EUROMATH
&
EUROSCIENCE
2018

Abstracts Booklet

original will be provided with ISBN
during the conference registration

Contents

PLENARY PRESENTATION

CERN – THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH: OPPORTUNITIES OF YOUNG RESEARCHERS AND TALENTED YOUTH – MATHS AND SCIENCE IN ACTION

Professor Evangelos Gazis, National Technical University of Athens, CERN

CERN is the European Organization for Nuclear Research, a world Center of Excellency in basic research and science. Scientists and Engineers are probing the fundamental structure of the universe. They use the world's largest and most complex scientific instruments to study the basic constituents of matter – the fundamental particles. The particles are made to collide together at close to the speed of light. The process gives the researchers findings about how the particles interact, and provides insights into the fundamental laws of nature.

CERN aims to engage with experts in science and technology in order to create opportunities for the transfer of CERN's technology and know-how to the industry. The ultimate goal is to accelerate innovation and maximize the global positive impact of CERN in society.

Workshop Contents: There will be given 4h talks and presentations of the CERN advanced technology about:

Accelerators and Detectors Technology
CERN contributes to the Big Data
Future plans of CERN after 2030
Medical Application from CERN's Technology

STUDENT PRESENTATIONS IN MATHEMATICS

MATHEMATICS IN LIFE

Nikolay Malykh, Elizabeth Paula Kozlova, Bogdan Reshetnikov, Georgy Lisitsin, Alexandros Konstantinou, Pupils of Pythagoras School, Cyprus

In the work different fields of applications of mathematics are examined, namely: Mathematics and music, Mathematics and education, Mathematics and sport, Mathematics and modern technologies. The purpose of this work is to demonstrate on particular examples, the way mathematics has penetrated all spheres of human activities, in one form or another. The use of mathematics in sports is represented by the example of basketball (strategy and tactics of the game, calculation of results). Mathematics in music reveals itself in symmetry, euphony and the construction of scales. The application of mathematics in education is exemplified by the development of the schools of ancient Greece and Rome and schools of a later period. The relation of Mathematics with modern life is shown in the section “Mathematics and modern technologies”.

It is difficult to name at least one kind of human activity which is not related to mathematics anyhow. Of course, it is impossible to disclose all the spheres of application of mathematics in one work, but the students used the analytical and research approach to the given task, and the corresponding conclusions were formulated by them.

MATHEMATICS IN COMPUTING

Dmitry Grebenin, Pupils of Pythagoras School, Cyprus

Computing heavily relies on mathematics. Such algebras as elementary, abstract and Boolean are the most commonly used in coding.

Variables, equality, inequality and functions are concepts of elementary algebra applied in programming. The difference between mathematical and programming variables is that coding ones may be of different types. Programming equality and inequality do not differ from mathematical. Their application in coding is comparing variables. Functions in coding differ from mathematical ones a lot. In mathematics, a function is a relation between a set of inputs and a set of outputs with the property that each input is related to exactly one output, whereas in programming functions do not necessarily have an input and/or input.

Abstract algebra is taught during the first year of Bachelor in Computing due to its wide use in the subject. Groups, sets, modules, structures studied by abstract algebra, are used in computing. For instance, a checksum mechanism CRC relies on finite fields.

Boolean algebra is a form of mathematics that deals with statements and their Boolean values. It helps control the program flow depending on whether a programmer-specified Boolean condition evaluates to true or false. Languages with no explicit Boolean data type, like C90 and Lisp, may still represent truth values by some other data type.

Mathematics are also applied in scientific software. Mathematics together with computers assist in physics, chemistry, biology, geology and even mathematics themselves. Computers are also used to teach mathematics to children. Thousands of programs are designed to help children with mathematics.

MATHS IN VIDEO GAMES

Fran Filipovic, OS braca Radic Koprivnica, Croatia

The first video game ever created is Ping pong, and the first game for computers is Spark! Created by two students from Institute of technology in Massachusset. My favourite video game is League of Legends because of its complex mechanics and correlation with mathematics. In this game the goal is to destroy enemy turrets on three lanes in on the map. If the team does that before the enemies, they win. Items one of the most important things in the game. There are cheaper items and they can be merged into larger, more powerful items. Without mana and energy players can`t use special abilities their character can cast. Another part connected to mathematics is mechanics of the game. Players that are bad at mathematics have a bad time playing League. It is required for player to calculate how the enemy will move to hit them. Player also needs to be unpredictable and swerve so they don't get hit by the enemy. The second game is Minecraft. In this game I will calculate surface and extent of same building and mathematically explain how to build that house. To conclude, video games have a lot of mathematics and they can be useful.

MATHEMATICS IN FOOTBALL

Niko Sertic, OS braca Radic Koprivnica, Croatia

Mathematics is everywhere around us, even in sports. The most popular and widespread sport in the whole world is football. I love and train football, so I decided to show you the connection between football and mathematics with a couple of examples.

The connection between football and geometry (football pitch and it's parts, football ball, football formations…), the connection between football and arithmetics - math operations (number of points in a season, number of goals, number of yellow and red cards), the connection between football and statistics (possession of the ball, number of shots on the goal, number of correct and incorrect passes…) as well as many others.

Through my training and watching football I have spotted all these connections and they helped me in mastering many mathematical tasks, so through football I started liking mathematics.

SHOPPING MATHEMATICS

Ida Rupcic, Tara Sambar, OS braca Radic Koprivnica, Croatia

We still remember our first doll and countless style combinations our imagination was creating. Encouraged by love for fashion and great interest in mathematics, we decided to make mathematical style shopping. Our shopping haul started with deciding the budget and sizing as well as drafting our clothing item. We discovered a mathematical formula for determining the perfect length for our skirt by knowing our own body and basic principles of the golden ratio. We discovered the power of style geometry and geometric shapes on clothing items.

We decided to compare store price and online price to price we were offered by our local sewer. We chose the cheapest option based on the responses. We couldn't have imagined mathematics would be present in every part of our survey. We've concluded that mathematics and style are two thing present in 21st century, refining our lives with their existence. Get ready to hear and see our discoverings about the importance of mathematics in shopping

MATHEMATICS IN JOURNALISM

Ena Omrcen-Ceko, OS braca Radic Koprivnica, Croatia

The journalists, by their nature, are aversed to dealing with mathematics. In fact, considering their statements, most of them choose journalism as an obligatory subject during their education, just to avoid studying mathematics. On the other hand, they are forced dealing with mathematics because most of their reporting work revolves around numbers. For example, some of the segments such as budgets, governments, economical predictions, ecological researches, unemployment rate and residential construction are filled with numbers. Math and numbers are playing the main role in the public politics and if journalists don't do valid job researching numbers, they will renounce a big part of their job as journalists. That's the reason why journalists, doing their job, get in touch with math more often that they predict. Besides, they are strongly related with graphical service and marketing service. At the first sight all of this may seem scary and intimidating, but if they get in some kind of trouble, they can count on accounting service. All in all, we can conclude that journalists, during their work, deal with math more often than they expected.

MATHEMATICS IN GAMBLING

Patricija Mihoci, OS braca Radic Koprivnica, Croatia

You may think that gambling is just luck. Well, I am going to show you that there is a lot more to it than just pure luck. I am going to use a comparing card game called Blackjack, also known as twenty-one. It is played between usually several players and a dealer, where each player in turn competes against the dealer, but players do not play against each other. It is played with one or more decks of 52 cards. The objective of the game is to beat the dealer in one of the following ways: get 21 points on the player's first two cards (called a "blackjack" or "natural"), without a dealer blackjack; reach a final score higher than the dealer without exceeding 21; or let the dealer draw additional cards until their hand exceeds 21. Although it looks like game on luck there is a way you can affect your score. All you need to use is statistics and probability. For example if value of your cards is 19 your next card needs to be 2 for you to not come out of the game. If you're playing with one deck there is 52 cards of witch there are four 2. And probability for you to get 2 is 3.8% which is obviously very low. So this is the proof that gambling is not pure luck and this is just one of hundreds of examples of math in gambling games.

MATHEMATICS IN CIVIL ENGINEERING

Nikola Kusek, OS Braca Radic Koprivnica, Croatia

Civil engineering is an engineering discipline that deals with designing, building and maintaining buildings, roads, bridges, canals, dams, etc. This is the second oldest engineering discipline after military engineering. Civil engineers are involved in the overall construction of buildings as well and their relationship with nature and the environment. Civil engineers in construction work closely cooperate with geodesists and specialized building engineers for construction materials, water supply, sewage, roads, railways, bridges, dams, and electricity supply.

