down the ratio of the colours used in the painting, using the same methods that I will use to explain how to mix colours.

MP62. UNRAVELING THE DEPTHS OF COFFEE

Maria Karevina
Med High Private English School, Larnaca, Cyprus

Could you imagine that something you probably consume daily, and are completely unaware of its industry and side effects. The world's second richest export,coffee, along with the world's most consumed drug, caffeine. Can coffee be produced sustainably? What must happen to ensure a decent cup in the next century? Coffee requires a titanic amount of resources to travel from farm to cup,at least partially thanks to its massive carbon footprint, climate change could make it impossible to drink in another few decades. The shortest trip that a coffee bean travels from farm to cup in the US is about 1,000 miles. The total carbon footprint for Costa Rican coffee across its full supply chain is 4.98 kg of CO2 per kilogram of green coffee. For coffee to be sustainable, the process doesn't just have to get greener, it's probably too late for that. Instead, the industry must adjust to climate change. Did you know that Starbucks uses more than 8,000 paper cups a minute, which adds up to more than four billion a year. 1.6 million trees are harvested every year for all of those single-use cups. It may seem shocking, but an overdose from consuming too much caffeine is possible. The truth is that exposure to high or even deadly levels of caffeine is more common and happens more easily than you may expect. Caffeine stimulates the central nervous system—that's the jittery feeling—which can lead to agitation and ultimately cause delirium and seizures.

MP63. FRACTALS

Gracie Chalhoub, Yali Vaknin, Mykyta Kryvyi, Maria Gryshko
Med High Private English School, Larnaca, Cyprus

Mathematically speaking, fractals are an intriguing captivating phenomenon that unravel infinite complexities in seemingly infinite shapes that possess the property of self-similarity. The English word traces its roots to the Latin word 'fractus', meaning 'broken' or 'fractured' given that there are fractal components within each fractal. The sheer complexity of fractals is indeed intriguing, you would be fascinated to learn that these intransigently repeated patterns, regardless how zoomed in or zoomed out you are, look identical, and are found all around us in the most fascinating and unexpected forms. This includes but is not limited to coastlines, snowflakes, trees and even miniscule things such as seashells or the blood vessels in our lungs. We seek to disclose the fundamental ideas of fractals and demonstrate their profound significance in Euclidean geometry while highlighting their wide and remarkable effect across a variety of scientific fields. Mandelbrot, the discoverer of this phenomenon and the Mandelbrot Set Fractal will be explained in detail alongside the chaos theory and how it is implemented through fractals. Through this intricate journey into fractal geometry, we strive to not only unravel the complexities of mathematical patterns but also gain insights into the intricate and unpredictable nature of the world we inhabit.

MP64. MATH IN A HEART BEAT

Elis Raif, Shana Ghossoub, Sevgi Sokmez
Med High Private English School, Larnaca, Cyprus

Can math help us learn more about our body?
Yes, since we have been learning more of the depth of math, we've come across the factors of the human heartbeat and generally the human heart and have found how interesting the mathematical history behind it is since us humans ourselves experience these factors on a daily. This study essentially hances into the complex realm of human heartbeat dynamics engaging in advanced mathematical techniques to model and analysis compounded patterns inherited in cardiac rhythms. You may ask what formula you could use to figure out how many times your beats per minute. We have made a formula together which is 15(seconds you have to count to get your heart rate) multiplied 4 multiplied by X (the amount off times your heart beats per 15 seconds) which is approximately equivalent to your essential heart beat per minute.
-15.(4)x.x)- = heartbeat per minute

MP65. MATHEMATICS IN RHYTHMIC GYMNASTICS

Dariia Khudobiak
Med High Private English School, Larnaca, Cyprus

When you think of gymnastics, the first thing that comes to your mind are flips, uneven bars, beam and even Simone Biles. But let me stop you right there, because we are talking about a different type of gymnastics.
Rhythmic gymnastics is a combination of acrobatics and ballet. It is an all-female Olympic sport with two disciplines—group and individual performances. There are five apparatuses: hoop, ball, clubs, ribbon and rope. As well as exquisite apparatus work, the gymnast must provide elements of body difficulty in their routines. It is a sport of precision and accuracy.
In this project, I will dig into the mathematics in rhythmic gymnastics, by using graphs, algebra and geometry. To be more precise, I will identify certain shapes, angles, figures using my knowledge of mathematics and the sport. Circle theorems, Pythagoras theorem, sine and cosine graphs are some examples of mathematical principles present in this project.

MP66. HOW GAMES CHANGE YOUR LIFE

Ekaterina Lomakina
Med High Private English School, Larnaca, Cyprus

It is common for society to think that if you read dozens of books each weekend, chat with friends after a cup of espresso, or go to work each day in the office on the 20th floor, then you are a normal and praised human, but if you, for example, play Minecraft at least twice a week, than you are a dangerous marginal, who should come to their senses immediately, no matter how many good things you've done before. Are games as destructive for personality as they say? What if I say that games might improve your cognitive skills, such as spatial imagination and reaction speed, as efficiently as physical training and maximize your neural activity as well as self-confidence? What if I say that games may strengthen your teamwork skills just as well as the offline world? Would you believe me if I said that games found their use even in medicine as a motivator for patients to continue their fight against cancer or that they can help in curing Alzheimer's disease? Games aren't bad or good - it's about the way you use them, and if you use them wisely, they can change the world.

MP70. THE INEFFABLE OF ROOT TWO

Filoxenidis Stavros-Loukas
Doukas School, Athens, Greece

The purpose of this article is to record the history of irrational numbers in ancient Greek mathematics and to provide several different proofs of the irrationality of the square root of 2. One of the most important contributions of the Pythagoreans to the history of mathematics is the discovery that the diagonal of a square is an asymmetrical magnitude to its side. The square root of 2 was probably the first known irrational number. Specifically, the geometric interpretation of the square root of 2 is the length of the diagonal of a square with a side length of 1, which is proved by the Pythagorean Theorem. In this article, reference will be made to the fact that the discovery of the irrational numbers is attributed to the Pythagorean philosopher Hippasus the Metapontian, who according to legend was murdered for this revelation. As the proof given by Hippasus is not preserved, we will give an idea of its form according to Aristotle's records. Next, we will present various proofs, some using properties of integers, such as divisible, using number analysis into prime factors and the principal of the least. Finally, we will present the modern efforts to approximate the square root of 2 with as many decimal digits as possible.

MP71. CITYSCAPES AND NATURE'S SYMPHONY: THE UNATTAINABLE HARMONY OF BIOMIMICRY

Kounatidis Stavros, Kiosis Antonis
De La Salle College, Thessaloniki, Greece

Amidst the grandeur of urban sprawls, a subtle discord resonates—a reminder that despite our earnest attempts at biomimicry in city planning, the nuanced symphony of nature remains elusive. This essay delves into the intricate tapestry of cities endeavoring to emulate nature's genius, acknowledging the inherent challenges and limitations. As our urban landscapes aspire to embody the resilience and efficiency perfected by ecosystems, we confront the gaps and intricacies that persist, prompting a critical examination of the interplay between human innovation and the irreplicable finesse of the natural world.

Fully replicating complex ecosystems within urban environments presents a formidable challenge for biomimicry. While urban planners increasingly draw inspiration from nature to inform sustainable city design, creating artificial ecosystems that mirror the intricacies of natural habitats remains elusive. Natural ecosystems are dynamic, self-sustaining, and evolved over vast timescales, integrating a myriad of species and intricate relationships. Attempting to fully emulate this complexity within the constraints of urban development proves challenging, as human-made systems struggle to achieve the depth of interconnectivity and adaptability observed in nature. Nevertheless, efforts to incorporate biomimicry principles in urban planning continue to advance, focusing on enhancing biodiversity and sustainability, even if the complete replication of complex natural ecosystems remains an aspirational goal.

In our quest to emulate nature's symphony in city planning, we find that the elusive harmony extends beyond the acknowledged challenges. This exploration hints at myriad ways we fall short, underscoring the profound intricacies where human innovation continues to grapple with replicating nature's unparalleled mastery.

MP72. HOW THE HOUSE ALWAYS WINS: DECODING CASINO MATHEMATICS

Christina Trontziou, Theodoros Stefanidis
De La Salle College, Thessaloniki, Greece

The games referred to as "luck-based," whether inside or outside a casino, are not solely dependent on chance. Their outcomes are strongly influenced by the skillful use of mathematics to calculate probabilities and odds. When engaging in gambling, the theory of probability is always at play. Every bet made carries a chance of winning or losing, with the odds varying based on the events in the games. Games such as poker, baccarat, and blackjack often favor casinos, but a few people have uncovered ways to understand how they operate and even win in gambling using basic math. This presentation delves into the specific domains where mathematics plays a pivotal role, unraveling the secrets behind why, in the grand scheme of casino games, the house indeed always maintains its advantage.

MP73. NON-EUCLIDEAN GEOMETRY

Sofiia Andrusenko
9-V Class, Ukrainian College No. 272, Sheptytskogo, 5A, 02020, Kyiv, Ukraine

Among the Non-Euclidean geometries, Hyperbolic geometry and Riemannian geometry are of particular importance, which are most often meant when talking about Non-Euclidean geometries. Hyperbolic geometry is the first geometric system different from Euclidean geometry, and the first more general theory (including Euclidean geometry as a limiting case). Riemannian geometry, discovered later, is in some respects the opposite of Hyperbolic geometry but at the same time serves as a necessary complement to it. A joint study of the Hyperbolic and Riemannian geometries made it possible to adequately clarify the features of each of them, as well as their connections with each other and with other geometric systems. The work compares both Non-Euclidean geometries and Euclidean geometry.

In Riemannian geometry the axiom is accepted: every straight line lying in the same plane as a given straight line intersects this straight line. This axiom contradicts the system of axioms of Euclidean geometry with the exception of the axiom of parallels. Thus, the system of axioms underlying Riemannian geometry must necessarily differ from the system of axioms of Euclidean geometry not only by replacing one axiom about parallels with another statement, but also in terms of the remaining axioms.

MP74. THE FOUR-COLOR THEOREM

Victoria Avgoustinou, Iason Georgilidakis, Eleni Ioanna Maragaki, Regina Neroutsou
Europaiko Protypo, Athens, Greece

This paper first takes us to England in 1852, where a young mathematics student, Francis Guthrie, tries to color the map of the regions of England using 4 colors. The mathematical puzzle-problem, which first formulated by Francis Guthrie, concluded that any flat map, with any number of countries, arranged in every possible way, can be colored with a maximum of four colors, so that two countries, with a common border, have a different color. So, four colors are enough to color any flat map. This mathematical problem was originally a conjecture, which means a mathematical claim that had to be proven. This conjecture troubled mathematicians for years, without being able to prove or disprove it, that is, for several years it was characterized as an open problem. Through our paper, we will present historically how a mathematical conjecture managed to prove mathematically and become the Theorem of Four Colors. For more than 100 years, several mathematicians have tried to prove this with classical mathematical proofs. In the 1960s and 1970s, methods were developed to use the computer to verify mathematical theorems. Indeed, in 1976 the Four Color Theorem was finally proved by Kenneth Appel and Wolfgang Haken from the University of Illinois. They were helped by John Koch and his computer, which worked for many hours. The Four Color Theorem was the first major theorem to be proved using a computer.
Our paper focuses on the concepts of conjecture, theorem and acceptance of a mathematical proof using a computer. It also includes original map designs colored according to the Four Color Theorem.

MP75. PASCAL'S TRIANGLE

Antonis Karikas
Pierce- The American College of Greece, Athens, Greece

The main subject of this project is Pascal's triangle. A definition of it as well as its history over the passage of time are given. There are instructions on how to construct one, clarifications on how to refer to each term of the triangle and a formula to calculate any number based on its location on the triangle. A lot of the triangle's simple properties and patterns are presented but some harder-to-notice are going to be analyzed further such as its connection with mathematical concepts like the Fibonacci sequence, the Normal distribution, Sierpinski's triangle and the famous numbers and e. It is shown that it can be used to easily solve any combinations problem and to calculate probabilities of outcomes happening out of specific phenomena. It is also explained how it is related to the binomial expansion and a "guide" on how to expand any $(x\pm y)$ n using Pascal's triangle is included. Interactive demonstrations using online applications are also a part of the project.

MP76. THE BRIDGE AND THE FOUR GUARDS

Kougianos Konstantinos, Dimitris Vourlokas, Manos Daskalakis, Michalis Trakas
Erasmios Hellenic German School, Athens, Greece

It's a dark night. Four royal guards have been ordered to cross a bascule bridge which is about to close in exactly 17 minutes. They have an important message for the King. Unfortunately, they have only one torch with them which they are able to use and only two individuals can cross the bridge at the same time, because the bridge is quite old. It should be mentioned, at this point, that two of the guards are not what we can call fearless and they get scared easily. The first guard needs 10 minutes to cross the bridge, the second one 8 minutes and the third one 2 minutes. The fourth one needs only 1 minute, since he is the bravest of all! If they do not succeed in crossing the bridge on time, they will be captured by the enemy and the King will never receive the message. Find out the way that all four guards can cross the bridge safely, before they run out of time!

MP77. THE INEFFABLE OF ROOT TWO

Aspasia Natsoulidou, Nikolaos Armonis, Philipos Dendrinos, Athina Vouvouna
Erasmios Hellenic German School, Athens, Greece

The infamous band of the Daltons are at it again. But, as always, they are caught red-handed by Lucky Luke. This time, however, he decides to assign the brothers a challenge. If they succeed, they will be free to go. Of course, Luke knows that they are hopeless and they will never find a solution to his riddle. So he makes them stand in a straight line from the tallest to the shortest. They are all able to see the people in front of them but they should look at the same direction. Each of the brothers is wearing either a black or a white hat (they don't know the color of the hat they're wearing.) They don't even know the exact number of white or black hats. They are not allowed to speak to each other while standing, and aren't allowed to say any other word except for "white" and "black". They also can't step out of the line or turn their heads around. They are given 2 minutes before the challenge begins to decide on a strategy. The goal of the challenge is to guess the color of the hat they are wearing, and can make up to one mistake collectively. How can they ensure their freedom?

MP78. MORE THAN ENOUGH SNACKS

Magdalini Georgiadi, Maximos Edouardos Minopetros, Anastopoulos Filippos
Erasmios Hellenic German School, Athens, Greece

One sunny day three friends, Filip, Magda and Max decided to have a picnic together in the local park, so they brought some snacks with them to share. Filip brought 3 packets of snacks and Magda brought 5 identical packets. When Max arrived, he realised that 8 packets of snacks were enough for everyone to enjoy. However, he still wanted to contribute somehow. Therefore, he decided to offer his share in cash instead of providing some more snacks. After making some quick calculations, he thought that 8 Euros was the appropriate amount, so he gave this amount to the other two kids so they could share it. Nevertheless, Magda pointed out that 5 euros for her and 3 for Filip was an invalid amount of money, so they started brainstorming… What do you think is the ideal way the children should share Max's cash, so that everyone is satisfied?

MP79. MOSER'S CIRCLE PROBLEM AND PASCAL'S TRIANGLE

Aggelos Pandoulas, Dinos Papathanasiou, John Logothetis
The Moraitis School, Athens, Greece

Explore the intriguing pattern: 1, 2, 4, 8, 16, ... and delve into the unexpected twist when a student proposes the answer 31 instead of the conventional 32. Could such an abnormal answer be correct?
This presentation unravels the mysteries behind Moser's circle problem, a captivating puzzle that involves dividing a circle into numerous regions by connecting points on its circumference. The seemingly straightforward pattern of powers of 2 surprisingly breaks down, and solving the problem provides a fascinating explanation.
To tackle the Moser's circle problem, the presentation starts off determining the number of chords and intersection points on the circle. Using Euler's polyhedron formula, a pattern emerges that remarkably mirrors a well-known property of Pascal's triangle. The presentation then shifts focus to the versatile aspects of Pascal's triangle, also talking about its history and unveiling its connection to the solution of Moser's circle problem.

MP80. FRACTALS: DIMENSION AND PATTERNS IN CHAOS

Lydia Kratsa, Alexia Argyri, Danae Valtara
The Moraitis School, Athens, Greece

Everyone has, at least once in our lives, come across a "Decision Maker", this small magnetic board game that can take our decisions for us. Regarding the way the game functions, a simple explanation is that it is based on luck or fate. But, what if, in reality, there is a way to know beforehand whether the pendulum will stop on "Yes", "No" or "Maybe"? What if, behind this, seemingly based on randomness, game lies a whole mathematical theory?
In this work, we explore fractals, mathematical patterns that challenge concepts of Euclidean Geometry. More precisely, we review their history, nature and dimension and present their major applications in arts and various scientific fields, such as medicine and astronomy.