For most people, they always had a special admiration for buildings that differed in their size or shape and which adorned beautifully in our environment.

Each of us lives in a building. I'm interested in how buildings are built and how much mathematics really is used, because it is everywhere around us. Looking at the buildings that I like, I realized that each building consists of different geometric figures and bodies that are interconnected. I wondered how engineers know what a building should be to withstand of external influences (wind, snow, earthquake), and how it is projected and built.

I'm sure a lot of math is needed, and I decided to calculate information needed to build a building like an engineer.

APPLICATION OF MATHEMATICS IN HOLIDAYS

Josip Mikulic, OS braca Radic Koprivnica, Croatia

Mathematics plays an important role in our lives. We can find it's applications everywhere: in cooking, music, video games, medicine, etc. One of the important applications of mathematics is in holidays. The best example is Christmas.

Among the Christmas expenses there is food, Christmas decorations, Christmas tree and gifts. To be prepared, we have to calculate the total cost and prepare the money. But Christmas is know for discounts, which is also something to be considered. The main steps here are to check how much money we have in the account, calculate the total cost of all we have chosen, add that cost to the cost of household expenses and deduct the total cost from our account.

Mathematics helps us and makes our lives easier. Especcialy through holidays like Christmas, Easter, New year, Halloween and many other holidays around the world.

APPLICATION OF PURE MATHEMATICS IN ECONOMIC THEORIES

Alireza Mousavi, Alireza Mohammadi, Shahid Besheshti, Zanjan, Iran

In this regard, it is sufficient to point out that most of the major economists of the last hundred years have been mathematicians. Alfred Marshall, William Stanley Jevons and… are among these economists. As to why mathematical language can benefit from the usual language in the economy, it should be noted for the following reasons: (a) the mathematical language makes it easy to understand and express the complex topics: in the real world, usually every economic variable is associated One-way or two-way with one or more other variables. Obviously, the analysis of these relationships, in descriptive language and also in graphic form, is subject to many limitations. Equations and mathematical models allow the theorist or economics researcher to express and study relationships between variables in a simpler but more accurate way. B. Many economic variables have a very small nature: a significant portion of economic variables have a very small nature.

For example, variables such as profit, income, and measurable earnings are in this field. For this reason, the quantitative nature of these variables requires computation and determination. (c) An economist is a mathematician: Most economic theories are based on the assumption that individuals and economic agents are "rational". Choosing an action by a rational person is in fact a practice of practical logic. When this choice affects the quantities and numbers, in this case it can be said that this rational behavior is in fact a mathematical practice.

IMPORTANCE OF MATHEMATICAL ECONOMICS

Alireza Mousavi, Alireza Mohammadi, Shahid Besheshti, Zanjan, Iran

For a long time, mathematical knowledge has provided appropriate facilities for providing accurate analyzes, describing the relationships between phenomena and reducing the forecast error for various sciences. The quantitative nature of economic variables along with factors such as the need for planning and ... has led to the development of the mathematic applications in the economy. Because of Simplification and strict observance in providing economic theories and especially the high precision of this tool, economists have used mathematics as a means to present their theories. Therefore, mathematical economics, such as econometrics, is not an independent branch in the knowledge of economics, such as microeconomics or macroeconomics, but mathematical economics is a research tool and a language for economic theories. In the real world, each economic variable is usually one-way or two-way communication with one or more other variables. For example, the level of prices in macroeconomic theories is influenced by variables such as government expenditures, currency volume, exchange rate, and so on. Obviously, the analysis of these relationships, in descriptive language and also in graphic form, is subject to many limitations. Equations and mathematical models allow the theorist or economics researcher to express and study relationships between variables in a simpler but more accurate way.

THE RELATIONSHIP OF MATHEMATICS AND MUSIC

Alireza Mousavi, Alireza Mohammadi, Shahid Besheshti, Zanjan, Iran

When we begin to investigate the relationship between mathematics and music, we will probably be more likely to call Pythagoras, Mozart, and Bach than others. But the first person to come to this connection was Pythagoras, a philosopher and Greek mathematician. The name of this scientist Great, undoubtedly, reminds us of his famous relationship in the right triangle. But he has also been active in the field of music. Many scholars consider him the father of science and some of the musicians of the father of music. Perhaps his definition of music after twenty-six centuries is still one of the most beautiful definitions.

"Music is a harmony of contrasts, a combination of opposites and reconciliation of the opposite elements ... Music is the basis of the integrity of existence in nature and the best rulers in the field of the universe. The music of the world is obsessed with harmony and the rule of law and provides a wise way of life. It gives us the ability to unite and unify".

In fact, in the life of a musician, mathematics plays an important role. Preparing a melody in one of the musical instruments and fingering correctly in the sequences is in fact a kind of mathematical problem. Even using different keys in playing the same melody related to math. Well, he often can listen to a song, and without having trained it beforehand or having the sequence of notes, he plays that song, because he recognizes the familiar arrangement and shape. This kind of thinking is very similar to who the mathematician read.

MATHEMATICS AND PHILOSOPHY: WHAT IS A LIMIT?

Giuseppe Calio, Giorgia Corrado, Liceo Scientifico “Luigi Siciliani” Catanzaro_Italy

The concept of limit was already present in the Greek mathematics, as a lot of results about area calculations obtained by some Greek mathematicians (like Archimedes) were based on a passage to the limit. Over the years there has been an evolution which led to a complete definition of limit by means of A. L. Cauchy and secondly by A. Weierstrass. There were many mathematicians who dealt with this topic by using a philosophical approach, such as Leibniz (XVII and XVIII century) who invented infinitesimal calculus.

Our work is based on the significance of limit:

In mathematics, given a domain**,** the set of "input" for which the function is defined, when the function is applied to any input sufficiently close to p (input), the output value is forced arbitrarily close to L (limit). So it defines a border, in which we are certain that the function does exist (Uniqueness of Limits of a Function Theorem, Squeeze Theorem);

In philosophy, I. Kant reflects on the limits of reason, in order to understand what are the fields that the man can explore in order to arrive to the truth. On the other hand, Hegel oversteps the concept of Kantian “island with immutable boundaries”, he is against all limits because the idea of limitation implies the limitation itself has been transcended implicitly.

The project focuses on the importance to acknowledge our own limits, as humans, in order to act within them without run the risk to cross the borders and behave immorally.

THE MATHEMATICAL WAY OF WINNING AT MONOPOLY

Joel Anicic, Prva Rijecka Hrvatska Gimnazija, Rijeka, Croatia

Everyone has played Monopoly at least once and either won excessively, controlling most of the properties and finances or somehow, with a bit of luck, got throw every round without going bankrupt or, most notably, lost everything in a horrible way. Most of the time players, especially the once who lost, attribute the outcome of the game to luck, and luck alone. And while luck does play a role it is far from the only decisive aspect of Monopoly. Strategy is the key to victory. It might sound strange that mathematics could provide a strategy for winning at Monopoly, but what Monopoly really comes down to is probability.

The likelihood of landing on a given field, the expected investment cost and revenue of properties, which properties are worth buying and will yield most in the long run..., all this can be explained with probability theory.

This way mathematics might give you a different view of Monopoly, as a game that isn’t always decided by luck, and make your future games a bit more successful.

THE MONTY HALL PARADOX

Karlo Andlovec, Maja Juric, Virna Nilovic, Prva rijecka hrvatska gimnazija, Rijeka, Croatia

A paradox is a statement that seems contradictory to the general perception. We can find paradoxes in biology, physics, logic, philosophy and mathematics. There are multiple types of paradoxes in mathematics: statistic, probability, infinity and geometry paradoxes. In our presentation we will be focusing on one of the probability paradoxes – the Monty Hall paradox.
The Monty Hall paradox is loosely based on the American television game show Let's Make a Deal and named after its original host, Monty Hall. The problem was originally posed (and solved) in a letter by Steve Selvin in 1975. Let's suppose that we are on a game show. We have to choose between 3 doors. Behind one door there is a car and behind the other two there are goats. We have to pick a door. The host will open one of the other doors and show a goat. Now the host is giving us a choice: we can stick with our previous choice or switch the door. Do we have a better chance of winning if we switch our choice?
We are going to explain the Monty Hall paradox using interactive methods which can be useful to you if you are ever on a game show.

BIOMATHS

Ritirato Chiara, Antonio Spina, Zerillo Alessandro, Liceo Scentifico G. Rummo, Benevento, Italy

Could you calculate the randomness of life? Did you know that Mendel laws are linked to probability? No matter what your answer was… we are going to show you soon. In our project we will also involve you in polygenic inheritance (when two or more genes influence one single factor) and how this concept is correlated to Gaussian curve.
In the biomedical sector, we are going to show how CAT (*computed axial tomography*) works, using Cartesian plane and straight lines. Are you ready? Let's start!

WITH MATHEMATICAL EYE

Boffa Anna, D'Aronzo Elvira, Iannella Miriam, Sabbatini Andrea,
Spina Antonio, Liceo Scentifico G. Rummo, Benevento, Italy

Travelling is one of the greatest adventures you could ever experience, but have you ever thought to travel…with mathematical eye?
Everything started in our homeland, in the city of Florence, taking into account some correlations between ratio and proportion in an architecture of Brunelleschi, the well-known "Spedale degli Innocenti" (1417-1436).
Brunelleschi was a Renaissance artist, who was influenced by Greek culture of proportions, so we decided examine in depth this point and we started our researches.
And our journey starts here, in front of the magnificence of Parthenon, Athens.
Here we have scrutinized the history of ancient Greece, in particular the origins of one of our common passions: the theatre. In fact we love comedies, and we have discovered how this genre has changed during the centuries, so we asked ourselves how the efficiency of a sketch could be calculated and we found a genial formula:
E = CEL [(iS - fS) + (S*T)]
E (effect)
CEL (comical emotional language)
iS - fS (the difference between initial situation and final situation)
S (surprise effect)
T (time taken to understand the sketch)
We decided to apply this formula to our favourite sitcom, "The Big Bang Theory", so we visited its studios in Hollywood. When we came back to Italy, at the airport, there was a football match and a lot of people watching were literally hypnotized by the screen. So, we realized how this sport is important for our country, and decided to analyze it in a mathematical way, using Pythagorean expectation.

MUSIC AND MATHS: HATE OR LOVE?

Formisano Anna, Ritirato Chiara, Zerillo Alessandro, Liceo Scentifico G. Rummo, Benevento, Italy

Did you know that music, the most beautiful among the seven arts, is strongly linked to mathematics? No matter what your answer was, we are going to show you soon. You will be involved in a journey to centre of the pentagram where you will find out the love story between music and mathematics, firstly discovered by the Greek mathematician Pythagoras.
Afterwards, Simone Stevino and Vincenzo Galilei revisited the previous music scale organization giving rise to 12-Tone Equal Temperament. This substituted the previous ratios discovered by Pythagoras introducing the irrational aspect of mathematics.
So we can consider Music as an art form and cultural activity whose medium is sound organized in time by a mathematically logical scheme. Let's be captured by the symphony!

TASTING MATHEMATICALLY

Adamo Giulia, Chietti Francesco, Panella Valeria, Savinelli Vincenzo, Simeone Francesca, Zeoli Domenico, Liceo Scentifico G. Rummo, Benevento, Italy

Mathematics and cooking: is it possible? Well, in our presentation we'll explain how some formulas and theorems can be used in the kitchen.
When we are cooking, even if we don't care about it, we apply chemical formulas and physical principles: tastes, times of cooking, balance of flavours, calculation of calories are all aspects of the cooking's world that hide mathematics rules.
If you aren't able to make a tasty hamburger, don't worry: Stu Ferrimond created a formula to cook the perfect one! Farrimond also provides some cooking tips: the hamburger has to cook for 9 minutes and a half on a grid at 150-180°C and has to be turned over just one time so that we don't lose its softness.
Moreover we have analyzed the "pizza theorem", which deals, with the division of an ideal circular pizza between two people eating the same quantity, having as a point of intersection of the straight lines that divide the pizza, any point different from the centre.
So we can say that mathematics is the backbone of every recipe, therefore is food necessary only to satisfy the mouth? Or does it also serve to study its numerical regularity?

MATHEMATICS IN MAKING CLOTHES

Filip Baronic, Iva Betlehem, Osnovna Skola Fran Koncelak, Drnje, Croatia

Without mathematics we would be not able to wear clothes. Why? The answer is simple: we can't do anything without mathematics. If we want to sew something, we have to calculate how many sewing cloth, thread, needles, energy and time we need. And also we can chose would we sew by hand or with sewing machine. For this decision we of course have to use mathematics, but this isn't only time when you need to use mathematics. With simple mathematics calculations we are able to see is our project profitable, which way of sewing is the best and of course we must use some measurements to create our final product. Actually mathematics has the biggest role in measurements and measurements have big and important role in making clothes. So, we want to show you how important mathematics is in making clothes. All those angles, shapes, lines and circles make connecting line between mathematics and making clothes. Be thankful to mathematics for your clothes that you are wearing.

BLOCKCHAIN: WHEN MATHS BECOMES THE FUTURE OF MONEY

Arina Ghanizadegan, The Grammar School, Nicosia, Cyprus

Money!
For some, the single word immediately evokes an image of business tycoons quickly buying and selling stocks on the Wall Street. For those who feel a more personal spark, money could simply mean the musical jingling of coins as they gently touch the keys in your pocket. However, things will no doubt become very different if we were to use the word “Cryptocurrency” instead. Although the mysterious topic of cryptocurrency and Bitcoins successfully makes its way into newspaper headlines day after day, many of us still have the tendency to stick with the traditional methods of payment in an attempt to avoid what seems to be the rocket science hidden behind this alien coinage. Yes, even today in the age of top notch technological advancements as we could say, barely anyone would think of never-ending computer codes and chain blocks when referring to money. WHAT IS the legendary Bitcoin after all? How does it operate and function? Catching a glimpse at the mathematical aspect of this amusing creation would of course answer a lot of baffling questions.

IS MATHS REAL?

Alexandros Violetti, The Grammar School, Nicosia, Cyprus

Is maths real or just a logical abstract? We cannot touch, smell or see maths but we can very carefully observe atoms, molecules and the universe. This begs the question. Do numbers exist? Surprisingly, mathematical realism as it is called, has been a topic of vigorous debate to this very day. To understand the philosophy of Mathematics one has to first clarify what the two major branches, realism and anti-realism are. Realism in its basic form argues that mathematical ‘bodies’ exist independently of the human mind and is divided into many sub-categories ranging from every-day Platonism to advanced Empiricism. Anti-realism such as Fictionalism on the other hand, holds that a meta-physical mathematical reality is simply falsehood and if mathematics simply ‘vanished’ from the world there would be no observable effect on the way things work! It’s when we look at maths from a philosophical angle that we realize that there is more to maths than just numbers.

MATHS VERSUS CRIME

Nikolas Loizou, Marisa Loizidou, Eleonora Kekkou, The Grammar School, Nicosia, Cyprus

Think about switching on your tv. Whats the first thing you see and hear on the news? Suspects found for the robbery of a bank, new evidence for the unravel of a homicide might be some of the headlines. Due to the ever-increasing number of crimes committed every day and the never-ending terrorist attacks throughout the world, forensic scientists and criminologists turn to mathematics to help solve these crimes and bring justice. For instance, using trigonometric functions in bloodstain pattern analysis the area of origin of blood in the three-dimensional space can be determined. If though, a dead body is found how is it possible to determine when the individual died? Newton’s law of cooling and some simple maths can be used to calculate it. In addition, the shooters location and weapon can be identified just by the bullet hole, working out projectile motion equations and energy loses equations.

THE SECRET OF RANKING

Elena Syllouri, Ourania Papakyriakou, Yuexuan Gu, Marina Artemiou,
The Grammar School, Nicosia, Cyprus

In mathematics we define a matrix as a grid-like arrangement of elements which in simpler words means a collection of numbers, symbols, or expressions, arranged in a fixed number of rows and columns. However, matrices where not created randomly, instead they were born to serve a purpose since matrix mathematics can be applied to several branches of science, as well as different mathematical disciplines. In this presentation we will introduce the practical uses of matrix mathematics in a variety of settings and more specifically their use in cryptography and in the page ranking algorithms of various search engines. Cryptography or simply the art of creating and solving codes dates back thousands of years however in the more recent years, matrices have played a crucial role in both encoding and decoding codes. Via the use of matrices an array of letters can be transformed into an unreadable message using what is known as an encoding matrix and then turned back to the original message using the decoding matrix or the inverse of the encoding matrix which is known only by the receiver thus keeping communications private. Matrices also have a crucial role in page ranking algorithms and it is through their use that webpages such as that of Google and Yahoo can predict what you want to search and make suggestions immediately when you have only typed just a few letters or phrases.