MP81. DECODING THE MAP COLOURING MYSTERY: A CENTURY LONG QUEST FOR THE FOUR-COLOUR THEOREM'S PROOF AND ITS FURTHER APPLICATIONS

Kiran Lavett
Pascal Private English School, Nicosia, Cyprus

What is the minimal number of colours needed to fully colour in a map without having colours share borders? It seems like an elementary level question; however, it took mathematicians over a century to produce conclusive proof. It started off as an innocent question posed by F. Guthrie, "Are four colours sufficient to colour any map on a plane or sphere?"
This question had gone through countless erroneous proofs, with the question evolving from maps to networks. The four-colour theorem's innate difficulty to prove led to influencing areas like computer science and graph theory.
My aim is to explore the extensive history of the proofs and theorems to find an effective way of proving this age-old theorem and exploring further applications.

MP82. FRACTALS UNVEILED: NATURE'S HIDDEN PATTERNS AND CHAOTIC SYMMETRY

Christiana Panayiotou
Pascal Private English School, Nicosia, Cyprus

Fractal geometry alters the way you perceive the world. You run the danger of losing your impressions of clouds, leaves, trees, and mountains from your early years. The understanding of these changes forever. For most of the fractals which appear in nature, smaller components are similar but not identical to the larger element.
The importance of fractals has rapidly frown since they reveal a consistency in physical and biological phenomena such as medicine, which were previously overlooked as random. Fractals provide a way to visualize and understand complex patterns that emerge from chaotic phenomena, therefore, making the effective tools in chaos theory. The butterfly effect which is the concept of chaos theory states that every small thing that happens in the world can have a huge impact in another part of the world.
In this presentation I will be exploring the concept of fractals, how they are formed, a few known examples such as Sierpinski Triangle, how fractals are found in nature and their applications in the world.

MP83. EGYPTIAN FRACTIONS AND METHODS OF WRITING A FRACTION, AS EGYPTIAN FRACTIONS

Nahal Mannani
Vagdard Skole, Copenhagen, Denmark

Ancient Egyptians used fractional numbers that all numerators of these fractions were equal to one and had different denominators. Because of this, these fractional numbers were known as Egyptian fractions. Today, these fractions have many uses in basic science and engineering. In this article, an attempt has been made to provide extensive information about different ways of writing a fraction in the form of Egyptian fractions.

MP84. PROVIDE APPROPRIATE METHODS FOR CALCULATING INFINITE FRACTIONS

Seyedeh Elisa Hashemi
Shahede Narges, Zanjan, Iran

Calculating the results of infinite and unfinished fractions has always been of interest to scientists of various sciences, because these fractions have very important applications in basic sciences and engineering. In this article, it has been tried to identify and categorize these deductions as much as possible. Then suitable solutions for these fractions will be provided. Results will be categorized for better use.

MP85. FINDING THE REMAINDER OF DIVIDING POWER NUMBERS BY A NUMBER USING MODULAR ARITHMETIC

Diana Mannani
Gxu, Copenhagen, Denmark

The remainders of the division operation have very wide applications in engineering and basic sciences. One of the computational problems is related to obtaining the result of dividing power numbers by a specific number. In this article, an attempt has been made to explain the rules of modular mathematics in a broad way. Then, the methods of obtaining the remainder of dividing power numbers by a specific number have been described.

MP86. PRESENTING A NEW AND CLASSIFIED METHOD TO FIND THE GENERAL SENTENCE OF NUMERICAL PATTERNS

Shayan Hasani
Iranian, Zanjan, Iran

Finding the general sentence of numerical patterns in engineering and basic sciences is very important. In this article, it has been tried to identify and categorize the numerical patterns first. Then, a new method should be provided to find the general sentence for these patterns. These numerical patterns include first and second degree patterns as well as power patterns

MP88. READ CHANGES: ANALYSIS OF LOSING WEIGHT ON A DIET

Mina Park, Minho Park
Saint Johnsbury Academy Jeju, South Korea

Reading changes is very important because it helps us to expect the future, can prepare the time ahead, is able to design the upcoming plans, and could even change the future. Changes also show up in our daily lives, such as when people are on a diet. We were curious why stagnation happens frequently on a diet. Because of that, we made a hypothesis which is that as time goes by, the amount of weight will decrease, we expect that lighter people need more energy. By using a running calorie calculator, we were able to confirm that our hypothesis is correct. To figure it out, we made a character named Sam (who was determined to go on a diet), and put Sam's age, weight, height, and running distance every single day. By the calculations, we could notice Sam's BMR and burned calories. Using that information we made a graph about Sam's weight changes, we could notice the reason why people stress out during a diet which is because of the changes of the BMR. After noticing why people stress out during a diet, we thought that we could use reading changes in other subjects to fix more problems about reading changes. After All, we learned that we could expect the future while reading changes. By reading change, we can design the future where we could grow much further.

MP89. WHY YOU CAN'T DEVIDE BY ZERO

Rok Felicijan, Jaša Stopar
SŠ Domžale, Slovenia

We were all thought that nothing can be divided by zero, but why is that? We have to look more deeply into the proof. Let's firstly look at what division really is. It's just counting up how many times you can subtract the devisor from the dividend where the number of subtractions is the quotient. As you divide by smaller and smaller numbers you get closer and closer to the infinity. For example, when you divide $1 \div 1$ it equals to 1, but when you divide $1 \div 0.1$ you get 10 and so on. You would think that $1 \div 0 = \infty$, because you can subtract 0 from 1 infinite-many times. But why is that not true? It's the same if you try $2 \div 1 = 2$ and $2 \div 0.1 = 20$ and you get closer to the infinity. So, if you equal $2 \div 0 = \infty$ and $1 \div 0 = \infty$ then you can equal both of the equations and you get $2 = 1$, which is most definitely not true. The second contradiction is when you try to divide with negative numbers. $1 \div (-1) = -1$ and then $1 \div (-0.1) = -10$ and as you get closer to 0 with the divisor, you get closer to the $-\infty$. You get two equations where $1 \div 0 = \infty$ and $1 \div 0 = -\infty$. Then you can equate it to get $\infty = -\infty$ which is also not true.

MP90. ZERO. THE MOST SIGNIFICANT NOTHING.

Nestoras Athanasopoulos, Ioannis Vergadis, Alexandros Dountsis, Ioannis Krasas, Spyros Xyropaidis
I.M.Panagiotopoulos School, Athens, Junior High School, Athens, Greece

In this presentation, we will attempt to approach the concept of zero and its significance in human history. We will embark on a journey, tracing the inception of zero and navigating through its evolution to the contemporary era. Examining its properties, we'll explore whether zero possesses a sign and if it falls into the categories of even or odd. Moving forward, we'll delve into the reasons why we cannot divide any number by zero except by itself, and through this, we'll touch upon the notions of infinity and limits. Towards the conclusion, we'll navigate through specific scenarios involving the limit of 0/0, unraveling the complexities that arise when attempting to determine the value of this mathematical expression. Through this comprehensive exploration, we aim to illuminate the multifaceted nature of zero and its profound impact on mathematical thought and reasoning.

MP91. THERE ARE 10 TYPES OF PEOPLE, THOSE WHO UNDERSTAND THE BINARY SYSTEM, AND THOSE WHO DON'T.

Michael Eirinaios Malavazos, Angeliki Tzifa, Ioannis Sklavis, Maria Karamitsa, Spyros Dimitris Farmakis
I.M.Panagiotopoulos School, Athens, Junior High School, Athens, Greece

In this presentation, we will explore fundamental numbering systems and investigate how they exist in human daily life, either facilitating it or posing challenges. Initially, we'll dive into the decimal system and other base systems, with a brief historical overview and insights into their development and adaptation over time. Next, we'll analyze the conversion processes between these systems. Conversion between numbering systems is a practical skill, and we'll examine techniques to transition seamlessly between decimal, binary and hexadecimal representations. Finally, we'll focus on the binary system, upon which all computer systems are based. We'll also present some problems that can be solved using this binary foundation.

MP92. FOOTBALL COMPLEXITY HIDDEN IN MATHEMATICS

Christoforos Kekkou, Giorgos Tsardellis, Konstantinos Skordis, Neofytos Neocleous, Antreas Miltiadous
American Academy, Larnaca, Cyprus

Everyone has an obsession, ours happens to be football. We thought football was just kicking a ball and running around, but our research has shown us that football is clearly based on mathematics and physics. In this presentation we are going to show how mathematics are connected with football and prove that without mathematics football would not be the same by providing various calculations and examples. Statistics are also used to show the chances of a team to win, draw or lose the game and also for making out the average of other actions in the game like offsides, fouls, corners and goals. Moreover, data is being reviewed from the coaches to provide past games' statistics which are utilized in a way that helps them predict how the opposing team will play.

MP93. GAMBLING MATHEMATICS

Elena Trapezanidou, Chrysa Alampriti, Constantina Zachario, Michalis Paraskeva, Notis Sakka,
Andreas Stavroulis, Giorgos Leonida, Konstantinos Kalli
American Academy, Larnaca, Cyprus

Gambling is elaborately tied to mathematics through probability theory, statistics and mathematical models. Odds in games of chance are calculated using mathematical principles, allowing both players and casinos to assess the prospect of different outcomes. Strategies in games like poker involve mathematical concepts, such as probability calculations and risk management. The application of mathematical principles provides a structure of comprehension and optimizing decisions in the uncertain environment of gambling. Through probability theory, casinos establish the odds for each game and determine the potential number of wins and losses for players. This mathematical foundation facilitates players to make informed decisions based on risk and reward. In this work, we explore fractals, mathematical patterns that challenge concepts of Euclidean Geometry. More precisely, we review their history, nature and dimension and present their major applications in arts and various scientific fields, such as medicine and astronomy.

MP94. ASTROMATH ODYSSEY

Martin Stanev, Stefanos Stylianou, Andreas Kyriacou, Dimitris Georgiou, Alexandros Pitsillides, Filippos Pratziotis, Antonios Ttantis
American Academy, Larnaca, Cyprus

Mathematics and astronomy work together like two atoms bonded together. They share a profound symbiosis, intertwining to unlock the secrets of the universe. Through this presentation our goal is to present to you how to calculate celestial distances and how to determine the size and shape of planetary orbits. This topic can also contribute to the prediction of unbelievable and shocking events such as eclipses. With mathematics, scientists can explain big ideas about the universe, like how it began and how galaxies change. For this reason, mathematics plays a significant role in the sector of astronomy. Scientists need to keep track of the data and its changes in order to enable them to construct the best possible rocket ships that will safely transport the astronauts in space. This construction includes a lot of calculations, a lot of shapes and a lot of dimensions since they need to construct a light and aerodynamic rocket ship that will easily enter space without any accidents. Mathematics and astronomy team up to explore space's secrets and learn more about our amazing universe. Just like that, through our presentation we are going to explore the variety of ways mathematics is connected to astronomy.

MP95. ROULETTE

Savvas Fragkeskou
American Academy, Larnaca, Cyprus

Roulette, a symbol of casino elegance, stands as a great example of mathematics in action. At its core, roulette works on principles of probability and statistics, branches of mathematics concerned with the predictability of certain events. The roulette wheel itself is kind of inspired from mathematical engineering, featuring 37(European version) or 38(American version) nearly arranged numbers that invite players to wager on a rich table of bets, each with mathematically determined odds. Every spin of the wheel is an independent event, meaning the outcome of one spin does not influence the next. This supports the concept of independence in probability theory. Players might use various strategies to win big, many of which are mathematical by nature. For example, the Martingale strategy suggests that after a loss, a better should double his bets on the same outcome to previous losses, assuming infinite wealth. This strategy, though pretty interesting is flawed due to the fact of house limits and the finite wealth of a player, revealing the harsh reality forced by mathematical restrictions. Thus, roulette serves as a classic casino game, full of strategies and mathematical truths highlighting the link between mathematics and the world of gambling.

MP96. WHY YOUR FRIENDS ARE MORE POPULAR THAN YOU

Maryam Shawki Mahmoud Daoud Soliman
American Academy, Larnaca, Cyprus

Knowing that humans are a naturally social species, it can be very important for us to interact with those around us. When we think of socialising and having fun, one word pops up in all our heads: “Friends”. Most of us greatly depend on our friendships. However, what are the links that determine the effects of friends and bonds on our local communities? How can we possibly use that to our own advantage, and to those around us? As usual, the vast application of mathematics can help us better investigate our social relationships. This leads to the ‘friendship paradox’, which not only states, but proves that your friends have more friends than you do, thus are more popular. This might be a hard pill to swallow, but it is a form of sampling bias and can be investigated just within your school, neighbourhood, or afternoon club. Nevertheless, it may be difficult to comprehend what is the importance of the friendship paradox in everyday life. The paradox has many pertinent advantages! Firstly, and most importantly, it allows us to track the infections within pandemics or epidemics and help immunise individuals by tracking the links and friendships of citizens. Moreover, it can play a big role in elections and advertisements, to help both track and manipulate the opinions and votes of individuals, leading to greater success. The friendship paradox is a very interesting aspect of mathematics, as it just proves to what extent maths can help shape and improve our everyday lives.

MP97. IS IT MATHS OR LUCK?

Eva Tofini, Arsinoi Charalampous, Evita Kouroumounou
American Academy, Larnaca, Cyprus

Mathematics and luck might seem like odd companions, yet they interact in intriguing ways. Math helps us understand probabilities which is all about predicting the likelihood of certain outcomes happening. And luck, well, that's all about chance and unpredictable events. From a mathematical perspective, luck can be understood as the result of probability and statistics. For example, lotteries are primarily games of chance, and mathematical principles like probability can be applied to analyze them. However, luck remains a significant factor, as lottery outcomes are inherently random. Strategies like selecting numbers based on frequency or avoiding commonly chosen numbers may have limited impact on improving odds. Additionally, winning the lottery is a life changing moment. But how do you win the lottery? Since a magical button is not available, mathematics remains the only tool to win. In the context of luck, probability theory allows us to quantify the chances of different outcomes in uncertain situations. For example, if you're playing a game of chance like rolling a fair six-sided die, mathematics can help determine the probability of rolling a specific number. In this case, the probability of rolling any particular number is 1 out of 6, or 1/6. By using mathematical calculations, we can also assess the expected value of certain events. Expected value is a concept that combines probabilities and outcomes to determine the average outcome over the long run. It helps us make decisions by considering the potential risks and rewards associated with different choices.

MP98. THE SYMBIOSES OF MATHEMATICS AND PSYCHOLOGY

Elina Chili, Daria Maksimova, Avgilina Kyriakidou, Katerina Efstathiadou, Kyriakos Marios Kyzouridis, Konstantinos Rossos, Margarita Paraskevopoulou
American Academy, Larnaca, Cyprus

Have you ever considered how a bunch of numbers and equations unravel the mysteries of the human mind? Mathematical psychology is a branch of psychology that explores how the application of mathematical techniques describe the psychological processes of the human mind. Another way that maths influences psychology is problem solving. Our brain, when trying to solve a problem, comes out with the best ways to deal with it. However, for a better response to any problem, you need data and this is where statistics steps in. Statistics also help in analyzing data from a psychological or social experiment. Moreover, psychologists use probabilities to see how well the human brain reacts to any challenge. Algebra is an important foundation in psychology. Even if it less emphasized it provides a better understanding of the complex mathematical concepts. These mathematical concepts also use formulas in order to measure IQ and perform types of intelligence testing.

MP99. MATHEMATICAL WONDERS OF NATURE

Lazaros Zeniou
American Academy, Larnaca, Cyprus

Mathematics are not only found in books and school but by looking around in nature you can find mathematics everywhere. Someone can easily see the fascinating relationship between mathematics and nature by carefully investigating patterns in both living things and non-living ones. To reveal the hidden order in nature, mathematical models are used to examine examples like the configuration of sunflower seeds and the complex designs found in honeybee hives. We can understand the mathematical aspects that contribute to the complexity and beauty of the natural world through the application of mathematical ideas like the Fibonacci sequence and geometric shapes. This presentation which combines biology and mathematics, improves our understanding of how living things function. It also emphasizes how important mathematics is for understanding and predicting patterns in the many landscapes of Earth. This presentation will highlight the fascinating connections between mathematics and nature, giving the complex environment we live in an additional level of excitement. And as Galileo Galilei said, "The universe is written in the language of mathematics, and its equations are the poetry of reality."

MP100. EQUATIONS OF ELEGANCE

Ellie Afxentiou, Mariam Kotzia, Panayiota Kyriacou, Polina Louka, Fotia Miltiadous, Antriana Nikola, Elisavet Papachristoforou, Maria Papaloizou
American Academy, Larnaca, Cyprus

Mathematics and fashion may seem like an unlikely pair, but they share a deep connection. Mathematics is fundamental in various aspects of the fashion industry, especially in design and production. Geometric shapes and patterns are crucial in creating aesthetically pleasing designs which rely on mathematical principles. Measurements and proportions, central to tailoring, involve mathematical precision to ensure the perfect fit. Additionally, mathematical algorithms play a role in the digital design process, aiding in the creation of intricate patterns and textures. Inventory management, supply chain optimization, and pricing strategies also heavily rely on mathematical models within the business side of fashion. Whether it's calculating fabric requirements, pattern scaling, or managing finances, math is an essential tool that contributes to the artistry and functionality of the fashion world, portraying a fascinating intersection between creativity and logic. As Yves Saint Laurent said "Fashions fade, style is eternal" meaning that while fashion trends may come and go, true style is something that lasts and never changes, just like mathematics.