VISUALISING MATH

Andreas Hadjikallis, American Academy Larnaca, Cyprus

A lot of people have the idea that math is all about numbers, letters and calculations. These people are usually the people that have problems understanding math and always ask “I don’t understand”, “This doesn’t make sense” etc. Well if you try to visualize it and think a bit more outside the box, it will make sense and it will be easier for you to see what’s going on rather than seeing just a lot of numbers, formulas and calculations have no idea of how to continue. The presentation concentrates on visualizing 5 basic concepts: The difference of two squares, The interior angle sum of a triangle, The area & circumference of a circle, The proof of Pythagoras theorem and Completing the square. The aim for this presentation is to proof to everyone that math becomes a lot easier if you visualize it.

THE CONFLICT BETWEEN INHERITANCE AND MATHEMATICS

Chara Toumba, American Academy Larnaca, Cyprus

It is December 14, 2014 and the story of Solomon, a new born baby from Portland Oregon makes headlines on NBC news. According to the article the “accurate” prenatal tests that were carried out by the doctors diagnosed the foetus as suffering from the “Trisome 18 syndrome”, a painful genetic condition that is nearly always fatal. Contrary to the odds, the brave parents decided to continue with the pregnancy and surprisingly Solomon was born healthy, refuting all scientific predictions.

Probabilities are widely used in medicine and especially in genetics. Various tests have been developed to predict the probabilities of certain diseases appearing or being inherited to the offspring through faulty genes. According to a study published in the New England Journal of Medicine, genetical and prenatal tests are highly accurate, but they are not always correct! Incorrect results however can lead parents to termination of pregnancies because they might not be willing to raise a baby predicted to be suffering from the Down syndrome.

Therefore what is supposed to be happening if the probabilities of inheriting such a disease are high? What are the parents supposed to do? Do probabilities fail to explain inheritance? Have you ever thought that a mistake of probabilities can even lead to an unfair death?

ORDER IN CHAOS – PEACE IN DISCORD – ASSURANCE IN PROBABILITY

Antreas Haperis, Nikolas Fournaris, American Academy Larnaca, Cyprus

The 20th Century has proven to be a vital century on scientific advances in the light of wars that could potentially destroy humanity. Although, amidst all the chaos, a man by the name of Edward Norton Lorenz had fought a different war. A war of Chaos. A war that, if won, could possibly reshape the way mathematics are to be used when considering probability. It was a war of seeking answers inside of the Chaotic Theory; where he suggested that a single flop of a butterfly's wings can cause the next potential catastrophic tsunami. To a more analytical extent, Chaos refers to the occurrence of unpredictable events one after the other. As in case of the deadly butterfly, in order to understand what we do not, we are required to set controllable conditions to a certain aspect and then simply let it go… Chaotic. So, could Chaos aid us on understanding more of scientific concepts and be used on such as well as including it in innovative acts? This is a journey through the theorem's nature and how Chaos itself can do more good than harm.

MATHEMATICS AND ART

Michalis Nicolaou, Sophia Tsokkou, American Academy Larnaca, Cyprus

Numbers, calculations and equations are the things that come in mind when one mentions mathematics. But, are mathematics really that boring? Have you ever thought of mathematics from a creative perspective? Well, from the 1990s the National Science foundation coined the term that swept educational institution across the nation STEM (science, technology, engineering and math). But in our eyes this term is wrong. We will go a step further and present STEAM (science, technology, engineering, art, and math). We can prove this term through 3 famous people: Leonardo da Vinci, Albert Einstein and Steve Jobs using examples from their work (for example, from Leonardo da Vinci the Mona Lisa and the Vitruvian man) and from Steve Jobs the Apple and Pixar creations).

WHY THE GOLDEN RATIO TAKES THE GOLD

Marianna Efstathiou, Anastasia Pipiou, Anastasia Stavrou, Antonietta Haliou, Nicholas Zacharia, Antonis Theodorou, American Academy Larnaca, Cyprus

What do seashells, stock market patterns and the milky way have in common? Simply the Golden ratio!
This ratio was first studied by Greek sculptor Phidian who was the one to study the golden ratio and applied it to create the Parthenon. Hence, the use of 'phi' which is a Greek letter. It is a great example of how mathematics can determine beauty. It is as aesthetically pleasing to the eye, as it is to all other senses. The ratio is 1:1.6… infinite like π but in this case, it is phi.
We all think that maths is restricted in numbers and values but who would have thought that we could sense it. So why golden you may ask? Why not silver or bronze? Well, first because we didn't name it! From the ancient pyramids to your most favourite desert. Thus, it may be known as the Divine proportion since it is so perfectly perfect. Furthermore, it is an idea that can be applied in anyone's job. You can be an economist and use the golden ratio to predict the stock market prices or a musician to compose the perfect symphony.

CIRCLE

Pantelis Koshias, Elena Biparva, Anastasis Christoforou, American Academy Larnaca, Cyprus

Imagine a world without football, pizzas or the wheel. Imagine a completely square world. The circle is arguably the most important and unique shape known. Its edgeless structure grants its usefulness in everyday life, while simultaneously troubling mathematicians since the beginning of civilization. To enable the otherwise laborious calculation of the area and the circumference of a circle, an unorthodox yet effective concept was constructed: the infinitesimal – an intangible number which is smaller than any imaginable Real number, but somehow still larger than 0. Over a great period of time, mathematicians questioned the integrity of this concept; however, after a constant set of rules of how to use them was constructed in the 1960's, the idea of infinitesimals was cemented. Now, in our presentation, we will use it, alongside the fundamentals of calculus, to prove famous equations such as $C = 2\pi r$ and $A = \pi r^2$.

EVERYTHING ABOUT NOTHING

Herman Wigge, Simon Ljungbeck, Polhemskolan, Lund, Sweden

In this project the meaning of nothing has been studied from a mathematical point of view. As the area is large, and there are different sorts of nothing even in mathematics, we picked a singular form of nothing to immerse ourselves into. The number zero.
It appears that the number has developed gradually, from being invented in Babylon under 600 B.C. to starting to resemble the zero of today in India, around 600 A.D. The presentation encompasses the emergence of the number zero and how the viewpoint on the number has changed throughout time. Finally, we have researched advantages and problems that emerged because of the introduction of the number zero.
It turns out that the number zero sticks out from its counterparts, needing special treatment to be usable in a majority of situations. Ultimately, the knowledge surrounding the number zero is massive, and the goal of this presentation is to enhance the audience's understanding of this specific number, and render its role in mathematics as a whole.

'AND YET IT MOVES''… AND SOMETIMES IT TREMBLES

Francesco A. Colosimo, Manlio de Pasquale, Pasquale Scalise, Liceo Scientifico "Luigi Siciliani"
Catanzaro, Italy

"... observing nature, we see that the mountains are not cones, clouds are not spheres, coastlines are not circles but are geometrically very complex objects ". B. Mandelbrot in "Les objects Fractals" of 1975, speaks about fractals: fascinating and mysterious geometric figures, which can define better than the Euclidian geometry in the world around us. Properties of the fractals can describe many natural events, for example earthquakes.
Our understanding of earthquakes is based on the theory of plate tectonics. Earthquake dynamics is the study of the interactions of plates (solid disjoint parts of the lithosphere), which produce seismic activity. Over the last fifty years, many models came up, which try to simulate seismic activity by mimicking plate interactions. The validity of a given model is subject to the various synthetic seismic activities; that can confirm the empirical laws, which describe the statistical features of observed seismic activity. Here we present an elementary proposal of a geometric model of earthquake dynamics, named ''The Two Fractal Overlap Model''. The model tries to emulate the stick-slip dynamics of lithospheric plates with fractal surfaces by evaluating the time-evolution of overlap lengths of two identical Cantor sets, sliding over each other.
Fractals and geometric transformation have been an educational topic developed in an extra time activity in our school.

CRYPTOGRAPHY

Negar Maleki, Farzanegan 1, Iran

Today, in the digital world, data protection is essential to the exchange of communications and commercial exchanges. Encryption is used to secure secure transaction needs. Given the importance of this issue and the transition from a traditional stage to a digital stage, familiarity with encryption methods is necessary. This article, in turn, examines public key encryption algorithms (asymmetric) and the private key (symmetric), the various aspects of the public key are examined and the characteristics of each one are expressed.

MUSIC AND MATHEMATICS

Mahyar Jafari Nodeh, Mohammad Reza Daviran, Shahid Beheshti Exceptional Talents, Iran

In the ancient world, music was considered to be an important subject for theoretical studies, on a level with pure mathematics itself. Boethius` famous (de institutione musica) is hardly concerned with the practical performance of music. It has much more to do with describing various rather trivial ideas about numbers. Once you have worked your mind around all those words and Boethius goes on and on through many paragraphs in this fashion then you see that he is really just describing the simple relationship

$$(n+1)^2 - n^2 = 2n + 1 = (n+1) + 1$$

In more recent centuries, Eular published a system of musical ratios which, although it may have had a certain mathematical elegance, was found to be musically usless.
Music: continuous or discrete spectrum?
Sound has a continuous spectrum of frequencies
Most instruments play a discrete subset of them
There are exceptions, like the violin
In contrast, a guitar has frets which make it discrete
Western music frequently selects 12 fundamental frequencies, f1,….f12 and then allows only the discrete set of frequencies $\{2^n f_i \mid n \in Z, i=1,\ldots,12\}$
Thus, f1,..,f12 are chromatic representatives for all the notes
The fundamental frequencies are usually labeled
C,C#,D,D#,E,F,F#,G,G#,A,A#,B
This is the chromatic scale
Other discussed subjects are:
1-The harmonic series 2-Symphona 3-Harmonious numbers 4- The tetrachord and ….

IMMIDIATE THIRD ROOTS

Arnica Kiani, Sevin Vosughi, Meeraj andisheh school, Iran

To calculate the third root, you should know the cube of these numbers:
=1,=8,=27,=64,=125,=216,=343,=512,=729,=1000
Knowing the cubes of these numbers calculates the third root of these numbers is very easy. Let's start with an example: What is the third root of the 314432? Consider the number of thousands of numbers. In this example it is 314. Because 314 is between = 216 and 343, then according to the table of cube 3, the third root must be sixty and the first. The first digit of the third root is 6. To determine the last digit of the third root, note that only the cube of the number 8, which ends in 2 = 512, so the third root of 314432 is 68. It's easy! Note that the digits from 0 to 9 are the last cubes of numbers 0 to 10. What is the third root of 19683? 1- 19 are between 8 and 27. 2- Therefore, the third root is twenty ... 3. The last digit is 3, like the last digit = 343, then the last digit is 7, that is, 27 is the third root of this number.
So we can use the above method to find a large cube without calculators using the above method. Here, our method for obtaining the last digit is only in the state that the original number of the cube is complete.

THE ROLE OF MATHEMATICS IN MEDICINE

Shakila Hamdy, Farzaneghan 1, Iran

All of us know that mathematics have taken part in many subjects. One of those subjects is MEDICNE. So, when you read this article, you will find out many important things about the role of the mathematics in medicine. Such as: Writing prescriptions, Drawing up graph, CAT scan, Cancer curing, Controlling a tumor; and one of the most interesting things I found was "A mathematical model to predict the outbreak of the infectious diseases"

PHILOSOPHY AND MATHEMATICS

Mohammad Ali Bigdeli, Mohammad Amin Jafari, Bright Student Shahid Beheshti School, Iran

Throughout history, various philosophical theories have been expressed, but philosophical theories have not been fully accepted by various philosophers, and the truth of these theories and their correctness criteria remain a problem that remains unresolved, but where was the fundamental problem? This was the question that philosophers did not have the ability to answer.
The expression of theories was done by the language, which itself was problematic. And was it because philosophy, over the years, brought maths that had a different language than language? By studying mathematical behaviors, it cannot be fully understood, but with mathematical-philosophical analyzes, like the limit of one, the power can be approached with the answer, which is tangled up and understood by the brain of the human analyst. Like the perception of which man has absolute zero.
If you do not consider absolute absolute zero then what does that mean? One, two, galaxy, or something else? Are infinite objects an integral part of existence? This is where you cannot talk about a relationship other than the whole. And on this basis, each of these objects can literally be. And this conjunction exists in the entire universe, and mathematical objects are the same. Now that they are created or discovered by the human brain, they are themselves, and this is true for philosophy as well.
Finally, it can be concluded that mathematics does not express philosophy, or philosophy did not initially give mathematics, but it can be said that both philosophy and mathematics have common concepts.

RUBIK'S CUBE

Patrik Aleksic, Patricia Baros, Bozena Markovic, Natali Marinkovic, Prva Rijecka Hrvatska Gimnazija, Croatia

The subject of our presentation is the Rubik's cube. We will have a demonstration on how to solve it and explain the math behind it all. We will cover the number of possible ways to arrange the cubes inside the cube itself, what it depends on and why we're not able to solve them all, the history of it and God's number. We will also talk about the different types of cubes and how they are solvable. Other than that we also plan on explaining how some people can solve it so quickly and how they use math while doing so.

ANALYSES OF NONOGRAMS

Ivan Ventsislavov Georgiev, Sofia Mathematics High School, Bulgaria

This project is in the field of science "MATHEMATICS". This paper introduces an innovative approach for Nonograms, widely connected with computer tomography. A computer tomography scan makes use of computer-processed combinations of many two-dimensional radiographic X-ray measurements taken from different angles to produce tomographic images.
Nonograms, also known as Griddlers or Japanese puzzle are picture logic puzzles in which cells in a grid must be black or blank according to numbers at the side of the grid, indicating the lengths of consecutive segments of black squares, to reveal a hidden picture. The general Nonogram problem is NP-hard (non-deterministic polynomial-time hard) and have widely varying difficulty levels. However, they have no theoretical limits on size, and are not restricted to square layouts. However Nonograms can usually be solved by hand.
In this paper, we mathematically analyse Nonograms, Tomograms and Minograms, their applications and properties and find useful lemmas, theorem and facts about them. Minograms are Nonograms, which have only one string of consecutive black squares in each row and in each column. Tomograms are Nonograms, for which the numbers above it show how many black squares there are in each column and these sideway show how many black squares there are in each row. Tomograms are easy to solve but rarely possess a unique solution and Minograms are very seldom solvable. Nonograms are somewhere in the middle - they are solvable and almost always have a unique solution.

SZEMEREDI'S REGULARITY LEMMA AND EXPANDER GRAPHS

Kaloyan Todorov Fachikov, Sofia Mathematics High School, Bulgaria

In this project we are going to look at Szemerédi's lemma, its another variation and its proof. It is very strong because it can be applied to every graph. First we will define some terms. Then we will also prove that in expander graphs maximum path between two edges is 4 and that regular pairs are almost expanding. Lastly we are going to prove Hajnal-Szemerédi's theorem but with different conditions, which is the main aim of our project, using many different theorems and lemmas, like Dirac's theorem and second variation of Szemerédi's lemma. Using all this helpful theorems we will improve the condition for the degree of the graph.

FRACTAL STRUCTURE OF DNA

Pavlovic Marija, Jurisic Milica, Mirjana Jovanovic, "Isidora Sekulic" Grammar School, Serbia

Fractals are formed from self-similar objects that ensue by self-repeating pattern thus forming smaller look-alike parts same as the entire object. Although Mandelbrot is considered to be the father of fractals, they owe its true existence to Giuseppe Peano, who defined a group of self-similar curves by which these are explained. Micro and macro world are both of fractal nature and so is, by definition, DNA, being a part of micro world itself. The paper will explain how fractal model of DNA, thanks to its characteristics, represents the most suitable way for DNA chain to fold, while comparing it to less suitable polymer model. Ever since the idea was first unveiled to scientific public, it has had a great influence on DNA structure analysis. Fractals started being widely used in oncology, astronomical research, biology, geology, engineering, psychophysics etc.

CRIMINOLOGY IN THE NEED OF MATHEMATICS

Daria Kovanova, Maria Kaltaveridou, Diastaseis Private School, Greece

Mathematics is not only equations and formulae. It is something much more than numbers and operations. It is ways of life, a way of thinking, reason itself. Mathematics is the development of our brain. By using it, we can unravel the biggest mysteries of the world and we can even solve crimes. Scientists use a variety of knowledge of biology and chemistry in order to help the police solve crimes but a deep comprehension of mathematics is also necessary.