MP101. FOOD IN EUROPE

Elena Andreou, Marilena Kakoulli, Myria Lambrou, Rebecca Mila Schulz
American Academy, Larnaca, Cyprus

Mathematics is intertwined with food in various ways. We will talk about the importance of mathematics in food since mathematics is something humans use every day and it takes a fundamental part in the world of food. It's in every corner of our lives and makes our life easier. For example, cooking involves precise measurements as well as adjusting recipes and ratios. Also, understanding temperature and time relationships is crucial for both baking and cooking. Overall, we want to establish that mathematics plays a huge role in both the production and the preparation of food. Moreover, exploring food from other countries is incredibly important because it allows us to experience different cultures and flavors. It helps us understand other cultures and different parts of the world in a deeper way. When we introduce new cuisines to different parts of the world, we develop understanding and appreciation for diverse traditions. In conclusion, our project will establish different mathematical concepts such as shapes, percentages, graphs, diagrams and ratios.

STUDENT PRESENTATIONS IN SCIENCE

SP1. A JOURNEY BEYOND: A ROCKETS FLIGHT TO OUTER SPACE

Antonis Christodoulou, Nicholas Christodoulou, Antonis Tymvios
The Grammar School, Nicosia, Cyprus

Scientists claim that we have only discovered 5% of the universe. There could be a whole world out there that we have yet to even theorize, let alone journey to and engage with. However, our planet is slowly transforming into a barren wasteland, soon inhospitable for the human race. Thus, one must question - where does our future lie? It is very possible that our future sanctuary is located far beyond the boundaries of our current knowledge of the universe. A myriad of Earth-like environments might be out there just waiting to be found. Using telescopes we can spot planets that have the potential to harbour life, but further tests need to be conducted on the very surface of the planet. In order to accomplish this, a rocket can be launched and directed to the planet, carrying a probe. Rockets are engineering masterpieces made to carry payloads through outer space, and to travel extremely far distances while conserving fuel to whatever degree possible. Despite their complex nature, the basic principles they use to function are relatively simple. By dividing a rocket journey into 3 phases, we can recognise the small goals of a rocket at each stage, and thus determine how it can achieve them. These 3 phases include: "exiting the atmosphere," "escaping Earth's orbit," and "cruising to destination." Crucially, rocket designers consider Newton's Laws to accelerate their rockets into the desired orbit, momentum laws for manoeuvre through space, aerodynamics and gravity assist to conserve fuel to the greatest possible degree.

SP2. AUSSIE AIRWAVES: RIDING THE PHYSICS WAVE OF BOOMERANG FLIGHT

Anastasia Pitsillidou
The Grammar School, Nicosia, Cyprus

Let's boomerang back to our childhood. A childhood with no fears, obligations, responsibilities but a hunger for play. Impatience running through our veins as we begged our parents to go outside and play with our boomerangs. Once we did, joy happiness and satisfaction wreathed us whole while dumbfounded by the magic of the boomerang. The return of the boomerang. However, is there an explanation for this? A boomerang is a curved throwing tool that is designed to return to the thrower. The unique shape and aerodynamic properties of a boomerang enable it to come back after being thrown. When thrown correctly, a boomerang follows a complex flight path known as the "returning boomerang effect." This effect is influenced by various factors, including the design, shape, and spin of the boomerang. The angle at which the boomerang is released, as well as the force and spin applied during the throw, all contribute to its flight path. Proper wrist flick and arm motion are essential for imparting the necessary spin and stability to the boomerang during its flight. Understanding these factors is essential for achieving the desired flight path and return of the boomerang. After all physics can be considered magical due to its capacity to unravel profound truths about nature, predict natural phenomena with precision, drive technological innovation, and explore mind-bending concepts that expand our perception of reality.

SP3. WHAT MAKES LIFE POSSIBLE ON A PLANET

Eva Toxqui
The Grammar School, Nicosia, Cyprus

Life beyond our planet has been questioned and debated about for centuries, by different disciplines and for different reasons. This has been an ongoing scientific debate, however despite the general pressumption that life does indeed exist beyond Earth there is still no proof to back up that statement. As our knowledge for the universe and life expands, though, new life-sustaining factors are discovered and new theories develop, it is more evident than ever that life could indeed be possible throughout the vastness of our universe. The work presented herein explores the key factors and conditions that make life possible, what made Earth the ideal planet for life, and whether/how these conditions can be met on another planet. It examines our current knowledge in astrophysics, in chemistry (especially the essence of water which is the core substance for life), and finally in biology (where the requirements for an organism to be considered a living are put under the microscope). The work delves into the complicated planetary characteristics on how these factors can be combined for the perfect conditions in order to create and sustain life beyond Earth.

SP4. UNLOCK LUCIDITY: A GATEWAY TO DREAM CONTROL

Anna Loizou, Andriana Charalambous, Markos Ioannou
The Grammar School, Nicosia, Cyprus

Have you ever wondered what it would be like to bend the fabric of reality, to explore worlds limited only by your imagination? Welcome to the enchanting world of lucid dreaming, where the question isn't "what if?" but "why not?". Why not turn your dreams into nocturnal adventures that are limited only by the boundaries of your imagination. Join us in an exploration of the boundless possibilities that unfold when dreams become not just a passive experience, but a conscious adventure.
The first step towards understanding lucid dreaming doesn't begin with questioning the Why but the How. Throughout this presentation we will be diving into the fascinating patterns that all our brains follow in a standard night's sleep cycle, as well as how to induce a lucid dream to an untrained mind. The potential is endless as progressive research on lucid dreaming opens doors to new psychological treatments in addition to orchestrating your own personal narrative all while getting a good night's rest. Even though lucid dreaming has been around long enough it's only received mainstream scientific recognition in the last few decades. After all, who doesn't want to hold their own version of reality in the palm of their hands.

SP5. THE STUDY OF EARTH'S MAGNETIC FIELD: IT'S PROPERTIES AND IT'S LINK TO MIGRATION

Maria Andrea Papachristou, Maria Dorzi
The Grammar School, Nicosia, Cyprus

Have you ever wondered how the migration of birds actually works? If there is a specific reason as to why animals migrate in the specific patterns that they do? Does it link to a bigger picture? Well, it does, it uses the earth's magnetic fields, in a concept called Magnetoreception. A simple concept such as the earth's magnetic fields can be used for something as important and complex as the migration of animals. The earth's magnetic fields aren't only used for migration, which cooperates the brains biochemical reactions mixed with electromagnetic induction but can also be used as a force field. This protects the earth from magnetic storms, that can come from solar winds and/or directly from the sun's magnetic fields. Solar storms can also intersect directly with magnetoreception as the earth's magnetic fields used by animals can shift causing a disturbance to their natural path of navigation. This disturbance can also be caused by the gradual ability of the natural shifting to the west of the earth's magnetic field over time. Scientists have also proclaimed from careful analyses that over the next 30 million years the earth's magnetic field will reverse. This poses the question of if this happened tomorrow what would happen to these animals using the magnetic fields as a tool for their migration. Consequently, making us question the challenges faced by migrating animals and their ability to reach their final destination.In this project, I will be discussing the effects of gut bacteria on our brain and how it stimulates the disease Ailzheimer. This project will also include researches made by different scientists on this topic.

SP6. THE FORMATION OF SEASHELLS IS IT RANDOM?

Stavros Larmou
The Grammar School, Nicosia, Cyprus

I'm sure we all have seen beautiful seashells at the seashore during our summer vacation, and as kids we used to collect them and take them home. Some of us even had a whole collection of seashells, each one being oddly unique. So, how are they created and how do they acquire that uniqueness? Molluscs are creatures that are firstly born without a shell, and create their own shell using their mantle, the organ responsible for secreting a fluid which creates the shells. Some molluscs do not even have a shell! The reason for that is still unknown, but it is believed that through natural evolution, some molluscs evolved and got rid of the shell, although the shell helps them by protecting them from predators and keeping their bodies warm and moist. Molluscs create their shell by following 3 main rules, which control how big, twisted and rotated the shell is. The mantle secretes the proteins at the shell opening, and by following these three rules the shell gets its own unique shape. The shape formation is mostly random, and each shell gets its own spikes, which are controlled by how easily the mantle secretes the substances, in other words how stiff the mantle is, and by the rate that the shell grows. Even though we think that shells take several shapes, in reality the shape is only one in all of the shells – a spiral!

SP8. SEISMIC IMPACT ON DIFFERENT BUILDING STRUCTURES

Aimilios Papasotiriou
The GC School of Careers, Nicosia, Cyprus

The movement of Earth's plates causes earthquakes, and the Pacific Ocean's Ring of Fire is one famously quake-prone region. These events frequently occur in countries like Indonesia, which is a part of the Ring of Fire. Investigating and resolving vulnerabilities there is essential. These earthquakes highlight the need for study and preparation because they not only cause significant financial losses but also endanger lives.
This study uses a two-part experiment to examine how various buildings are affected by earthquakes. First, we build several structures and measure the horizontal displacement of the buildings using the same frequency controlled vibrations similar to earthquakes. The strongest sample from the initial test is then selected, and is shaken once more using various frequencies vibrations. This allows us to observe how it responds to different earthquake scenarios.
The objective is to gain a better understanding of how buildings respond to earthquakes. The results may advise safety rules and provide useful guidance for constructing stronger and more durable structures, especially in seismically vulnerable places.

SP9. TASTING MOLECULES

Sotia Koukou, Konstantinos Patinios, Anastasia Stylianidi
The GC School of Careers, Nicosia, Cyprus

“Listen I have spent 4 years in high school learning Chemistry and believe me, all those hours spent doing homework and studying for tests have gone to waste. Look at me, I’m a chef, doing what I love without ever having to use those useless calculations I did back then” ... is what we heard the chef of our favourite restaurant telling a client. The thing is, she is wrong; VERY wrong. Chemistry and cooking are two very different and yet similar topics. All the “magic” happening in your kitchen which turns a pack of flour, a spoonful of chocolate and a pinch of salt into a tasty bite that feels like heaven for your taste buds; is called, chemistry.
We decided to investigate the ingredients in our favourite food ever. Cookies. Explaining the purpose of flour, showing the difference between baking powder and baking soda, investigating butter, eggs and many more ingredients is the main target of our project; connecting them of course, to the cookie recipe. We will show pictures of the chemical structures of the different ingredients and explain their different properties and impacts in food.
Didn’t you ever wonder why Chemistry plays such a big role when it comes to cooking? Or maybe why you love chocolate so much? Or why did your mom always tell you not to eat a lot of cookies because they are unhealthy? Well then... just wait to hear our project.

SP10. MASTER MANIPULATORS: PARASITES, THEIR EFFECTS AND IMPORTANCE

Kalia Lefkati
The GC School of Careers, Nicosia, Cyprus

A parasite is an organism which lives in another organism, known as the host. The parasite relies on the host for its survival by feeding off of its host, stealing any nutrients it consumes, and reproducing inside of it. The first interaction between a parasite and a host was 515 million years ago when a worm stole food from a brachiopod. Parasitic infections can affect all animals, including humans, and often harm them, sometimes even killing them.
Parasites are still only viewed as useless, disgusting, and evil. We often ignore their importance. Such an example would be their safer use in the place of pesticides. At the same time, the fascinating science behind their behaviour-altering effects on its host is dismissed.
This presentation dives into five examples of “mind-controlling” parasites – a wasp which changes the web design of its spider host, a fungus turning ants into zombies, a flatworm causing fish to dance, a protozoan creating risk-taking hosts, and a worm leading to suicidal crickets. Their lifecycles, morphology and mechanisms which allow them to manipulate their hosts are investigated, aiming to emphasize the significance of parasites, and specifically some of the positive outcomes of the actions of the behaviour-altering parasites, to change our perception of parasites, and understand their captivating intelligence.

SP11. EXPLOITING OXIDATIVE STRESS FOR NON-INVASIVE TUMOUR TREATMENT

Iolie Demetriou, Marileni Iacovides, Andriana Kyprianou
The GC School of Careers, Nicosia, Cyprus

The aim of the project was to investigate cutting-edge scientific advancements in non-invasive cancer treatment. Oxidative stress, an otherwise vital and highly regulated process within an organism, can be taken advantage of, leading to a high-precision medical treatment with astonishing results and prospects. Biological processes are exploited to deliver the medicine specifically to malignant cells and spare normal healthy cell populations decreasing side effects observed with many chemotherapies. Nanotechnology plays a significant role in engineering matter to the nanoscale allowing for the medicine to preferentially accumulate to the tumour site based on its poor vascular architecture.
The interdisciplinary nature of this treatment combines elements of nanotechnology, material science, biology, and chemistry to bring state of the art life-saving therapies. The chemical and biological understanding of redox chemistry and the metabolic pathways of cells allowed nanotechnology and material science to produce an entity that interferes with the normal redox cycle of the cell from the inside. A light-sensitive molecule, otherwise non-toxic, is administered. In the presence of light, a chain of reactions is initiated which produces radical species within the cell, sealing its fate. This disturbance of the cycle leads to damage of cell organelles and genetic information leading to its inability to replicate and eventually dying. The basic understanding of targeting particular cell populations within an organism will be explained along with current treatments under study making use of redox chemistry in the fight against cancer.

SP12. MAKING IONISING RADIATION VISIBLE

Antonis Pissarides
The GC School of Careers, Nicosia, Cyprus

This project will take you on a journey to understand radiation, the invisible force that is all around us. Radiation will be made visible and easy to understand in a live performance using a cloud chamber.
Firstly, the origins of radiation will be explained and then its effects on the environment will be discussed. An exciting part of this project is the cloud chamber, a special device used in physics. This makes the paths of charged particles visible, by creating small clouds along the way. It literally helps us see the invisible!
During the live demonstration, we use the cloud chamber to see how waves radiate, as well as their paths. This hands-on experience combines theory with the real world and helps us understand the important role radiation plays in our lives. In short, my project is an easy-to-use and fun way to study radiation. Using a high school made cloud chamber, to make the invisible visible and offer a direct view of the effects of radiation. Join me in my presentation to better understand the unseen forces shaping our world.

SP13. ROCKETS

Orfeas Marios Kladeftiras, Evangelos Pitsillis
The GC School of Careers, Nicosia, Cyprus

Rockets are projectiles that are propelled by ejecting gases derived from the combustion of solid or liquid fuels. The speed of rockets is determined, among other factors, by their size and the speed at which the gases escape. Rockets are used to deliver satellites in space, aiding communications and helping us explore what is out there.
To understand how rockets manage to reach high altitudes at high speeds we constructed our own experimental rocket by using a plastic bottle and added to it features like an aerodynamic front and stands that help it align prior to take-off. Fuel and combustion have been replaced with a chemical reaction that releases a gas which would propel the rocket in the air.
Understanding the chemical reaction occurring allowed us to investigate different amounts of the reactants. The aim was to achieve the highest altitude possible! The experiments involved the use of different combinations of baking soda and vinegar. The gas produced during the reaction was sealed in the bottle with a cork, pressure would build up and when the pressure was over a certain threshold the cork would be pushed out and the instant gas release would thrust the bottle in the air. The time taken for take-off and maximum distance travelled was our points of reference for redesigning our rocket. Eventually, our rocket exceeded the height of a two-storey house!
This project helped us understand why ‘rocket science’ is used to describe a complicated topic. Watch along to see them flying! (and us running away).

SP14. UNRAVELING THE AERODYNAMICS OF PAPER AIRPLANES

Angelos Christoforou, Theocharis Karatsiolis, Aris Papallis, Andreas Stylianou
The GC School of Careers, Nicosia, Cyprus

We will explore the fascinating world of aerodynamics as it applies to paper planes, digging into both basic and advanced concepts. Beginning with fundamental principles like lift, drag, and thrust, we gradually progress to more intricate aerodynamic phenomena. The study incorporates simulations to visually represent the complex dynamics of paper planes in flight, providing a hands-on understanding of aerodynamics.

Moreover, we will explore the application of formulas and statistical analyses to quantify the performance of different paper plane designs. By examining real-world scenarios and flight data, we will demonstrate how these mathematical tools contribute to optimizing paper plane efficiency. The synthesis of basic principles, advanced concepts, simulations, formulas, and statistics provides a comprehensive view of the aerodynamics of paper planes.

This research not only enhances our understanding of aerodynamics but also highlights the practical applications of these principles in everyday life. From designing more efficient paper planes for entertainment to drawing parallels with larger aircraft. The insights gained from this study offer a valuable perspective on the impact of aerodynamics in various contexts.

SP15. UNVEIL THE SECRETS OF SCIENCE TOWARDS A BETTER FUTURE

Maria Ioannou, Olivia Kattou, Antonia Kyriakou
The GC School of Careers, Nicosia, Cyprus

Genome represents the complete set of genetic material in an organism, and advances in biobanking, genomic sequencing and Genome Wide Association Studies (GWAS) and IT technologies have revolutionized our ability to decode and interpret this complex information.