And here arises the question "why?"

Because mathematics play a significant role in crime investigations as it helps criminologists elaborate a series of problems. These problems include trajectories, fingerprints identification, vehicles speed and DNA detection as they are often based on statistics and equations in order to reach the solution of a crime.

According to research, mathematics is as necessary as the well-grounded mathematicians are in order for them to solve crimes.

EXPLORING THE ANCIENT GREEKS' MYSTIC AND TOPOGRAPHICAL SYMMETRIES

Thanasis Bakalis, Stelios Samaras, Sofia Bakali, Christodoulos Karapatakis, Diastaseis Private School, Greece

Geodesic triangulation of ancient Greece is a miraculous mystery. If we study the position of temples, sanctuaries and cities, we can see that geometrical patterns are formed such as isosceles and equilateral triangles, concentric circles passing from the same point as well as straight lines perceptibly joining cities together.

This harmonious relation comes to us, the younger ones, as a picture of colossal conception, making us shiver from great excitement.

It's worth wondering thus, if all this happened by a curious coincidence or as a result of mathematical calculations able to touch perfection. Is there a well-hidden secret refusing to be revealed even in these days?

MATHEMATICS AND MUSIC CAN EXPLAIN EVERYTHING

Soultana Fani Adamidou*, Alexios Flamouropoulos, Diastaseis Private School, Greece

Mathematics and music are two sciences which are strongly interrelated. These two arts have been affecting each other since ancient times and this interaction comes to our days. Music is a way of life and expression. Through music you can "travel" by carrying melodies in your inner self and in this way you can feel the beauty filling your soul and spirit.
Music therefore, is a way of expression that is common to every person. In parallel, the beauty of mathematics, for those who can comprehend it, lies in the simplicity, the symmetry and the elegance of their formulation. For Plato, mathematics was presumed "the utmost culmination of beauty". In addition, mathematics is undoubtedly a universal communication code.
When we seek for interrelations between music and mathematics, we reach the conclusion that MATHEMATICS AND MUSIC CAN EXPLAIN EVERYTHING.
No harmony would exist if numbers were not in existence. There would be no harmony if no man existed so as to listen to it and reckon it as such in order for numbers to be the appropriate tools for it.
No harmony can exist by itself.
Is it mathematics of music or music of mathematics that affects the human brain and activates it?

MATHEMATICS - POETRY: AN UNDOUBTEDLY CHARMING ENCOUNTER

Alexios Flamouropoulos, Soultana Fani Adamidou, Diastaseis Private School, Greece

As Nobelist Theoretical Physicist Heisenberg once said:
"...There are only two languages with which man can describe nature; Mathematics and Poetry"
Do mathematics and poetry have common characteristics, similarities, some relation, or are they separated by a vast gap as many believe?
Poetry is not only a way of expressing emotions, but also an attempt to interpret the world. It is man's general perception of beauty, which becomes the cause of inspiration for all areas in which it is expressed. Mathematics is the science concerned with quantity (meaning numbers), structure (that is, shapes), the connection between all countable things in reality and imagination.
- Is there such thing as a relationship between mathematics and poetry?
- How can mathematics and poetry bring together logic and emotion?
- How much and to what extent is our brain influenced by the poetry of mathematics and the mathematics of poetry?
- Could, perhaps, mathematics and poetry be the two windows which we need to open in order to gaze into and realize the chaos of reality?

THE PRINGLES FUNCTION

Saga Anderholm Hansson, Linnea Olsson, Polhemskolan, Lund, Sweden

Crisps are a beloved snack and the Pringles have a unique distinction: their shape can be described by the hyperbolic paraboloid. Therefore, we wanted to find exact function for our favourite crisps.
Our presentation will be about measuring a Pringles crisp to determine the constants a and b in $z = (\frac{y}{a})^2 - (\frac{x}{b})^2$, which describes the hyperbolic paraboloid. This function is infinite, so for it to resemble a Pringles crisp, we have to limit it. From above, the crisps look vaguely oval-shaped. The function for the crisps from "above" can therefore be roughly approximated using the following formula: $1 = (\frac{y}{c})^2 - (\frac{x}{d})^2$. In the end of our presentation, we will also briefly discuss other areas of application.

MATHEMATICS AND PHOTOGRAPHY

Aleksandra Dziadosz, Polhemskolan, Lund, Sweden

Mathematics can be found everywhere, even in the field of art. And to be specific, even in photography. Different photos are seen everywhere and behind every single one of them some amount of math is hiding. This presentation will briefly be about the usage of mathematics in photography, bringing up things such as the golden ratio and the rule of thirds, also a couple of rules that take use of simple mathematical formulas. In short, the presentation will be about everything that is needed to take the perfect pictures with some help of math.

MATH IN URBAN PLANNING AND CONSTRUCTION

Jakov Dolenec, Andrija Njers, Gimnazija “Fran Galovic” Koprivnica, Croatia

Ever since the early days of humankind, human needs have conditioned the planning of places of residence. Survival is a priority and therefore it is in the foundation of every civilization, as well as every human being. For example, the first caves where prehistoric people lived were places near a hunting ground, located on a territory that is easy to defend from wild animals.
In our talk, we will present some mathematically regularly designed cities and their streets (mathematically built cities), the reasons why they have been built in a particular form and the functionality of such urban planning. Why were medieval cities built in star shape? Is it related to the defence of the city? How have Barcelona and Palmanova been built? What is mathematically correct in the streets of Ciudad de Mexico, Paris and San Francisco? Does it help with accessibility, navigation, shortest distance, bus and tram lines? You can find the answers in our presentation.

A DAY IN THE LIFE OF A DESTRUCTIVE PROJECTILE

Andria Athanasiadou, Anna-Maria Hadjigregoriou, Constantinos Ioannou, Polycarpos Yiorkadjis, The GC School of Careers, Nicosia, Cyprus

Have you ever wondered how skilled marksmen are able to strike their targets at large distances with remarkable accuracy? How do engineers calculate the trajectory of military weapons such as mortars? Or even, how medieval war machines such as catapults with simple math, were able to siege castles and towers by launching large rocks at them, at high velocities, to cause damage? What factors affect the journey of a bullet that every sniper should consider? Can really a small change in air temperature or wind velocity gift life to the intended victim?
Well, your thirst shall be quenched! By using kinematic equations of motion, and some Microsoft Excel magic, we were able to analyze the motion of these projectiles as they fly through the air for the sole purpose of obliterating their target. The probabilities of hitting the bullseye are small but significant!
In order to accurately and efficiently strike our target, we must know what angle our mortar is firing from. To hit the bull’s-eye from a distance of 1 km, one must know the angle of elevation of their rifle. Through the wonders of mathematics, we can show you how it’s done.

WARNING: Do no try firing mortars at home.

SIMPLE MATHEMATICAL MODELS IN MUSIC

Nika Pishkari, Farzanegan 1, Iran

Mathematics is a powerful tool in the modeling of real world phenomena. It can be applied in music science. For example, harmonic series appear in tuning-up a device. In the opera hall, it is possible to use harmonic series to synchronize two instruments simultaneously. This paper describes how to make a simple models in music science with basic mathematics.

WHODUNNIT? MATHDUNNIT!

Anastasiadou Chara, Pavlou Kristina, Yamasaki Patrickiou Helena, The GC School of Careers, Nicosia, Cyprus

Strands of hair, traces of blood and the big question; “Who did it?” When a crime takes place, investigators are in charge of collecting and analysing any evidence found on the scene with the aim of unravelling its motive, the means used and, ultimately, the culprit. Such a task requires the application of logic and problem-solving skills, both of which are grounded in mathematical theory and practice.

After a bullet is shot, blood stains are created, which are then analysed by using trigonometric functions and stringing techniques to determine the angles of impact. Using projectiles, significant information can be acquired regarding the trajectory of the lethal bullet, leading to the discovery of the perpetrator’s height and position.

One of the most critical stages in investigating a crime scene is deducing the time of death, considering that it can play a vital role in the elimination of suspects and bring the case one step closer to justice. Newton’s Law of Cooling as well as principles of entomology are two of the main methods used for that purpose.

Additionally, utilizing statistics can be useful in various aspects of investigating a crime scene. Criminal analysts study the probability of encountering matching fingerprints and DNA samples in order to identify the suspect. Examining the stria patterns on any found bullets can help trace the weapon and its owner.

It is therefore safe to claim that criminals can only be caught using maths!

WHAT MAKES MATH AWESOME?

Stjepan Delekovcan, Gimnazija “Fran Galovic” Koprivnica, Croatia

Math is such a simple yet such a complex system of rules which apply to numbers, structure, space and change.

When people think of math they just think of boring numbers. They think of how complicated it is and how it makes no sense. When I think of math I see a game which gives me a lot of freedom as long as I respect rules that my teacher taught me. I have always been amazed by how much data we can calculate after being given just a little information. I have also been amazed by how many shapes we can construct without measuring or calculating using only a divider and a ruler.

In my presentation I’m going to talk about fun and interesting ways we can perceive and enjoy math. I’m going to talk about some interesting mathematic phenomenon such as the Fibonacci Sequence and Pascal’s Triangle. I will also compare math with some other, easy to understand concepts from everyday life such as sports and art.

I want to show people that math isn’t just the science of numbers and that it can be treated as a sport or as an activity which we enjoy doing.

MAGICAL SQUARE

Ailin Mirzaee, Roshd School, Zanjan, Iran

A magic square is an arrangement of the numbers in an $n \times n$ matrix, so that sum of the numbers of any row, any column, or any main diagonal is the same. Matrix 3×3 has 9 houses. Put the X in the middle of the matrix. Put the X plus 3 in the top left corner and X minus 3 in the lower right corner. Put the X plus 1 in the top right corner and X minus 1 in the lower left corner. X plus 4 in the middle of the third row and X minus 4 in the middle of the first row. X plus 2 in the middle of the third column and X minus 2 in the middle of the first column. So if we want to convert a particular number like 153 into a matrix 3×3, we divide it into 3. So it's 51.we put 51 in the center of the matrix. We divide the number of matrix houses by 2. So, by dividing 9 by 2, the number is 4.5. We do not count half and consider the number four. From number 51, we reduce the number 4 and add another number four again. Therefore 47 and 55 are obtained. So 47 is at home 1 and 48 is at home 2, and the number 55 is at home 9. We present the algorithm for creating various magic squares. We can generalize this method to 2n+1 and 2n matrices.

DATA COMPRESSION IN MUSIC INDUSTRY

Nima Rastgar, Amirhossein Ghorbani, 23rd Misagh St., Zanjan Ct, Iran

In the last decades, the improvement of the technology has affected the quality of the musical files. Initially audio files had low qualities and large sizes. Nowadays, technology engineers, with the help of Mathematics and specific algorithms, are able to compress audio files and they have made audio formats with high quality and low size. Thank to data compression, scientists have reduced the size of files from 50% up to 60%. The process of musical data compression should be done step by step and in this way there are many different formats. In audio compression, information redundancy is reduced by using different methods like “Omission of the same sounds” and “Encoding”. For example “MP3” is one the best and the most famous formats and we will discuss about it in our paper. Here are some ways to compress the audio files. In all audio files, some sounds are played simultaneously, but in compression procedure, the low sound is omitted and only the high sound is heard. In this procedure, the quality is almost as the same as the previous file but the size is reduced (Lossy Audio Compression). Also the range of frequencies of human voice is different from what they are in musical data, and by particular encoding methods the sound will be in high quality and with low bit rate and as a result in low size (Speech Encoding).

MATHEMATICS AND BALLET

Brenda Yuritzi Martinez Contla, Honorable Secondary School number 1, Mexico

Have you ever thought about the relationship between ballet and mathematics?
Ballet is an art and mathematics a science. Both are disciplines that are characterized by their self-demand and complication.
But you know about the wonder and infinity of movements that the body can make when dancing, in each movement the body is represented geometry. But how is it possible?
In classical ballet the perspective and image are fundamental, therefore the geometry offers a path to perfection in the proportions and forms of the body on the stage.
For example, in ballet some figures are perfect represented by polygons. The movements between these positions are executed following relations of symmetry. Each sequence of movements, like a turn are composed of an algebraic structure; you need to see the force that is needed to make the turn, the center of the body to find the perfect balance.
Bertrand Rusell said: “Mathematics is only the art of saying the same thing in different words”

ON PERFECT NUMBERS

Martin Lofstrom, Polhemskolan, Lund, Sweden

Already the ancient Greeks were interested in perfect numbers, numbers defined as such, that they are equal to the sum of their respective positive divisors excluding the number itself, and as early as when the elements of Euclid were written, one of their properties were proved. Despite its’ long tradition, it is a field with a lot more to discover. For example, neither the existence nor the inexistence of odd perfect numbers has been proved.
Two proofs have been fundamental for the research about perfect numbers. The first is the proof that every number with a certain prime factorization is perfect, which was firstly recorded by Euclid around 300 B.C. The other is that every even perfect number has this prime factorization. Only two millennia later this was proved by Euler, probably because the notion of function is a powerful tool in the proof.
In the presentation, proofs of these theorems will be given, hopefully in a simple and pedagogic way. Hopefully, these proofs will not only give you an additional mathematical fact, but also inspire you by the methods which will be used therein.

SEQUENCE RESULTING AS SOLUTION OF TWO COMBINATORIAL PROBLEMS

Russu Vladimir, Theoretical lyceum A. Puskin, Chisinau, Republic of Moldova

Often combinatorial problems are very difficult. However, a difficult combinatorial problem can be simplified that is the goal of science – to serve people.

For example, a common problem: a city has the form of a rectangle and a network of n streets towards North-South and m streets towards East-West. How many ways are there for tourist to get from vertex South-West to the North-East one of the city moving in the direction from West to East and from South to North across the streets?

This problem can be reduced down to the similar one that is about the number of ways to place m red balls and n yellow ones in a tube.

Our purpose is to examine the sequence resulting as the solution of 2 combinatorial problems.

First problem: $2 \times k$ an $2 \times n$ rectangles are given; dominos represent 1×2 rectangles. How many ways are there to full $2 \times k$ and $2 \times n$ rectangles with dominos so that they will contain an equal number of vertical dominos?

Second problem: two parallel lines are given. The first contains k, the second one n indicated points. These points form pairs so, that segments, connecting points in each pair, do not intersect. What is the number of pairs?

Solutions of these two problems result in a reasonable sequence. In our work we study properties of this sequence and it's connection with other well-known sequences.

IT ALL STARTED WITH A BET

Zorpas Stephanos, The G C School of Careers, Nicosia, Cyprus

Some people learn to solve the Rubic's Cube to train their minds, others to fake intelligence and some do so simply to impress people. When I was ten my father didn't think I could be self-taught to solve the Rubic's Cube let alone to do so in less than a minute. So he challenged me…."Here is your Cube. I bet you can't learn how to solve it in under a minute".

In the process of learning how to solve it I became fascinated by it though and wanted to know more. Who came up with this and why? Is it just mathematics, spatial orientations, permutations? Is it all about the algorithms? Or is it all of the above? More questions such as what's the least number of moves required to solve it sprung into my mind? How about other similar puzzles such as the pyraminx, the 2X2, the 4X4 and the gear ball?

Well, the bet was on, and in no time I was the winner and proud owner of a brand new PS4.

A CIRCLE ROTATES TOWARDS EXCITING MATHEMATICS

Galati Lina, Pachni Ioanna, Perroti Loukia, Pimbli Natalia, Tzanetou Elena, The Moraitis School, Greece

Suppose you want to construct a waterslide that will take you in the least time down to a given point. Which would the waterslide's curve be? Also, imagine that you have a circle rotating inside another circle of twice the diameter. What shape would any point on the small circle make? Moreover, is it really impossible to turn a circle into a square of the same area?

In our presentation, we address all these problems that have one main common characteristic: the (rotating) circle. We also show that these problems are not only brainteasers with mind-blowing solutions, but more importantly, have led to the rise of fields within Mathematics such as the Theory of Variations.

ELLIPSE: AN INCREDIBLE, YET OFTEN OVERLOOKED CURVE

Georgiou Stavroula, Nikolarea Nikolina, Mamais John, The Moraitis School, Greece

The intersection of a plane with the surface of a cone can create four shapes, which are called conic sections. The Ellipse is one of them and although it is present in our everyday lives, we do not really pay attention to it.
In our presentation, we demonstrate methods to draw ellipses, specifically the trammel method, the use of the ellipsograph and an interesting approach using two pins, a pencil and some string. We discuss characteristics like the foci, eccentricity, the reflective property and more. And, of course, we mention instances in which ellipses appear in the real world. Did you know, for example, that all planets of our solar system follow elliptical orbits? Do you know how elliptical whispering galleries work? We also present other applications in the fields of medicine and architecture.