Many diseases are the result of errors in the coding parts of genes and these can be detected with the above technologies. Such an example is microscopic haematuria, blood leak into the urine, with up to 1% of the population showing such evidence. In the presence of a family history of microscopic haematuria, the preferred approach is to perform a genetic test by analysing the DNA before the nephrologist attempts a renal biopsy, an invasive and risky procedure.

At the biobank.cy Center of Excellence in Biobanking and Biomedical Research of the University of Cyprus, we extracted DNA from peripheral blood samples of patients with forms of inherited haematuria syndromes, aiming to detect pathogenic variants (mutations). With the use of DNA sequencing, many pathogenic variants were identified confirmed with polymerase chain reaction (PCR) technique.

In some patients no responsible pathogenic variants were found indicative of the presence of other genes taking part in the disease. Whatever treatment would work for one group would not necessarily work for the other and genetic testing opens up the path to personalised medicine avoiding unncecessary delay to treatment and potential toxic side effects.

SP16. HARVESTING ELECTRICITY FROM PLANTS

Evalena Papadopoulou
The GC School of Careers, Nicosia, Cyprus

Electricity is essential to life as we know it today. Often, its production involves damage to the environment. We need the environment, without it, we would cease to exist. This is why new technologies have been developed such as wind turbines, solar panels, and hydro power. All of these alternative sources bear huge costs and take up vast spaces. A new investigation into generating electricity directly from plants, while the plant is growing, without harvesting the plant, yields promising results that add to the toolkit of green energy. The principle is that during photosynthesis, the plant produces organic matter excreted via the roots into the soil. Bacteria in the soil then oxidise the organic matter and release electrons. The electrodes used to harvest these electrons are made of carbon; stable and not harmful to the environment. All in all, a non-toxic, environmentally friendly battery is being built underground!

Currently, 16% of the population, 1.3 billion people out of 8 billion, do not have uninterrupted access to electricity, many not at all. By utilizing this new technology, electricity can be produced wherever living matter exists, providing electricity to remote communities whilst preserving the natural habitat.

SP17. TIME TRAVELLING

Marcos Pitsillides, Michail Kravets, Andreas Roderich Kyrykos
The Senior School, Nicosia, Cyprus

Many of you are time travelers and you might not even realize it. No, I'm not talking about futuristic gadgets. In simple acts like when you are walking, you are taking a small step into the future. This is called Time Dilation. It is the idea that as you move through space, time itself is measured differently for the moving object than the stationary object. For motion that is near the speed of light, this effect is noticeable and allows a way to travel into the future faster than we normally do. Let's say you get sent into space going at 99% the speed of light for 5 years. When you get back you will have travelled roughly 31 years in the future. You may wonder – how does this make any sense??? Let us explain it in more detail.

SP18. THE AMAZING WORLD OF 3D GLASSES

Ariel Makri Levy
The Junior & Senior School, Nicosia, Cyprus

Have you ever wondered how 3D glasses make movie characters seem like they're jumping out of the screen? This presentation is all about the cool science behind these glasses and what they might do in the future. 3D glasses work by tricking our brains into seeing depth. Our brains usually do this by combining the slightly different images our two eyes see.

The earliest 3D glasses used red and blue lenses to send different colored images to each eye (anaglyph glasses). But these weren't perfect – the colors looked weird, and the pictures weren't very clear. Then came polarized glasses, which use special lenses to send different light to each eye. These glasses made the images in movies look clearer and more colorful. Most of the 3D movies we watch today use these glasses. There's also another type called active shutter glasses. These are super smart glasses that quickly block one eye, then the other, in sync with the movie. This makes the 3D effect even more amazing, like things are really popping out at you.

But 3D glasses aren't just for movies. Imagine using them to learn in school, where you could see things popping out of a book. Imagine textbooks and educational resources enhanced with 3D elements, where students wearing 3D glasses can see diagrams, scientific models, and historical events come to life in three dimensions right off the page. And with virtual reality (VR), these glasses could take us to completely new worlds, mixing real and make-believe things together.

SP19. SPACE JUNK

Ioannis Episkopou, Roma Theocharides, Veronica Kalyvitou
The Senior School, Nicosia, Cyprus

This presentation provides a comprehensive exploration of the escalating issue of space junk and offers proactive strategies for its prevention. As Earth's orbit becomes increasingly cluttered with defunct satellites, spent rocket stages, and various forms of debris, the potential for catastrophic collisions rises, posing threats to operational satellites and manned missions alike. This presentation thoroughly examines the current state of space debris, underscoring the imperative for international cooperation in addressing this critical challenge. With a focus on promoting space sustainability, the presentation delves into technological solutions, including advanced tracking systems and innovative debris removal technologies. Additionally, it delves into policy recommendations aimed at fostering responsible space practices. By cultivating a collective commitment to space debris mitigation, the presentation endeavors to raise awareness and inspire actionable measures. The overarching goal is to ensure the long-term viability of Earth's orbital environment, thereby safeguarding the future of space exploration.

SP20. BREAK IT DOWN & RECONSTRUCT IT

Ioannis Ivan Symeonides, Matheos Gedeon, Polina Lebedeva
The Senior School, Nicosia, Cyprus

The mortality rate for awaiting a transplant organ is 17 people per day. Statistically, 1 out of 3 burn victims require flaps from the unaffected skin to heal, which get infected and dry out leaving nasty scars and possibly fatal infections. Our project proposes a new concept that can eliminate all these modern-day problems making us live safer and healthier lives, not for us individually but for everyone. The new method we propose is called decellularization and recellularization. These new innovative techniques are like magic tricks in the world of medicine, where an object (in this case tissues or organs from plants and animals) is made to disappear and reappear in a different form, wholly transformed. Imagine an old, worn-out house. Decellularization is the process of stripping it down to its bare framework, removing all furnishings, and leaving just the skeleton. In medical terms, this means taking an organ or plant or tissue of any kind and removing all its cells, leaving behind a scaffold - the organ's basic structure. Then comes recellularization, like refurbishing that house with brand new furniture and decorations, making it as good as new. Here, new, healthy cells of the patient or of meat are introduced to this scaffold, creating a fully functional replacement tissue or organ. Our project strives to revolutionise the world as we see it now creating a future with less pain and less health issues.

SP26. HOW DO AIRPLANES FLY?

Eleni Zantidou
The Grammar School, Nicosia, Cyprus

The human mind has always been fascinated by the concept of flying. It has been 120 years since the Wright brothers changed the world with their first Wright Flyer. Although technology has grown by leaps and bounds since then, the science behind flying has remained the same. Heavier that air flight is made possible by the careful balance of four forces: weight, lift, thrust and drag. For flight, the aircraft’s lift must overcome its weight, and the thrust must balance its drag. The lift acting mainly on the wings, enables the plane to fly. Many factors affect the lift force, such as the cross-sectional area of the wings and the angle of attack. Experts still argue about how exactly lift is generated. One way of explaining lift is through Bernoulli’s principle and the other way is through Newton’s Third Law. The thrust, from the engines propels the aircraft forward. Drag is the force opposing motion, thus reducing efficiency, and to minimize it, planes are as streamlined as possible. Furthermore, aircrafts have different designs depending on the force they want to maximize, which make them suitable for a specific function. During the flight, pilots can change several features to control these four forces. The purpose of this presentation is to explain the basic aerodynamic principles and how the forces acting on the airplane affect its movement, and how the shape affects the forces acting on it.

SP28. UNRAVELLING THE MYSTERIES OF STEM CELLS

Naomi Gerber, Odysseas Pavlou, Noa Phil
Med High Private English School, Larnaca, Cyprus

Since we were young, we have strived for breakthroughs in science, which would gift resolutions for humanity. Have you ever imagined the possibility of cells becoming any organ in the body? Sounds impossible right? Stem cells have the unique ability to divide and transform into different types of cells. They exist in the bodies of many living organisms and have the potential to develop into various tissues and organs.

Stem cells are remarkable cells that make them fascinating for scientific research, potential medical applications and studying them can be intellectually stimulating and awe-inspiring. Their unique properties, including pluripotency and the ability to differentiate into various cell types, have opened up new avenues for research and potential applications in treating various diseases and injuries.

In this project, we will be discussing: What are stem cells and the different types, Hierarchy of stem cells, Biotechnology behind stem cells, Impacts and improvements on humanity.

SP29. THE HEARTBEAT-CLOCK CONNECTION

Romy Haddad, Sofia Hadjikleanthous
Med High School, Larnaca, Cyprus

Unveiling the hidden ties between the beating of our hearts and the ticking sound of the clock, we find a deep connection as they both share a rhythmic quality that reminds of the fleeting seconds and the pulsating rhythm within us. Poets and writers have often used this phenomenon as a literary device to convey the fleeting nature of life, whilst doctors used it to find ways to preserve life; picture the heart, that mighty pump, orchestrating the symphony of our being, pulsating in harmony with the mysterious internal clock that measures the enigmatic flow of time. Moreover, the heart's cadence, beating a rhythm that ranges from 60 to 100 times per minute, its conductor the sinus node—a group of specialized cells generating electrical impulses, orchestrating the heart's captivating contractions and the symphony of life. And let us not forget the whimsical ticking sound of the clock, brought to life by an intricate dance of gears and springs. Together, these delightful heartbeats and tick-tocks remind us of the marvelous tapestry of existence and the playful passage of time.

SP30. MUNCHAUSEN BY PROXY

Olga Georgiou
Med High Private English School, Larnaca, Cyprus

Munchausen Syndrome by Proxy is a rare mental illness where a person repeatedly fakes disease, illness or even psychological trauma in order to gain sympathy or attention from others. Most victims usually lie about their symptoms, sabotage medical tests and even inflict harm upon themselves in order to obtain said symptoms. Victims are aware that they are fabricating, lying or trying to get attention, but they are unaware of the causes or reasons behind their behaviour. Research over the years has proved that most victims of Munchausen were either neglected, sexually abused, mentally abused or physically abused during their childhood, hence feeling a need to obtain a caregiver position to those they care about or their loved ones and to ensure the care and sympathy they never got as children, albeit harming their loved ones in the process. In this project, I will attempt to delve into the possible causes or triggers resulting in this disorder, as well as the impact it has on the victims. I will also be discussing the possible symptoms and biological aspects and factors that result in this disorder. Furthermore, I will be exploring one of the most famous cases of Munchausen by Proxy; Gypsy Rose and Dee Dee Blanchard. Along with the research on this case, I will also briefly be discussing the Nature - Nurture debate and a possible reason as to how and why victims obtain this illness.

SP31. WHAT LIFE LOOKS LIKE IN DIFFERENT BIOMES

Mohamed Ben Zerti
Med High Private English School, Larnaca, Cyprus

This Euro science project is about the variety of different factors which affect the development of complex interconnected ecosystems and displays the result of complex life being affected by those factors. The project will show the results of these factors and explain why certain ecosystems are the way they are. In order to achieve this this presentation will into deep detail into the exact concepts which affect biology. These things will be things such as surface area to volume ratio, nutrients, organ systems and multiple other fundamental biological concepts which are vital concepts for biology. The Presentation will also go into deep detail explaining ecology and connecting the things it said earlier about fundamental biological concepts and factors which affected ecosystems to explain ecology as a whole and explain biomes so that it can answer the question of what does life look like in different biomes. So, in conclusion the presentation will explain factors which affect ecosystems, fundamental biological concepts such as surface area to volume ratio, sexual reproduction and more and the project will explain complex interconnected ecosystems and connect its previous explanation for this. The presentation will do this to explain what life would look like in different biomes.

SP32. LYE AIN'T LIE

Sofia Arampatzi, Leonidas Giachanatzis, Efthalia Eirini Delistavrou
De La Salle College, Thessaloniki, Greece

It is well known that chemicals such as those contained in detergents used for washing clothes are a threat to our health. Some scientists believe that the use of detergents has caused an increase in asthma and allergies and prevents the healthy development of a strong immune system. We have therefore decided to study the consequences and propose ways to solve this phenomenon in order to protect our personal health, looking at statistical research and models provided by the scientific sector. Lye, chemically known as sodium hydroxide (NaOH) or potassium hydroxide (KOH), is an ingredient used in industrial and household products.

This inorganic compound is highly alkaline and caustic, known for its ability to react strongly with fats and oils, making it the most environmentally friendly washing agent. Specifically, lye is the ash water and is one of the most ecological approaches to cleaning ever invented by man. Rainwater is used for its preparation because it contains no salts or other added chemicals. In earlier times it was used to bleach clothes, but also instead of soap for washing.

Our experiment focuses on washing clothes using lye and aims to investigate the effect of lye, the strength of fabric fibres and the cleaning and fragrance of clothes. Before we begin, we will look at the washing instructions on the labels of the clothes to ensure its compatibility with them. Through this experiment, we seek to highlight the potential beneficial properties of lye in the field of laundry, offering a greener and more economical result in terms of cleaning clothes and personal hygiene.

SP33. WHAT OCCURS IN THE BRAIN OF A BULLY AND A SERIAL KILLER: A BIOLOGICAL PERSPECTIVE AND THE SIGNIFICANCE OF EMOTIONAL INTELLIGENCE

Nikoletta Chanoumidou, Aikaterini-Maria Tzika
De La Salle College, Thessaloniki, Greece

“Anyone can get angry—that's easy. But to be angry with the right person, to the right degree and at the right time, for the right reason and in the right way—that is not easy.” Aristotle, Nicomachean Ethics. Every day in the news, we watch incidents of escalation of violence in schools, heinous crimes in the immediate family environment, but also more widely in society. Desperation and rage are mounting and irrationality has taken the place of logic. This presentation aims to raise a reflection on how modern neuroscientific achievements regarding our knowledge of brain structure can be used to understand outbursts of anger and violence and much more to reveal the relationship between brain and emotions. Can neuroscientific findings help design emotional education programs that cultivate emotional intelligence, promote mental health, and help prevent school and community violence? In our presentation, we cite modern documented scientific data and clinical examples from everyday life and modern news, which demonstrate what happens in the complex mass of brain cells when we feel despair, hatred, anger, emotions that push us to lose control of our actions and ignore every moral imperative. It is not enough, however, to establish what is simply happening. If we deeply understand the interactions of brain structures in moments of anger and fear or even unspeakable joy, we open a way to see what we can do to control destructive emotional impulses and emotionally educate modern individuals. Finally, to return to the passage from the Nicomachean Ethics, which prefaces the summary of this presentation, we aim to demonstrate through neurological data that, perhaps, emotional intelligence is a more vital talent in life than our intelligence quotient.

SP34. COMPARE ELECTROLYTES IN ENERGY DRINKS TO FRESH AND CONCENTRATED ORANGE JUICE

Anthi Amanatidou, Fevronia Beli
De La Salle College, Thessaloniki, Greece

Energy drinks are becoming more and more popular in our society, especially amongst young people. This type of potable liquid full of sugar and stimulants is often consumed after a strenuous activity as a replacement for water or juice to keep the concentration of sodium balanced. More precisely, they are constantly advertised as a beverage that can instantly boost your energy levels and increase your stamina when it comes to exercising. However, a plethora of people are still wary of the effects of these drinks. Thus, we decided to carry out an experiment in which we will measure the amount of electrolytes in several energy drinks such as Hell, Gatorade etc., as well as the ones in orange juice both fresh and concentrated and later we aim on comparing the results of the assessments. This project will allow us to discover which of the drinks is the best choice when it comes to providing us with the necessary energy to complete an activity, seeing that the electrolytes are essential minerals that are required for numerous bodily processes. In simple words, they are the ones responsible for the energy boost one feels after consuming any energy drink or juice. The greater their content in a drink, the greater the effects on our body. In this experiment, we will use a combination of various materials and equipment, such as a digital multimeter, in order to find out which of the beverages is the most beneficial for the human body.

SP35. TIDE, AN IMPRESIVE NATURAL PHENOMENON

Victoria Vamvakari, Despoina Samara
De La Salle College, Thessaloniki, Greece

Nowadays, many people are worried about the fact that the sea level is starting to increasing dramatically due to global warming. Although, misinterpreting the right meaning of this situations can lead to wrong conclusions. That is one of the main reasons why we decided to study and prepare a presentation about tide in order to prevent possible fears and raise awareness about this natural phenomenon.
Tides are a natural phenomenon that occurs when the sea level rises or falls. More specifically, they caused by the combined effects of gravitational forces exerted by the moon and are also caused by the Earth and Moon orbiting one another.
The phases of tide are 2, the phase when the water is higher and the vice versa. The phase of the tide where the water presents the greatest "daily" height is called high water (h/w). On the contrary, the phase where the waters present the smallest "daily" height is called low water (l/w). The height difference between high and low tide is called range of tide. This can vary in places by up to 10 m.
Another interesting fact, is that the phenomenon of tides is closed related with the phases of the moon. It also slightly depends on the gravitational force of the sun.
Taking all the above into consideration, we are inclined to believe that tide would be an interesting phenomenon to analyze and present to our peers.

SP36. CREATIVITY AND MENTAL ILLNESS

Maria Ioanna Athanasopoulou, Aimilia Raditsi, Konstantinos Ntompros, Aimilios Oikonomidis
De La Salle College, Thessaloniki, Greece

Today’s world is the result of the interactions of certain personalities who have left their mark in history. Einstein, Tesla, Edison or even Beethoven, Chopin and Agatha Christie to name a few. Them as well as many more were the leaders of scientific, musical and literary fields, leaving a permanent mark. However, it was not a rare phenomenon for one of them to show some kind of specialty. Beethoven for instance used to compose his music while taking a bath. French novelist Balzac, was solely inspired from midnight till noon which resulted in him drinking up to 40 cups of coffee in a day. Due to the fact that Leonardo Da Vinci disliked sleep, he used to sleep for a quarter of an hour in four hour intervals. Subsequently, it has been really seen that intelligence and various types of psychological peculiarities are generally associated here and there. At the same time, studies have shown that people with mental disorders, like the aforementioned ones, tend to have low levels of latent inhibition. Thus, in this study we want to see the association among creativity and psychological or mental disorders while investigating the nature of latent inhibition and analyzing the effects it has on certain brain functions.

SP37. LiDAR TECHNOLOGY: UNVEILING THE DEPTHS OF PRECISION

Stavros Orestidis, Melina Triantafillou, Alexandros Manaos
De La Salle College, Thessaloniki, Greece

In a world with a growing energy crisis, South Koreans, faced by a need for optimized climate control, have adopted two popular yet contrasting strategies used in residential apartment rooms with modern HVAC systems, defined as intermittent and continuous. Both are intended to satisfy human thermal comfort parameters, while using the minimum amount of energy, effectively minimizing the cost of use. Intermittent control activates discontinuously, allowing for natural heat transfer between the room and the outside environment until the point that exceeds thermal comfort parameters, whereas continuous control operates uninterrupted, constantly adjusting for the heat transfer. In the context of this research, continuous control also includes the utilization of different set point temperatures at different times, such as during sleep, yet will remain on as long as the occupant is in the room. Previous case studies done by Tunçbilek et. al., Benakopoulos et. al., and Wang et. al. in Denmark, Turkey, and England respectively suggest that there was a significant decrease in energy usage under intermittent control. This corroborates the second law of thermodynamics and its entailing equations, which were also utilized to show less heat transfer ergo less energy usage under an intermittent strategy rather than continuous. As the rate of heat transfer varies under different types of insulation, research was also conducted under different types, thicknesses, and areas of insulation. To minimize energy and cost, this research concludes that an intermittent climate control strategy should be adopted.

SP38. ACTIVITY OF VITAMIN C AND OF ITS SUBSTITUTES

Pasmatzi Katerina*,Manola Sophia
De La Salle College, Thessaloniki, Greece

On the occasion of the third sustainable development goal of the UN “Good health and well being” which aims at the future international development of the world, we decided to focus on an issue of major importance: nutrition. For this reason, we study Vitamin C, scientifically known as ascorbic acid, which offers a plethora of benefits and as a result, it is an essential part of a balanced diet. More specifically, ascorbic acid is a critical factor for many processes of the human organism, such as antioxidant properties, participation in the composition of collagen, strengthening of the immune system, etc. Unfortunately, it is common knowledge that nowadays not only public health but also well-being are sacrificed to the output of profits. Some examples are genetically mutated foods and substitutes. Seeing that, we came to the conclusion that the experimental study of vitamin C with the passage of time, its quantity depending on the cultivation method and its content in various fruits and substitutes, is totally needed. In our project we will create a proper experimental setup to measure the content of vitamin C in various solutions. Based on our knowledge on related subjects (chemistry and biology) and conducting the appropriate literature research, this process is feasible and viable with the use of two compound reagents: iodine tincture usp, DCPIP. Thus, the measurement of vitamin C will be achieved with the maximum possible accuracy through the observation of its contact with the two reagents**.**

SP39. ANTIBIOTIC RESISTANCE

Vasilena Georgieva Chakarova
125th Secondary School "Boyan Penev", Sofia, Bulgaria

In this topic, we’ll be discussing some subtopics like: What is an immune system? What is an antibiotic? Groups of antibiotics and antibiotic resistance.
From the beginning of life bacteria were the first type of living organisms to inhabit earth. They are also the organisms which first learn how to evolve and multiply, therefore there’s a huge branch of biology especially separated for these species. Around us, there are many bacteria which are separated into two different groups – those that attack us and those which live everywhere. In other words, harmful and non-harmful the common names of different bacteria living in different conditions are called microbiomes. From differential microbiomes, there are differential consequences and everyone has its different systems for dealing. Everything started in the 20th century with the revolutionary creation of the first antibiotic called penicillin which helped scientists understand the immunity of cells, which later resulted in the creation of many different antibiotics. However, the more antibiotics made the more immunity of the bacteria grew and now scientists are trying to discover new alternative ways of creating new ways to cope with bacterial infections.
The scientific consultant for the project is Georgi Miloshev, a teacher at 125th Secondary School “Boyan Penev”, Sofia, Bulgaria.

SP40. SLIME MOLD

Lachezar Orlinov Ivanov
125th Secondary School "Boyan Penev", Sofia, Bulgaria

Slime mold grows mostly in damp places or rotten wood. They are similar to mushrooms in many properties but they have some differences. Slime molds can do some amazing things far beyond what you might imagine. They have been on our planet for billions of years before any plant or animal life appeared, with over 900+ species capable of living on every continent, including Myxogastria. The development of slime molds is quite similar to fungi, namely through spores that can sit for years in the soil, waiting for the perfect moment to continue their life process. What makes them special is their way of moving and their ability to handle complex tasks.
One of these tasks, for example, is to get out of a maze at the exit where food awaits them, remembering where they came from, regardless of whether they were repeatedly cut into small pieces or even to build an entire subway on a similar principle.
The scientific consultant for the project is Georgi Miloshev, a teacher at 125th Secondary School “Boyan Penev”, Sofia, Bulgaria.

SP41. CENTER OF MASS OF IRREGULAR POLYHEDRA

Tsvetina Tsvetislavova Antova, Selina Aleper Aleytin, Rumen Yulianov Rumenov
125th Secondary School "Boyan Penev", Sofia, Bulgaria

Our project is focused on finding the centre of mass of irregular polyhedra. One of the methods to determine the centre of mass is the barycentric method, where weights with equal mass are suspended at the vertices of the figure.
Finding the centre of mass is straightforward when dealing with a homogeneous body of regular shape, but it becomes more complex for non-uniform bodies or irregular polyhedra. How can we determine the point of application of the gravitational force to ensure the body is in stable equilibrium?
In our presentation, we have visualized the different steps with original video clips. To answer these questions, we will perform demonstrations together, requiring the following materials: scissors, a stand, non-extendable hemp threads, a small plumb bob, a marker, clay, and a knife.
We have developed an interactive poster with a QR code for additional information. Our project's scientific consultant is Desislava Chergarska, a teacher at 125th Secondary School “Boyan Penev”, Sofia, Bulgaria.
Keywords: barycentric method, irregular polyhedra, point of application, centre of massThe scientific consultant for the project is Georgi Miloshev, a teacher at 125th Secondary School “Boyan Penev”, Sofia, Bulgaria.

SP42. SMART WASTE MANAGEMENT

Khatuna.Artsividze, Tamta.Beridze, Nino.Birkaia, Tekla.Bandzeladze, Demetre.Artsividze, Mete Kilinc, Mahmoud Ala'a Mahmoud Tayyeb
American International School Progress, Tbilisi, Georgia

Nowadays, our planet is facing a number of important environmental challenges due to population growth, developed manufacturing industry and unsustainable use of resources. One of the most problematic issues is waste management.
An important challenge of our country is the reduction of waste so it is necessary to promote the separate collection of waste.
it is key to correctly present the mentioned problem to the society, especially to the next generation in order to realize their responsibility and their own role in it.
Such global issues are united in the subject STEM, where it is possible to benefit from the correct use of smart technologies. (SDG 9; SDG 11).
In connection with these issues, the project "Smart waste management" was implemented, which is focused on the SDG 12. Within the framework of the project, we discussed the importance and need of effective waste management. Students have conducted a study and determined that the older generation has less experience in waste management, 3R strategy and secondary use of resources.
The students decided to explore the structure of a waste processing plant and created a virtual waste processing plant on the visual programming platform Tinkercad.com.
At the next stage of the project, we created a smart trash can using an Arduino microcontroller, which automatically opens when approached, and this, among many other advantages, provides a product that improves hygiene standards. (SDG 6).
Finally, students created posters to promote waste management and introduced them to the school community.

SP43. THE EFFECT OF CLIMATE CHANGE ON GEORGIAN REGIONS

Helya Kamali, Petr Perekorenko, Lizi Tkebuchava, Aishwarya George Menachery, Rusudan Japaridze, Ilona Arutiniani
American International School Progress, Tbilisi, Georgia

Climate change denotes prolonged alterations in temperature and weather patterns. Since the 1800s, human activities, primarily the combustion of fossil fuels such as coal, oil, and gas, have emerged as the principal catalyst for climate change. Research by climate scientists underscores human responsibility for nearly all global warming observed over the past two centuries, with far-reaching consequences on health, agriculture, housing, safety, and employment.

Our study focuses on elucidating the impact of climate change on specific regions of Georgia, including Tbilisi and resort areas. In the context of sustaining winter tourism, we identify two crucial indicators: the duration of snow cover and its depth. According to OECD findings, a 1°C rise in the global mean air temperature is projected to elevate the snow line by 150m. Our presentation aims to illustrate the repercussions of climate change, particularly global warming, on our nation.

Georgia boasts a richly diverse physical geography encompassing mountains, plateaus, lowland plains, glaciers, wetlands, arid zones (semi-deserts), lakes, and rivers. Roughly two-thirds of the country is mountainous, with 20% situated at elevations of 2,000 meters or higher above sea level.

In addressing the challenges posed by climate change, we advocate for an immediate reduction in fossil fuel consumption and the resolution of industrial issues. Furthermore, we envisage the development of an application intended for every citizen of our country. This application will monitor individual activities, aiming to curtail personal contributions to climate pollution and foster a sustainable future.

SP44. ION THRUSTER

Kampanis Konstantinos, Maniotis Dimitris, Kalochristianakis Harry
Pierce – The American College of Greece, Athens, Greece

The project focuses on developing a small-scale ion thruster, an environmentally friendly propulsion system. Unlike traditional designs, it relies on the corona discharge principle instead of an ion gun. Utilizing 3D-printed parts, the thruster simplifies the process by using regular atmospheric air, making it cost-effective and easy to replicate at home. With no moving parts and minimal maintenance requirements, the thruster aims to contribute to greener and more efficient propulsion systems for future space missions. The goal is to assess its efficiency relative to conventional ion thrusters, marking a significant step in advancing sustainable space transportation. Current limitations and future applications will be discussed.

SP45. HOW A DIFFERENT FIELD OF GRAVITY CAN AFFECT A LIVING ORGANISM?

Charisopoulos George, Katsimichas Thalis, Lagogianni Foteini, Petropoulos Giannis, Vonatsou Nicole
Pierce – The American College of Greece, Athens, Greece

The gravitational field of the Earth is considered stable at a specific place. In this presentation, we will explain theoretical approaches on the effect of fluctuation of gravity on living organisms. The presentation is divided in several parts which cover certain organisms ranging from plants to humans and we will examine specific cases of how this theory can be applied in case one day humans expand and colonize different planets in which there are possibilities of survival and sustainability. Our survival will be decided by factors such as whether plants will be able to grow, so a sustainable source of nourishment can be achieved. Also, we will see how the human colonizers' skeletal and muscular structure will be affected in the distant planets and how their movement and everyday life will be changed. Moreover, the impact of a potential spaceflight on space-travelers will be examined. Additionally, the fact that space-travelers will constantly be in microgravity or zero-gravity environment will affect them physically (e.x. bone resorption).

SP46. HOW TO FIND WHICH BASKETBALL PLAYER CAN GO PRO?

Pavlos Minas Kotsis, Angelos Kyriakidis Mpimpas, Emmanouhl Koukos
Pierce – The American College of Greece, Athens, Greece

Many young players worldwide have the aspiration of becoming pro athletes in their selection. However, it is truly rare that any of them succeeds. As a result, it is extremely hard for coaches and managers to find which player will prevail and become a professional basketball player. Is there a way to examine if a young player (i.e., children) has genetic advantages to reach the peak of his/her professional life and play at the highest level of their sport of preference? Well of course there is! Our team has researched the biometrics of pro athletes (specifically basketball players), and the results are not disappointing. For us to find out which player has the biometric stats to go pro, we present in our study that is it possible to examine specific exercises that can be performed by children from the age of nine to fourteen need to perform to examine if a professional basketball career is possible. Through various exercises that young players perform, it is possible to indicate which players are ahead of their competition when it comes to physical strength/velocity/explosiveness. To conclude, even though it is hard for basketball coaches to select which players have the attributes to become famous professional basketball players, it is possible for coached and sport management professionals to examine the athletic background and specific future prognostics of a young athlete.

SP52. THE RACE AGAINST DRAG: THE ART OF PHYSICS IN FORMULA

Desislava Markova, Meriem Fereva, Valeria Topalova
American College of Sofia, Bulgaria
National Gymnasium of Natural Sciences and Mathematics "Academician Lyubomir Chakalov

While for many Formula 1 can be a fan sport or cars driving around in circles, for engineers those cars are much more than that. They are pieces of art that work so well they can almost redefine the laws of physics. In our research, we will dive deeper into the various tactics engineers use to defeat drag, or when needed – maximize it. We will look at how Bernoulli's principle is applied to almost every element of the car, explain why an F1 car is a plane flipped upside down, and explore the intricate dance between speed and resistance. We will also present the upcoming innovations to Formula 1 that are interconnected to advances in physics and reveal how they can soon be transferred even to the road cars we see everyday.

SP53. LOAD SIMULATION ANALYSIS ON VEHICLE-BRIDGE INTERACTION PARAMETERS FOR DYNAMIC AMPLIFICATION AND BEAM BRIDGE PERFORMANCE

Yoana Troeva, Svetoslav Ivanov
American College of Sofia, Bulgaria

This paper deals with the analysis of dynamic loads on beam bridges and the examination of the estimated numerical modeling through experimental 3D model testing. In particular, we evaluate the various characteristics of the vehicle-bridge system, including structure span, fundamental frequency, road stiffness, and roughness and gross load mass, that impact the dynamic amplification. The dynamic amplification factor (DAF) relates the dynamic performance of a certain load to its quasi-static performance. We could hence use it for the estimation of dynamic load allowance and the prevention of both bridge crack initiation and growth when reaching the fatigue limit. Moreover, in our study, we will consider various configurations of one, two, and three loaded vehicles that move with positive or negative velocities on the beam bridge. As a consequence, it is shown that the change in dynamic amplification for great values of the gross vehicle mass is almost negligible compared to the discrepancy gap between smaller weights, suggesting inverse proportionality between the DAF and weight. We compare our mathematical approximation of the dynamic amplification factor from the conducted simulated test trials with recently established data from previous studies and inspect the reasons for the discrepancy.

SP54. FUTURE UNDERWATER CITIES

Silvana Lia Aprile, Davide Rota
ISIS “Europa”, Italy

Italy and Europe are wonderful, and we personally love the seas that surround it. Cities located on or near the sea such as Venice, Naples and its splendid islands are unfortunately at risk and few know it, they are in danger precisely because of the sea and this leaves us dismayed. Obviously it's not his fault, just as it's never nature's fault. As usual, the cause depends on human activities. You will travel with us between the glaciers of the Alps and the Mediterranean Sea, but not only that, and we will discover what is happening to water in all its forms and together we will estimate the future of our coasts, in particular the Italian ones. For our purposes we will use satellite images to compare the evolution of the coasts over time but we will also use few glasses of water.

SP55. LESS SNACK MORE STEP

Fausto De Iesu, Sirya D’Errico
ISIS “Europa”, Italy

Nutrition education is not a science for professionals only, but it can already be learned at school in order to act consciously starting from the basic knowledge of STEM disciplines. Our parents, our friends, television, especially in commercials, continually mention the word calorie. But what exactly are we talking about? How much can a calorie really do? In our workshop we challenge you to think about how much work, walking and other things allow you to make snacks and how this energy, if used well, can help fight energy waste and the consequent pollution produced by urban mobility. If you know a little about equivalences and proportions, I will convince you to take a walk and leave the car in the garage.

SP56. DISCOVERY AND STUDY OF SOME BENEFICIAL BACTERIA AND FUNGI IN DAMBALKHACHO (MOLDY CHEESE)

Anastasia Matchavariani, Bagrat Kharaishvili, Ani Goduadze,
№63 Public School, Georgia

Dambalkhacho is a unique element of Pshauri life and culture. It is a variety of soft, moldy cheeses that have been made in the mountains since ancient times. Its history spans two centuries, it must have been widely spread in Georgia, particularly in Pshavi. Dambalkhacho is a secondary product of milk processing used as a new product. No mechanical and modern technologies are involved in its production. Today Dambalkhacho is prepared in two ways: as primary - from skimmed milk and as secondary - from curd left over from butter churning.

In 2014, the Georgian National Agency for the Protection of Cultural Heritage recognized the technology of Dambalkhacho as a monument of intangible cultural heritage. The research results have confirmed that the technology of making Dambalkhacho has no analogs. The biochemical composition of dambalkhacho mold has already been partially investigated. It has been established that the excessive content of cephalin, lecithin, and other groups of lyctids prevents cholesterol accumulation in the blood vessels and it has many other healing properties.

We have researched and studied the biochemical composition of dambalkhacho and discussed in detail the importance of its constituent chemicals for the organism.

The purpose of our research is to popularize the lame curd. In our presentation, we present the possible effects of the biochemical composition of dambalkhacho on the body.

SP57. BIAS IN ARTIFICIAL INTELLIGENCE

Leon Gkougkoulias
1st Gymnasium of Papagos, Greece

Artificial Intelligence has entered our everyday lives. Machine learning algorithms are extensively used by the government, by universities, in commerce and in traffic. There are solid cases of reported bias in many of these applications. The presence of bias in machine learning applications threatens the fundamental human rights, including but not limited to access to education and work, equality, freedom of speech and in some cases life itself. In order to understand bias in artificial intelligence the causes of it are investigated, whether originated from the human programmers and scientists or from errors and the process of developing a machine learning algorithm is analyzed. Then the potential for bias insertion either deliberately or accidentally in each stage starting with the collection of data, the model selection, the initial training and then the verification stage is examined via real case examples. Last but not least the case of having bias in the hardware itself is presented. Finally the solutions proposed by different stakeholders are taken into account, in order to make a proposal for the protection of human rights and in particular, the human rights of children and teenagers from bias.

SP58. THE FUTURE OF HUMANITY AND ARTIFICIAL INTELLIGENCE

Tevdore Namgaladze, Niko Firosmanis
American College of Sofia, Bulgaria
Saint King Tamar Gymnasium of the Patriarchate of Georgia

In the realm of modern science, humans stand atop the hierarchical ladder among Earth's living organisms. The pinnacle of human existence is attributed to development, driven by the extraordinary capabilities of the human brain. The boundless evolution of unique thinking skills, particularly creativity, remains a marvel not fully explained by science. As we delve into the 21st century, the forefront of human development is marked by the creation of electronic gadgets and the advent of artificial intelligence (AI). Coined by American scientist John McCarthy in 1955, AI is defined as a program or computer capable of human-like thinking and decision-making.

The landscape of AI has evolved significantly since McCarthy's initial definition, raising profound questions about its limits and potential autonomy. Concerns about AI development, its ability to exist independently of humans, and the prospect of replacing human roles evoke societal stereotypes and unfounded fears. The juxtaposition of innovation and caution becomes crucial, as the very advancements sought by humanity throughout history can potentially transform into destructive forces.

This discourse forms the core of our conference, centering on the development of artificial intelligence and its critical evaluation. Our presentation will unveil the findings of public surveys, shedding light on prevalent stereotypes and societal attitudes. Through a comprehensive exploration of both positive and negative facets, our objective is to address the pressing question: "Can artificial intelligence truly replace a human?" In this critical evaluation, we aim to navigate the delicate balance between progress and prudence in the pursuit of innovation.

SP59. THE SCIENCE BEHIND MENTAL DISORDERS

Gaia Nufusi
Levent College, Nicosia, Cyprus

The brain sends and receives electrical and chemical signals known as Neurotransmitters. Their job is to carry these messages from one neuron to the next. Billions of neurotransmitter molecules constantly work to keep our brains functioning, managing everything from breathing to our heartbeat to learning. These signals can get affected or even changed by a person’s emotions, mood and state of mind. This means that mental disorders such as depression, anxiety and even just having a negative approach for a long time can have a long-term harmful affect on those signals. By finding ways to possibly change the damaged neurotransmissions, we might be able to control a person’s mental health.

SP60. UNLEASHING POSSIBILITIES: OUR ROBOTIC ARM PROJECT

Denaxa Lida Maria, Sougiannis Anastasios Marios, Spyridakis Georgios, Tsakagianni lEfstathia-Ilektra
I.M. Panagiotopoulos School, Greece

The increasing use of robots is changing our world in many ways. Nowadays, with everything becoming digital, advancements in robotics and artificial intelligence are affecting businesses, societies, and our everyday lives. This paper explores how we designed, built, and used a DIY Robotic Arm. We worked together to make a working model using affordable materials and open-source technology.
Drawing inspiration from principles such as kinematics, mechanical design, control systems, and programming languages like Python and C our Robotic Arm is programmed to pick up objects, mimic some simple human movements, and even play a small part in our daily life. In this presentation, we'll take you through the step-by-step process of creating our Robotic Arm, explaining the creative methods we used.
Just like any project, we faced challenges. We'll talk about these problems in detail, sharing how we solved them. Plus, we'll tell you about our ideas for the future of our robotic arm, thinking about how it could be used even more and made even better.

SP61. UNLEASHING POSSIBILITIES: OUR SCHOOL VOICE ASSISTANT

Evangeliou Alexandra, Evangeliou Georgios, Giotis Orestis, Stavridis Marios, Stavroulidakis Antonis
I.M. Panagiotopoulos School, Greece

Starting with the importance of a voice assistant today, these handy tools play a big role in providing useful information. This paper takes a closer look at how a voice assistant works, unveiling the behind-the-scenes details that make it tick.
In today's world, creating a voice assistant has become surprisingly easy. Our exploration reveals how user-friendly tools and technologies make creating a voice assistant straightforward.
Our Talk & Learn project, based on Pythonic Simplicity, ensures easy interaction for all, enhancing the school experience. The modular design makes updates and maintenance a breeze, creating an efficient system.
Our School Voice Assistant does a bit of everything – answering school questions, cracking jokes, and keeping you updated on the weather. Join us in unraveling the details of voice assistant technology and discovering how easy it is nowadays to create your own.
Looking ahead, our goal is to make our voice assistant even better, expanding its language skills and knowledge base.

SP62. CARBON AROUND US

Silvana Lia Aprile, Fausto De Iesu
ISIS “Europa”, Italy

At school, as students, in physics and chemistry lessons, we often deal with the study of carbon and the structures it forms in nature, but we really understand its importance when together with our teachers we reflect on its presence due to wicked human conduct: the increase of the greenhouse effect and the consequent global warming. Fortunately, not far from our school there is a large public park where nature with its trees makes us feel protected and serene.
Do you know why? Do you know how much a single tree can capture excess carbon dioxide in the atmosphere over its lifetime? In this workshop we will learn to respect nature and understand how much it can help us against the negative effects that our ignorance entails.

SP63. THE GALILEAN TELESCOPE

Nadia Gharaibeh, Ghazal Hamdan, Maya Constantinou
Med High Private English School, Larnaca, Cyprus

Have you ever wondered how the telescope helped us learn more about space?
Thanks to the father of modern physics, Galileo Galilei, we are now able to learn more about our milky way. The Galilean telescope was named after him; constructed in 1609, his telescope used a combination of convex and concave lenses. His telescope was a refracting telescope, convex objective lenses were used to gather light and focus in order to present an image. This significant piece of history is displayed at the Museo Galileo in Florence, Italy. Moreover, this invention improved the magnification of distant objects, allowing Galileo to make astronomical observations. For instance, he was able to discover that four moons revolve around Jupiter, as well as seeing that Venus had similar phases to our moon (which related to how Venus revolved around the Sun). Galileo also worked on the mathematics of motion and conducted experiments to study the effects of gravity. His use of mathematics to describe and analyze physical phenomena helped pave the way for more advancements in physics and mechanics (which were further developed by scientists like Isaac Newton).

SP64. HOW CAN AIRPLANES FLY MORE SAFELY?

Chanmin Kim
Yongsan International School of Seoul, South Korea

People travel more often in airplanes in the modern era. I remember the first time I boarded on an airplane when I was two years old. I was afraid of falling off. Until now, I am still worried that a plane crash might occur whenever I travel abroad. Then, I came to wonder: how does a plane fly when it is so heavy? Is there any way to make airplanes fly more safely? I have tried to answer my questions by researching about it. I went to a library to read books about planes, and watched science videos online. Using the information from what I learnt, I have conducted experiments about how to fly airplanes more safely with styrofoam planes and plastic bag parachutes. To make a plane fly, a plane needs two main forces: Firstly, the force needs to make a plane go forward. To speed up, it needs engines and wheels. The wind goes inside a fan and the ignition machine inside fires up the wind. The hot wind makes the plane go forward by driving force of the air. Next, it needs a special force to go up which is called “Lift”. To be able to take off to the air, wings are helpful. The reason why the lift force makes the plane’s wings lift up is that there is a difference in air pressure. Air flows from high pressure to low pressure, when air flies backwards with the help of engine power, it flows faster above the wings because the shape of the wings is in streamlined form. Fast air-flow causes low air pressure above the wings. The bottom part of the wings has relatively high air pressure. The difference of air pressure makes the plane go up and that is called Lift.

$$Lift = \frac{1}{2}\rho V^2 C_L S\,,$$

(ρ = Air thickness, V = Air speed, S = Area of wing,CL = Wing shape)

A large percentage of plane crashes in the world happens when engines are not operating properly and start to slow down, which causes a plane to fall. To make planes fly safer, keeping the “Lift force” as much as possible and reducing the speed of falling would be necessary for the safety. According to the “Lift Formula” above, one of the factors that affects the Lift force is the area of wing. To understand further, I performed two experiments on how to reduce the speed of falling plane. Firstly, I attached plastic bag parachutes on the plane to make resistance to gravity. Secondly, I made wider wings to keep the lift force. Based on the result, I think the use of parachutes and wider wings may affect the falling speed of a plane. However, there needs to be more research about how to make strong but not too ponderous devices and how to make the most adequate size and weight of the dives are.

SP65. DARK ENERGY AND DARK MATTER

Kim Doyun, Kim Jiwan
O-Sung Middle School, South Korea

This study explores the revolutionary potential of dark energy and dark matter in advancing human progress. Dark energy, the force driving the universe’s expansion, and dark matter, enhancing gravitational forces within galaxies, hold untapped potential for technological advancement and sustainable energy solutions. Our research team aims to unveil strategies to harness these cosmic components for humanity's betterment. By compiling scientific literature, we identify promising methods endorsed by the scientific community. Dark energy, constituting about 68% of the universe, could be a game-changer in the energy realm. Unlike conventional power plants, including nuclear fusion facilities facing installation challenges and risks, dark energy offers an opportunity for more efficient and sustainable power generation. Beyond terrestrial applications, dark energy’s abundant distribution in space makes it a viable candidate for futuristic space travel propulsion systems. Dark matter, elusive yet promising, offers applications in enhancing semiconductor technologies and developing advanced medical scanners. Despite residing in the theoretical domain, these applications undergo rigorous scientific investigation, hinting at a future where dark energy and dark matter are integral to technological and scientific advancements. In conclusion, our study highlights the transformative role of dark energy and dark matter, paving the way for sustainable development and a new era of human advancement.

SP66. WHICH PAPER AIRPLANE WILL GO THE FURTHEST? PAPER AIRPLANES AND BERNOULLI'S PRINCIPLE

Gaon Lee
Shepherd International Education, South Korea

Flying is always exciting. Among the things that fly in the sky, the one we can most easily encounter is a paper airplane. I was curious about what shape of paper airplane would fly the farthest. Depending on size, material, and shape, which paper airplane will fly the furthest? I am going to compare three different shapes of airplanes in small, medium, and large sizes using regular A4 paper and Korean paper. I would like to measure and compare the flight distance according to each condition (size, shape). I am trying to determine the correlation between paper airplane flight distances depending on size and shape and find out which shape and size is the optimal paper airplane.
I also want to understand Bernoulli's principle through an airplane that never falls and how it can make a rear airplane take off. Through experiments with paper airplanes of various shapes, I will find out the correlation between the flight distance of paper airplanes depending on their size and shape, and even learn about Bernoulli's principle. By understanding Bernoulli's principle, I will learn how a real airplane takes off and how a paper airplane that never falls continues to fly.

SP67. THE MYSTERY OF VIBRATIONS: UNDERSTANDING RESONANCE

Donghun Park, Hyeonwoo Kyon, DongMin Lee
Osung Middle School, South Korea

Currently, resonance phenomena occurring in structures and mechanical systems arerecognized as important issues that negatively affect safety and performance. In particular, a deep understanding and effective response to resonance phenomena are urgently needed as damage and noise caused by these phenomena increase. This study aims to improve the safety and performance of structures and systems by understanding the principle of resonance and presenting practical and innovative solutions by systematically identifying its problems. Combining experiments and theoretical modeling to represent resonance phenomena, a precise analysis of resonance phenomena in structures and systems and an optimized solution is presented. Resonance occurs because the two frequencies coincide and the amplitude increases exponentially, destroying the system. Methods to prevent this include a tuning mass attenuator to balance the natural frequency by changing the material, a vibration insulation system to lower the vibration transfer rate, and a dynamic absorber to give force in the opposite direction. This study is an experimental and theoretical study based on understanding resonance phenomena in structures and mechanical systems. It aims to present practical solutions for improving safety and efficiency. Depending on the conclusion, stability, and efficiency can be embedded in buildings and various systems.

SP68. A STUDY ON THE FACTORS AFFECT THE QUALITY OF SLEEP

Jaein Ryu, Jungwoo Lee
St. Johnsbury Academy Jeju, South Korea
Uchon Elementary School, Seoul, South Korea

We started this study because we could not find why we were sleepy all day even though we seemed to sleep enough. Through this experiment, we learned about the factors of sleep that we can adjust to increase sleep quality and health most efficiently. We utilized the following 9 factors: the starting and ending time of sleep, elapsed sleep time, lasting time of sleep stages, numbers of waking up during sleep, and average heart BPM. Two authors, a 10-year-old male and a 11-year-old female, slept with a sleep-detecting smartwatch for 3 months and recorded the results on a google spreadsheet. We analyzed the data with graphs and charts to see which elements correlate with the quality most. We found two most important components that affect sleep: the time when we fall asleep and the duration of sleep. The best bedtime to get high-quality sleep for 10-11 aged children was 10:30 to 11:30 and the sleep needed to last for about 9 hours in order to have a good night’s sleep. In that time, the quality of sleep reached 80 out of 100. When the data was off that time, the quality of sleep dropped to about 60 to 70 out of 100. Many people think that sleeping for a long time would let you have better quality sleep. However, according to our research, too much sleep rather decreased the sleep quality. Additionally, there were other factors that affect sleep such as the sleeping startpoint.

SP69. WHAT HAPPENS WHEN MUSCLE GROWS?

Jimin Shin, Yuhyun Nam, Jiyul Lee
Cornerstone Collegiate Academy of Seoul, South Korea

Have you ever tried exercising? Whether you exercise or not, this research will answer some of your questions. We have always wondered about how muscle grows. Most people think that the muscles that are on the outside of the body grow after the recovery of the damaged parts. However, what about internal muscles? This got us questioning whether we can hurt our internal organs in order to make muscle growth. The first part of the research classifies muscle types and shows two types of muscle growth. In the big category of muscle, there are smaller categories such as voluntary muscle and involuntary muscle, and within those categories, there are skeletal, smooth, and cardiac muscle. Muscles grow either in hypertrophy or hyperplasia. Muscle growth entails damage in muscle.

The muscles are damaged while exercising and after some time to rest, the muscles repair and get bigger. But with the growth of the muscle, there might be pain within the growth. The major types of muscle pain are chronic exercise pain and inflammatory myalgia. It doesn't mean that the muscles will grow if you have muscle pain. The muscles can grow without muscle pain or with it. There should be a routine of exercising and eating, for the muscles to grow.

In the case of growing our muscles in a healthy way, consuming the right amount of protein can be helpful. The muscles are going to be damaged after exercising. Then, the muscles are going to start a cycle called the alanine cycle. This cycle can make a new type of protein like myosin, actin, alanine etc. Next, the damaged muscles are going to take in these proteins to make muscles stronger. People often exercise and want their muscles to grow. They should be able to consume enough nutrients that help their muscles to grow. Also, they will need the right information to reduce muscle pain and know how the muscles grow.

SP70. UNEXPECTED TRAVELER: VIRUS GLOBAL WARMING ALLOWS VIRUSES TO GO ANYWHERE AT ANYTIME

Luke Chae, Clara Choi, Elly Kim
St. Johnsbury Academy Jeju, South Korea

This research delves into the critical yet underexplored dimension of global warming: its amplification of virus proliferation, posing novel challenges to public health and safety. As global warming increasingly threatens our environment and health, understanding its influence on pathogen dynamics becomes imperative. Our comprehensive study is designed to examine the intensified effects of global warming on the dissemination of various viruses, with a specific focus on their transmission mechanisms and associated health risks. Our investigation categorizes viruses into three distinct groups based on their transmission vectors: airborne, aquatic, and those ancient viruses emerging from melting glaciers. We conduct an in-depth analysis to establish the relationship between escalating global temperatures and the heightened transmission of these viruses. The study's findings are alarming, revealing that global warming is a significant catalyst in the spread of viruses across all three categories. We observe a direct and robust correlation between rising temperatures and an increase in virus transmission rates. The results of our research highlight the dire need for immediate and concerted global efforts to combat global warming.

We propose innovative, community-centered strategies and advocate for global collaboration to mitigate the threats posed by climate change. By doing so, we aim to secure a more sustainable and health-secure future. This study significantly contributes to the ongoing global discourse on climate change and public health, emphasizing the urgency of addressing these intertwined crises.

SP71. UNVEILING THE POTENTIAL OF ARTIFICIAL SUNAND THE EVOLUTION OF ATOMIC THEORY

Daniel Chae, Hayun Park
St. Johnsbury Academy Jeju, South Korea

This study originated from a curiosity about the tiny particles of matter, the atom, and the exploration of its application to contemporary society. We researched the historical evolution of atomic theory and the development of an "Artificial Sun" through nuclear fusion and fission. The journey started with John Dalton in 1803 and progressed through other luminaries, including Erwin Schrödinger in the 1920s, reshaping our historical perspective for understanding the nuclear processes. We explored the history of atomic theory, tracing its development from the early 19th century to the 20th century. Commencing with John Dalton's Solid Sphere model in 1803, we navigated through J.J. Thomson's Plum Pudding Model in 1897 and Ernest Rutherford's discovery of the atomic nucleus in 1911. Advancements by Niels Bohr in 1913 introduced the planetary model, leading to Erwin Schrödinger's quantum atomic model in the 1920s.
Simultaneously, our objective was to answer this question: "How can the principles of nuclear fusion and fission be harnessed to create sustainable energy solutions like the Sun? Employing a scientific approach, we started with theoretical concepts of the Artificial Sun, followed by a comprehensive literature review and research on many applications in nuclear plants, desalination, and aerospace engineering.
Our study confirmed this chronological overview has significantly advanced our fundamental understanding of atomic structure. Furthermore, it demonstrates how the continuous evolution of atomic theory and the “Artificial Sun” in nuclear science, can be applied to various aspects of our lives, addressing essential needs in energy, healthcare, military, and beyond.

SP72. COLOR PERCEPTION AND LIMITS

Jaewon Lee, Yehryeng Hong, Seoyoon Moon, Hajoon Lee
Cornerstone Collegiate Academy of Seoul, South Korea

This research begins with a curiosity about how the main character, who is colorblind, perceives the world in the Netflix drama "The Glory." It explores the changes in visual perception and the limits of color based on the environment and characteristics of the subject. The study covers the definition of color and its fundamental principles, including the interaction of light with objects, and the processes of color perception. It addresses the evolution of vision due to environmental factors, the diversity of vision based on the subject, and the limitations in color perception due to the health status of the subject.
The first part discusses the definition and basic principles of color. This includes the interaction of light, molecular surface interactions, absorption and reflection, and cognitive recognition. This section provides a foundational understanding of how colors are formed and perceived.
The second part explores the evolution of vision due to environmental adaptation. It examines how various living beings have evolved their visual capabilities in response to their environments. Some species have developed other senses at the expense of sight, while others have developed advanced visual systems. This indicates a broadening range of color perception abilities among species.
The third part deals with the diversity of vision based on the subject. While humans typically perceive a wide range of colors through three types of photoreceptor cells, birds, with four types of photoreceptors, can see ultraviolet light and a broader spectrum of colors. This shows that even within the same species, there can be variations in visual capabilities.
The final part investigates the limitations in color perception due to the health status of the subject. Color blindness, an inability to accurately distinguish colors, can be congenital or acquired, and factors like retinal damage and exposure to intense light wavelengths can affect vision. This implies that the absence of certain photoreceptor cells can limit the range of perceivable colors. This study delves into the complexity and limitations of color perception as influenced by the environment, individual characteristics, and health conditions.

SP73. WHAT WOULD HAPPEN IF YOU FELL INTO A BLACKHOLE?

Tia son, Bella Yang, Aiden Kim, Tero Kim
Shepherd International Education, South Korea

We were curious about the phenomenon of blackholes in the universe and its effects on heavenly bodies. This exploration delves into the hypothetical scenario of what might happen if an object, or even a 4th grade student, were to fall into the gravitational pull of a black hole. We start with investigating properties of a black hole such as the event horizon, the invisible boundary separating the known universe from the unknown. The presentation then ventures into the surreal physics governing these cosmic entities, highlighting the mind-bending effects of extreme gravitational forces, time dilation, and an interesting process called spaghettification. Through engaging visualizations we unravel the fate of matter and explore distortions of space and time near a black hole. Concluding with implications for our understanding of the fabric of spacetime, the presentation encourages contemplation of the broader mysteries that black holes pose to the scientific community in present times. We hope to stimulate awe and wonder into our physical universe on the frontiers of astrophysics.

SP74. THE INFLUENCE OF TEMPERATURE ON VOLUME

Seojun Park
Branksome Hall Asia, Seogwipo City, Jeju-do, South Korea

This study was inspired by a curious observation while eating Jjamppong, a Korean spicy seafood noodle soup. I noticed that the wrap covering the bowl became concave, leading to an interest in why the wrap did not bulge despite the hot soup, but instead formed a concave shape. To explore this phenomenon, an experiment was conducted where hot water was poured into glass cups, and each cup was then covered with a wrap. These setups were placed in two different environments: one at room temperature and the other in a refrigerator.

Throughout the experiment, the changes in the shape of the wrap on each cup were continuously monitored and measured. The wrap on the cup in the refrigerator showed a more pronounced concave deformation compared to the one at room temperature. This observation was explained using Charles's Law, which relates the volume and temperature of air. The cooler temperature in the refrigerator caused the air beneath the wrap to contract more significantly, resulting in a more pronounced concave shape.

The conclusion from this experiment is that temperature variations significantly affect the volume of air, thereby altering the shape of the wrap. This finding has practical implications in understanding the behavior of air under different temperature conditions. It can be applied in various fields, including explaining why hot air balloons are able to fly and why bicycle tires become flat in winter. This simple experiment not only provided insights into a common everyday occurrence but also highlighted the importance of fundamental scientific principles in our daily lives.

SP75. THE PAPER AIRPLANE IS BACK!!

Seungjoo Lee
Shepherd International Education, Seoul, South Korea

The paper airplane is back! The way an airplane takes off into the sky and a boomerang comes back to the thrower is because of something called 'lift,' which is created on their wings due to a principle called 'Bernoulli's Law.' Despite the 90-degree difference in the wing setup between an airplane and a boomerang, this law still holds true for both. This means we can create a paper airplane that behaves like a boomerang by launching it vertically into the air. The path that the boomerang takes when it comes back can be influenced by the number of wings it has, whether two, three, or four. More wings result in greater air resistance, which makes the boomerang's path smaller. However, by adjusting something called the 'elevator angle' of the boomerang paper airplane, we can control its air resistance, which allows us to change the size of its flight path and how long it takes to return. If there's no elevator, it wouldn't return.

The less elevator there is, the less air resistance and the larger the trajectory. The more elevator there is, the more air resistance and the smaller the trajectory. If the elevator, length, and width are different, we can even create a three-stage boomerang paper airplane that returns in a specific order. By understanding Bernoulli's Law, we can launch multiple boomerang paper airplanes at the same time, creating a spectacular display with their different return times. So, Bernoulli's Law can transform a simple paper airplane into an exciting and educational experience!

WORKSHOPS

WS1A/1B. BLINKING LIGHTS: SOLDER YOUR OWN CIRCUIT

Deutschmann Bernd, Maier Christoph, Juch Nikolaus
Tu-Graz, Head Of Institute, Tu-Graz, Master Student, Tu-Graz, Bachelor Student, Austria

Our world would not be the same without electronic circuits. Mobile Phones, TVs, computers, etc., practically everything has electronics inside. Building a circuit by yourself is easy, and we will show you how. First, we will explain a little bit about all the different electronic components used, after which, we will start working with the soldering iron to create a small circuit, called astable multivibrator. Of course we provide help if needed. Hopefully everything works at the end, but if not, we are here to learn and make it work, like real engineers do, with patience and measurement equipment. Of course you can keep the circuit you have soldered.

Duration: 60 minutes each workshop (25 active students)

WS2. PEDAGOGICAL DIFFERENTIATION WITH THE MILAGE LEARN+ PLATFORM

Mauro Figueiredo
Universidade do Algarve, Portugal

With this learning platform teachers can create content for students and the digital portfolio of students is created automatically. It is possible to have tasks with different levels of difficulty which enhance pedagogical differentiation to improve student learning.
This app is supported by a pedagogical model designed to motivate students and promote active, student-centred learning, with greater autonomy and different learning styles in a gamified environment and with educational videos.
Students can learn by playing using the free MILAGE LEARN+ APP for mobile devices and for the web. This app is a learning platform to support students in the autonomous solving of problems implementing a pedagogical model that includes gamification, self and peer assessment.
With this app the student solves tasks with different levels of difficulty to win points for the ranking.
When the student solves the task there is available the solution for self-assessment and an educational video explaining it.
Students they can also assess the peers for revising the content knowledge and for the game.
Students can access educational content online or it can be used in the classroom.

Workshop for teachers

Duration: 60 minutes

WS3. PLAY TO LEARN WITH THE MILAGE APP

Mauro Figueiredo
Universidade do Algarve, Portugal

Learn by playing using the free MILAGE LEARN+ APP for mobile devices and for the web. This app is a learning platform to support students in the autonomous solving of problems implementing a pedagogical model that includes gamification, self and peer assessment. With this app the student solves tasks with different levels of difficulty to win points for the ranking.
When the student solves the task there is available the solution for self-assessment and an educational video explaining it. Students they can also assess the peers for revising the content knowledge and for the game.
Students can access educational content online or it can be used in the classroom.

This workshop is for students

Duration: 45 minutes

WS4. BEYOND THE CLASSROOM WALLS: EXPLORING VR IN EDUCATION

Kyriakos Matheou
Cyprus Mathematical Society

Nowadays there is an explosion of new applications that utilize artificial intelligence to improve our efficiency at work or use them in our daily needs.
Within the framework of the workshop, a selection will be made for the presentation of specific artificial intelligence applications with specific proposals for their use in classroom activities, or for preparation, organization, production of material by teachers or students.

Duration: 75 minutes

WS5A/5B. BEYOND THE CLASSROOM WALLS: EXPLORING VR IN EDUCATION

Vlasis Kasapakis, Professor
University of Aegean, Greece

Description: The workshop begins by introducing participants to the concept of Virtual Reality (VR) and the technology behind it, providing a basic understanding of what VR is, how it works, and the hardware and software that enable it. This involves discussing the hardware components like headsets, controllers, and sensors, as well as the software and networks that support VR experiences. Then, the workshop highlights the potential of VR technology in supporting the educational process by discussing how VR can be used in educational settings to enhance learning and engagement, including concrete examples that are currently being used. Finally, the workshop elaborates on the pedagogical aspects of including VR in education, its impact, and the benefits and challenges of incorporating VR into educational settings to transform the learning experience.

Duration: 60 minutes each workshop (25 Active participants)

WS6. CLIMATE CHANGE EDUCATION WITH GEOSPATIAL TECHNOLOGIES. THE STEAME APPROACH FOR MAPPING GLOBAL CHALLENGES

Prof. Dr. Rafael de Miguel González
President of EUROGEO
European Association of Geographers
Associate Dean for International Relations & CI Director
University of Zaragoza

The teaching of climate change is one of the key aspects of the new European Area of Education (Green Education), but also of many national curriculums of Geography in lower and higher secondary education. For an appropriate teaching of climate change, it should be based on scientific knowledge of climate data, and on the estimates made by the IPPC, and implementing inquiry-based approach strongly supported by geospatial technology.
Both premises, geographic science and geo-information, are, in turn, the foundations of the ArcGIS Dashboard “Teaching the Future”. It gathers impressive instructional resources based on a large number of climate data, the mathematical processing of which provides a spatial representation of the evolution of the climate in past decades, but also projections for the decades to come.
In this way, an educational plan based on the scientific approach (climate science, GI science) is proposed. The technological component of geospatial information is combined with the mathematical basis of the data represented, this being an outstanding example of the STEAME model for Geographical Education on Sustainable Development.
Teaching the Future believes innovative learning approaches afforded by citizen science can provide students with the tools to recognize complex macro-interactions of factors both on a local-to-global perspective. They should be able to make complex reflections on climate challenges, gain interdisciplinary knowledge, ranging from geography to STEM to humanities and language learning. Therefore, teachers should be trained how to embed scientific climate data and digital technologies in an interdisciplinary approach that makes connections between subjects and opens global perspectives.

Duration: 45 minutes

WS7. THE POWERFUL ROLE OF ENTREPRENEURSHIP INSIDE AN EFFECTIVE STEAME LEARNING ENVIRONMENT: THEORY AND PRACTICE ON REAL EXAMPLES OF PROJECT BASED LEARNING IN STEAME SCHOOLS

Yiannis Lazarou
Mathematics Teacher (STEAME education)
Pagkyprion Gymnasion, Cyprus

Could Entrepreneurship be the perfect "glue" to firmly bond all Sciences, Arts and Communication? An education approach that actively involves Project Based Learning is an effective way to provide students with hands-on experiences and develop a practical understanding of how their skills can be applied in the real world. This is a complete workshop on how to incorporate entrepreneurship into STEAME education using PBL as well as up-to-date examples of good practices currently applied in STEAME schools.

Duration: 60 minutes

WS8. HOW CAN WE USE LEARNING ANALYTICS TO IMPROVE MATHEMATICS UNDERSTANDING IN HIGH SCHOOL THROUGH STEAME APPROACHES?

Andreas Skotinos,
European Association of Career Guidance (EACG) and Cyprus Mathematical Society

Mathematics is considered a central subject to be studied in schools and particularly in high schools in almost all educational systems around the world. The reasons for this centrality may vary considerably but the consensus is that time and effort should be devoted to its teaching and learning. On the other hand, students have serious cognitive and affective difficulties with the topic, and they have difficulties in becoming competent at it and even if they succeed, many fail to see the point of studying it.
The importance of the subject of mathematics in school stems out of the centrality of its goals that include its role in cognitive development, logical reasoning and problem solving, its interdisciplinary understanding, its support for functional thinking and applications, its contribution to collaboration and thinking and its active role in connecting human needs and activities to the real world. In this context it is an important constituent of the STEAME approach.
In this context it is crucial to develop approaches that will help in identifying strengths and weaknesses in understanding the subject of mathematics in a learning process involving the STEAME approach. In recent years a basic tool supporting this idea are the learning analytics. Learning Analytics (LA) is a field that focuses on collecting, analyzing, and reporting data about learners and contexts in which learning occurs. Thus the partners in the learning process have the possibility for a broad range of information relating to both to the learners as well as to the facilitators of the learning process for purposes of optimizing and understanding the learning environment in which it occurs. He
In the workshop the participants will have the opportunity to consider the various issues that are the concern of the question leading to the present workshop, i.e. “How can we use learning analytics to improve mathematics understanding in high school through STEAME approaches?” Furthermore they are expected to consider the goals and objectives that would be the object of the workshop, they would get an introduction to what Learning Analytics is and use it in a range of activities around the question. Finally they would have the opportunity for reflection and discussion on the issue.

Duration: 45 minutes

WS9. BEST MATH STRATEGIES FOR FOSTERING CREATIVITY

Valentina Gogovska
UKIM, Faculty of Natural Sciences and Mathematics-Skopje, North Macedonia

This abstract delves into optimal strategies for cultivating creativity within the realm of mathematics education. It investigates pedagogical methods that go beyond rote memorization, emphasizing problem-solving, using tasks which could be solved with different ways, exploration, open-ended tasks, tasks with generalization and real-world applications. By fostering an environment that encourages curiosity and divergent thinking, educators can effectively nurture students' creative mathematical abilities. This research aims to identify and highlight actionable approaches to inspire a new generation of mathematically creative minds full with long-lasting structural knowledge and deep understanding. The proposed, completely solved tasks will encourage students to think, practice, and gradually acquire structural and permanent knowledge.

Duration: 45 minutes

WS10. TRIANGLES AND QUADRILATERALS – SOME OF MY FAVORITE PROBLEMS

Robert Geretschläger
President World Federation of National Mathematics Competitions (WFNMS), Austria

There are many wonderful properties associated with triangles and quadrilaterals. Some, like the Pythagorean Theorem or angles in a cyclic quadrilateral, are standard material taught in classrooms all over the world. Others, like the Nine-Point Circle or the Butterfly Theorem are perhaps not known as widely, but still quite familiar to anyone preparing for competition mathematics. Then there are others that are just as pleasing aesthetically, but perhaps not so widely known. In my presentation, I would like to present some of my favorite properties of this type. All problems will be presented with full elementary solutions, using only standard Euclidean tools.

Duration: 45 minutes

WS11. GENCRAFT AI IMAGE GENERATOR

Georgios Tzachristas
Student, National Technical University of Athens, Greece

Gencraft is an innovative online platform at the forefront of AI image generation, providing users with the ability to transform text prompts into stunning visual creations in their preferred style. This cutting-edge tool leverages advanced artificial intelligence algorithms to generate images that align with the textual descriptions provided by users.

The platform's user-friendly interface allows individuals, whether they have a background in AI or not, to seamlessly navigate and harness the power of AI for creative expression. Users can experiment with various styles, offering a versatile range of artistic outputs, from realistic to abstract, depending on their preferences. Gencraft's capabilities extend beyond mere image generation, fostering a dynamic environment for creative exploration.

In an educational context, Gencraft stands as an exemplary tool for showcasing the intersection of language and visual arts within the realm of artificial intelligence. By presenting Gencraft in a workshop, participants can witness firsthand how the platform translates textual input into visually captivating images, providing valuable insights into the potential of AI in the creative process.

Moreover, Gencraft opens doors to discussions on the ethical considerations surrounding AI-generated content, inviting participants to explore the implications of such technology in various industries, from art to design and beyond. With its user-friendly interface, diverse styling options, and potential for sparking insightful discussions, Gencraft serves as an engaging and accessible gateway to the world of AI-driven image creation.

Duration: 45 minutes

WS12. PROJECT-BASED LEARNING STEAME ACTIVITIES FOR STEAME SCHOOLS

Eleni Papageorgiou, PhD
Cyprus Pedagogical Institute, Cyprus

In this workshop teachers and students will be engaged into STEM activities, to identify key elements that define students' learning experiences within a Project-Based learning environment. Teachers will have the opportunity to explore methodologies and strategies for engaging and supporting their students' needs in a STEAME project, while students will be challenged to design, develop, and construct hands-on solutions to a STEAME problem.

Duration: 60 minutes

WS13. MATHEMATICAL GAMES

Mara Grašić*
Osnovna škola "Braća Radić" Koprivnica, Croatia

Mathematical games for kids can be fun and educational. Many of them are based on numbers, shapes and patterns, and help develop logical thinking and math skills.
Finally, it can be extremely entertaining. Games and activities that incorporate math concepts help children have fun while learning and developing their math skills. That way, it doesn't have to be boring and difficult, but can be turned into something that's fun and exciting.
It is important to choose games that are suitable for the child's age and level of knowledge and that will motivate them to learn and develop mathematical skills. Mathematical games are not a substitute for traditional methods
Learning, additional activities that contribute to the overall development of children are already useful.
In our workshop, students will develop their creativity and logical thinking while playing.

Workshop for students

Duration: 45 minutes

WS14. SCIENTIFIC DECATHLON

Hiie Asser, Maksim Ivanov, Natalia Ivanova, Julia Klochkova
Tartu Annelinna Gymnasium, Tartu, Estonia

Decathlon is one of the most popular sports in Estonia. This competition consists of ten athletics events: 100, 400 and 1500 m, 110 m hurdles, long jump, high jump, pole vault, discus throw, javelin throw and shotput. The athlete's result is determined by the sum of the points they receive for each event.
The decathlon format has been taken as a basis when compiling various educational scientific games.
During the workshop, students will be introduced to several tasks from two such games: computational and experimental decathlon. For example, in the first game, instead of running 100 meters, participants will need to determine in a limited time, among 100 given examples, the number of examples with a specified answer, and instead of long jump, compose from given numbers the longest possible chains of numbers according to given rules. Each event is worth a maximum of 100 points, and the closer the participants' answer is to the correct answer or the best possible answer, the more points the participants receive.
During this workshop participants will be able to take part in a full decathlon called "Units of Measurement", where, for example, instead of 100 meters, they need to, with the help of a stopwatch, measure the result of one athlete in this discipline with their eyes closed, and instead of long jump they need to cut from a spool of thread a length equal to an athlete's jump length without measuring equipment, and so on. The winners will be awarded prizes.

Workshop for both students and teachers

Duration: 45 minutes

WS15. EDUCATIONAL WORKSHOP "BRAIN LABORATORY"

Madlen Kirkor Christova, Teodora Stanislav Vasileva
125th Secondary School "Boyan Penev", Sofia, Bulgaria

The workshop is part of a broader research student activity on the theme "Challenges of the Future" and has the following design:
Activity: Teams of students create and present mind maps on the challenge "What if...?" with topics in the fields of mathematics, science, and technology. The maps include hypotheses, predictions, research on available and necessary resources, interviews (surveys) among peers, parents, and specialists. Procedure: The session is conducted as a workshop during EuroScience 2024, Rome. Each team decides on the format and method of presentation: multimedia product; study; real model. The session concludes with a general discussion.
Sample topics: "What if there is no gravity on Earth?"; "What if our system has two suns?"; "What if we all live in a watery environment?"; "What if there are no numbers?"; "What if we can change the color of our skin?";
End result: Mind maps on individual topics
Participants: Students – up to 30 (main group); 10 (participants from Bulgaria as moderators). The session is open, and other representatives can attend.

Duration: 45 minutes

WS16. EDUCATIONAL WORKSHOP "MY SMART HOME"

Jasena Valerieva Christova, Ivayla Ivaylova Radkova, Desislava Ananieva Chergarska
125th Secondary School "Boyan Penev", Sofia, Bulgaria

The workshop is part of a broader research student activity on the theme "Challenges of the Future" and has the following design:
Activity: Discussion, short interviews and mind maps related to the everyday use of smart applications and technologies. The session is divided into three parts:
Presentation of individual ideas and research on the advantages and/or disadvantages of coexisting with "smart" machines (discussion)
Creating a survey (speed interviews) based on pre-prepared questions related to the use of artificial intelligence
Creating mind maps and filling them in by switching teams
Procedure: The session takes place within a workshop during EuroScience 2024, Rome.
Duration: 45 minutes
End result: Mind maps
Participants: Students: 40 (main group); Specialists: 2. The session is open, and other representatives can attend.

Duration: 45 minutes

WS17. WORKSHOP on "ΕΠΙ – STEAME"

Sotos Voskarides
Affiliate Professor, Cyprus University of Technology

The term **«ΕΠΙ – STEAME»** (in Greek "SCIENCE"), adds to the Latin term ”**STEAME**” (**S**cience **T**echnology **E**ngineering **A**rts **M**athemeatics **E**ntrepreneurship), the Greek letters: **Ε** [Επιμέλεια (Logistics)],three consecutive letters of **Π** [**Π**εριβάλλον (**E**nvironment), **Π**αιχνίδι (**G**ame), **Π**αιδεία (**E**ducation – **E**thics) and letter ”**Ι**” [**Ι**στορία (**H**istory)]: Επί – ΙΣΤΑΜΑΙ = I standon top, therefore "I am a specialist".
This idea is not new: 2500 years ago Pythagoras' students were learning Science, Technology, Engineering, Arts and Entrepreneurship, Logistics, Ethics, Environmental Studies, History (and Geography) and Philosophy.
The term **"ΕΠΙ – STEAME"** refers, among others, to the need of applying in today's Educational System at least a very big part of Pythagoras's approach and Philosophy, using Alternative Teaching and Learning Methods, including Gamification. Otherwise a STEAME professional, not only will be practically insufficient to meet his carrier and personal life targets but also maybe dangerous for the society.
"ΕΠΙ – STEAME" has a prerequisite: Educators Love the children of other people, Love Truth, Happiness, Creativity and also are doers rather than thinkers.
One targeted application of **"ΕΠΙ – STEAME"** is the Project **”MOSSAiC”**, which means «Mathesis On Saturday – Sunday, Arts, imagination, Creativity) for children of ages 12 to 16 (with their parents most of the times present as well).
The meetings, on Saturdays, Sundays and one afternoon of a weekday, without structured agenda, take place on mountains, by the sea, in silent corners in cafeterias/ restaurants, in ancient sites, in Universities, in Mother Nature etc. and cover various subjects, including Artificial intelligence.

Workshop for both students and teachers

Duration: 45 minutes

WS18. DRAWING NICE KNOTS

Christian Mercat
Directeur adjoint de l'IREM de Lyon, Université Claude Bernard Lyon 1, France

Knotworks are used to adorn beautiful medieval books or make splendid jewellery and "tribal" tattoos. They look beyond human reach! But no, with the help of graph theory, you will be able to reproduce, design yourself and remember nice looking knots.

Duration: 45 minutes

WS19. MAGICAL MATHEMATICAL TRICKS

Christian Mercat
Directeur adjoint de l'IREM de Lyon, Université Claude Bernard Lyon 1, France

With the help of mathematics, you will become a real mentalist. A few questions and instantly you make a successful guess. Let's inquire together to unravel the mystery and study the many disguises where this simple but fundamental trick is the key of XXIst century AI power.

Duration: 45 minutes

EUROPEAN STEAME ACADEMY SYMPOSIUM

SY1. HOW THE INVENTION OF THE MICROCHIP CHANGED OUR WORLD

Bernd Deutschmann
Professor of Electronics, Head of Institute of Electronics, Technical University of Graz, Austria

The invention of the microchip changed the world a lot! Imagine a tiny chip of silicon, smaller than your fingernail, that can do lots of big jobs in computers and gadgets. Before microchips, computers had a hard time dealing with big numbers and information, but now they can handle it easily. This made things like smartphones and laptops possible.
One cool thing about microchips is something called Moore's Law. It says that every couple of years, the number of tiny switches on a microchip doubles. This means computers keep getting faster and smarter over time! Microchips aren't just for computers. They're used in lots of things like phones, games, and even in medical devices that help people stay healthy. So, the invention of the microchip has made our world more connected and super interesting! It's like a tiny superhero that helps everything work better and faster.

SY2. STEAME ACADEMY: STEAME TEACHER FACILITATORS ACADEMY

Gregory Makrides
University of the National Education Commission, Krakow, Poland and THALES Foundation of Cyprus

The European Higher Education and Research Area is going through a transformation process that is pushing Europe to a leading position on the way to a green digitalization of societies. The environment of learning, including methods and spaces is expected to change drastically. With knowledge of today's technologies, we can only imagine the future but the way forward is almost clear. In this presentation we attempt to describe the learning in the future in both school and higher education as their evolution needs to develop in parallel. The presentation will discuss results from several funded projects by the European Union, with highlights from the running project STEAME-Academy: STEAME Teacher Facilitators Academy (www.steame-academy.eu).

SY3. TASKS WITH PROOFS AS A TOOL FOR DEEP UNDERSTANDING IN THE MATHEMATICS CLASSROOM

Valentina Gogovska
UKIM, Faculty of Natural Sciences and Mathematics-Skopje, North Macedonia

In the mathematical classroom, tasks that require proofs play a crucial role in facilitating deep understanding and fostering critical thinking skills. This abstract examines the positive impact of incorporating tasks with proofs into mathematical education. We explore the benefits these tasks offer, including enhancing problem-solving abilities, fostering logical reasoning, and nurturing creativity. Tasks with proofs are well-suited for challenging students to develop a deeper comprehension of mathematical concepts and their underlying principles. By engaging in rigorous proof construction, students are encouraged to analyze, dissect, and critically evaluate mathematical propositions. This process allows them to gain a deeper appreciation for the logic and structure that govern mathematical reasoning. Furthermore, working on tasks with proofs in the classroom environment provides students with opportunities to collaborate, discuss, and critique each other's proofs. This peer-to-peer interaction nurtures a collaborative learning atmosphere that encourages students to engage in deeper reflection and refinement of their mathematical arguments. Moreover, engaging in proof-based tasks can instill important life skills such as effective communication and the ability to respectfully articulate and defend positions. In addition to the academic benefits, tasks with proofs also contribute to the development of problem-solving skills. As students encounter and tackle challenging problems requiring proof construction, they learn to approach complex situations with clear methodologies and systematic thinking. These skills are transferable to real-life situations, where logical problem-solving and critical thinking abilities serve as valuable assets. The incorporation of tasks with proofs also promotes creativity in the mathematical classroom. Students are empowered to explore alternative approaches, find elegant solutions, and uncover new insights. By encouraging creative thinking, tasks with proofs inspire students to think beyond conventional boundaries and develop a deep appreciation for the beauty and elegance of mathematical problem-solving. The proposed, completely solved tasks will encourage students to think, practice, and gradually acquire structural and permanent knowledge. Overall, the inclusion of tasks with proofs in the mathematical classroom enhances the educational experience by fostering critical thinking, problem-solving abilities, and creativity. By providing students with opportunities to construct and communicate rigorous proof-based arguments, educators promote an environment where students can engage more deeply with mathematical concepts and develop lifelong skills that extend beyond the classroom.

SY4. THE UNUSUAL AND THE MYSTERIOUS: WHAT SCIENCE THINKS

Massimo Longo
Department of Chemical Science and Technologies University of Rome Tor Vergata, Italy

We often hear about mysterious, magical, inexplicable phenomena and the contrast between those who believe they are all genuine and those who choose to evaluate them with a scientific attitude. One of the most common thoughts is: "Science can't explain it, so it denies its existence." But how does science differ from pseudoscience? What does it mean to independently observe a natural or unexplained or seemingly mysterious phenomenon? How much can we trust ourselves or other witnesses to unusual events, no matter how much in good faith? Do we prefer to believe or understand? With the help of images and some surprising experiments that will engage the audience, we will try to answer these questions.

SY5. HARMONY IN CULTIVATION: EXPLORING AQUAPONICS' SUSTAINABLE SYMPHONY

Davide Frassine, Francesco Scuder, Enrico Luigi Redi, Roberto Braglia, Antonella Canini
Tor Vergata University of Rome, Botanic Gardens, Viale Guido Carli snc, Rome (RM), Italy

Aquaponics, a symbiotic integration of aquaculture and hydroponics, represents a sustainable approach to cultivation that harmonizes natural processes to maximize efficiency and productivity while minimizing environmental impact.

The symbiotic relationship between fish, bacteria, and plants forms the cornerstone of aquaponics systems. Fish waste provides essential nutrients for plant growth, bacteria convert the ammonia rich waste into nitrates, while plants purify the water, creating a closed-loop ecosystem that mimics natural aquatic environments. By harnessing this synergy, aquaponics offers a resource-efficient solution to traditional farming challenges, such as water scarcity, land depletion, and chemical pollution.

Aquaponics systems are highly adaptable and can be scaled to fit various environments. Their modular design allows for flexibility in production, making them suitable for both commercial and domestic use.

Thanks to its adaptability, aquaponics emerges as a crucial element in future endeavors toward extraterrestrial colonization, offering a scientifically robust method for sustainable food cultivation. By utilizing closed-loop ecosystems, aquaponics has the potential to cultivate essential crops amidst the resource limitations of off-world landscapes.

At the Botanic Gardens of the Tor Vergata University of Rome, research is being conducted aimed at improving the aquaponics system in terms of plant yield and enhancing the quality of the products. The research lines focus on the use of bio- and nano-fertilizers, promoting resource sustainability and circular economy principles, thereby adding value to the already virtuous and eco-friendly method of soilless cultivation.

Through continued research, innovation, and adoption, aquaponics has the potential to revolutionize the way we grow food and steward our planet's resources.

SY6. THE UNIVERSALITY OF MATHEMATICS: THE CENTRAL LIMIT THEOREM

Prof. Domenico Marinucci
Department of Mathematics, University of Rome "Tor Vergata", Italy

One of the most fascinating aspects of Mathematics is its universality – it is amazing how the same tools and equations appear in contexts which are apparently completely unrelated one with the other. In this short talk we will illustrate this phenomenon by means of a particular example, i.e., the ubiquitous role of the Central Limit Theorem and the Gaussian distribution in Astronomy, Physics, Gambling, Finance, Number Theory, Statistics and Data Science.

SY7. QUANTITATIVE METHODS IN CLIMATE SCIENCE: A POSSIBLE ROLE FOR MATHEMATICS

Prof. Piermarco Cannarsa
Department of Mathematics, University of Rome “Tor Vergata”, Italy

We know that the climatic characteristics of the Earth have undergone significant changes throughout the history of the planet. Today, we are witnessing increasingly rapid and intense climate changes, likely caused by human intervention for the first time in the history of our planet. But how can we determine what the Earth's temperature was a thousand, ten thousand, or a hundred thousand years ago or even further back in time? The question is not only motivated by curiosity: by reconstructing the temperature of the past, we can identify possible anomalies in the present.
A very useful tool for the study of paleoclimate is the analysis of the oldest ice layers - although these deposits of planetary history are becoming increasingly rare. How can we deduce information about the temperature of the entire planet from measurements that necessarily involve only certain regions and only in certain time intervals? Mathematicians studying climate try to answer these questions. Naturally, it is necessary to have a well-formulated model, not excessively complex so that it can be studied theoretically, but appropriately calibrated to capture the most salient features of climate dynamics.
In this conference, we will see how energy balance models can be used for this purpose. These models were introduced in the 1960s by Russians and Americans to study the effects of the so-called nuclear winter. We will see how these models have revealed secrets of the very distant past of our planet and how they help us understand the potential impacts on tomorrow's climate from the variation of certain climate agents, such as solar radiation or the amount of greenhouse gases present in the atmosphere.