P VERSUS NP

Antonis Bourtzinakos, Dimitra Iosifidou, Stefanos Kantaros, Ioanna Kolyva, Pantelis Mexas, Panagiota Mouteveli, Elena Tziveleki, Georgia Okka, Loukia Pragmateftaki,Dimitris Proios, Evgenia Skagkou, Giorgos Sgourakis, Zanneio Experimental Lyceum of Piraeus, Greece

In this work we try to study one of the most famous mathematical problems that is yet unsolved, namely P vs NP. The P vs NP question (one of the six millennium prize problems) regards the difference between the class of problems that can be solved in polynomial time by a deterministic algorithm and the class of problems that can be solved in polynomial time non-deterministically. Are these problems identical in terms of time complexity or not?
We present the history behind the problem, explain the importance of the problem regarding various domains (from science to art) and explore the applications that its solution will provide. We then proceed by giving all the necessary definitions needed to describe the problem in a concrete way, we present some problems from both P and NP, while we also try to catch the essence of the difference of these two classes by also exploring their meaning from a philosophical point of view. Finally, we conclude by studying the reduction proof method, the main mathematical tool used in order to understand in which class each problem belongs.

COLORING SIERPINSKI TYPE CARPET

Radoslaw Peszkowski, Andrzej Szablewski, Jan III Sobieski High School in Krakow, Poland

In our presentation we will show a solution to an interesting problem concerning the Sierpinski Carpet. It is well known, that this object is a fractal. That means that taking a part of it and enlarging, we will get the same object. The Carpet is constructed recursively. Our question is: What is the number of edges in various steps of creating the Sierpinski Carpet? During the presentation we will answer this question, and we will show many interesting mathematical relations in the Sierpinski Carpet. We will also present a version of this question involving colors.

POLYNOMIALS: FROM A ROUTINE EXERCISE TO A VAST GENERALIZATION

Pawel Jarosz, Oliwia Jarzęcka, Arkadiusz Ludzik, 7 LO im. Zofii Nalkowskiej w Krakowie, Poland

Our starting point is the following routine problem: given two numbers such that their sum is 1 and the sum of their second powers is 61, determine the sum of their third powers. We observed that in order to answer this question, it is not necessary to know the numbers separately. We also observed that this also the case to determine the sum of fourth powers and higher powers. We started to look for general formulas and discovered striking patterns. We will present them, partial proofs and some computer experiments.

SOLVING FERMAT EQUATION IN 2x2 MATRICES

Antoni Dera, Kajetan Grzybacz, Alicja Madeyska, 7 LO im. Zofii Nalkowskiej w Krakowie, Poland

The equation

$$x^2+y^2=z^2$$

has infinitely many, nontrivial solutions in integers. They are known as Pythagorean triples. A similar equation

$$x^n+y^n=z^n$$

for n greater or equal 3 has no solutions in integers. This fact is known as the Big Fermat Theorem and has been proved only recently by Andrew Wiles. We learned about matrices and wondered if Fermat equation might have solutions in integral matrices (i.e. such that every term is an integer). We will report about our ongoing experiments and partial results obtained so far.

HOW MATHEMATICS WON WORLD WAR II

Sergei Novikov, Mariia Goncharova, Ekaterina Lazebnik, The Heritage Private School, Limassol, Cyprus

A cryptographic invention and among the greatest encryption devices in history, the Enigma machine was created by the German engineer Arthur Scherbius towards the end of World War I. Its main purpose was the encryption and decryption of radio messages. Throughout the next couple of decades, it was developed using new, highly secure cryptographic methods. Furthermore, the use of the machine by the German military during World War II was crucial in ensuring secret communication and undercover operation. It was extremely difficult to interpret Enigma codes in order to decipher its message without having an identical machine, as there are millions of possible encoding combinations. Although not impossible. The British, gathering some of the strongest minds in country, tried breaking the Enigma code. Hut 8, a team led by Alan Turing, eventually succeeded by creating a machine that became one of the world's first computers. This was considered by western Supreme Allied Commander Dwight D. Eisenhower to have been "decisive" to the Allied victory. Historians estimate that breaking Enigma shortened the war by more than two years and therefore saved countless causalities.
Our research revolves around the history of the Enigma machine, the details of its operations and the attempts to break the code. Using a simplified method, we will show how each letter is encoded. Let us explore the importance of decoding Enigma during World War II, the passion, persistence and methodology that finally won the war!

BAYES' THEOREM

Nicolas Georgiades, Charalampos Zacharia, The English School of Nicosia, Cyprus

In our presentation, we will explain Bayes' Theorem and how it is linked with conditional probability. The theorem describes the probability of an event, based on prior knowledge of conditions that might be related to that event. We will illustrate Bayes' Theorem through real life situations. One such situation is when a patient visits the doctor and undertakes a test for a rare disease and tests out positive. However, what's the probability of that person actually having the disease, given that the test is not 100% accurate? Additionally, Bayes' Theorem can be applied in situations where we have knowledge of the outcome but don't know how we reached it. Suppose we have a number of balls of two different colours placed in each of three bowls and one ball, whose colour we know, is picked out randomly. We can use Bayes' Theorem to find from which bowl the ball has most likely originated. Another example could be that one of your friends tells you that he is 100% sure that something will happen, but you don't believe him. Can you use Bayes' Theorem to prove your friend wrong?

MATHEMATICAL FALLACIES

Georgia Tzyrka, Savvas-Odysseas Makariou, Vasiliki Kalimera, Christia Kai, The English School of Nicosia, Cyprus

The universe cannot be read until we have learned the language and become familiar with the characters in which it is written, as once said by Galileo Galilei. This is the Mathematical Language! And the letters are the infinite numbers, curves and other geometrical figures. Mathematics is the one that directs the flow of the universe, a precise model of real phenomena and an explanation to common fallacies we, as human beings have. Imagine. It's the end of a long action movie. The hero and villain are in a mad chase over a city skyline to deactivate and trigger a nuclear bomb respectively. The villain throws himself down on a curved piece of architecture and the hero throws himself into the air and hits a lower part of the curve with the intent to slide to the bottom faster. But they both take the same time to reach the end of the curve. How, and why is that? Well, this is due to the tautochrone curve theorem, proved by Huygens back in the 17^{th} century. Yet as far as the laws of this ingenious language refer to reality, in fact its numerical letters are not certain, and as far as they are certain, they do not refer to reality. We tend to look at all numbers as fixed finite figures, without questioning why. Why is it that we take $0.9\dot{}$ to be 1, or why 1 may be equal to 2? Well, all these can be proved!

PRIMALITY TESTING AND CARMICHAEL NUMBERS

Martin Boyanov Stefanov, Sofia High School of Mathematics, Bulgaria

Nowadays our data or information security becomes more and more important sometimes equally vital as our own life security. It is difficult to imagine life without credit cards, e-commerce or password protected personal data. Cryptography is applied in all three areas above and even beyond them.
What we need mostly in order to crypt any information is a large prime number. The larger the number the more secure is the encryption and the more difficult it is to prove its primality. This is where the need to find more and more effective primality test comes from.
The first part of the project gives an overview of prime numbers, their infinity and first methods for primality testing. The work continues with review of Fermat's Little Theorem, Carmichael numbers and Carmichael function, the Rabin-Miller test and how these methods could be applied for primality testing as well as what their failures are. The author's contribution in the current project apart from summarizing the theory and its rationale, is in the developing different example-problems demonstrating these methods.
More and more is done to simplify the algorithm of primality tests in order to find faster large prime numbers necessary in life.

WONDERWOMEN

Lilikaki Marianna, Mavragani Christina, Safarika Eleftheria, Zein Christina,
Pierce-The American College of Greece, Greece

Mathematics as a science have existed for a period of approximately 2500 years and throughout these 25 centuries of human history many people have had a significant effect in their development. Most of us have indeed heard in a discussion or read in an article the names of prominent mathematicians such as Archimedes, Newton, Gauss and several others, while some of us are perhaps even familiar with their work. However, what most of us seem to be unaware of is the fact that the mathematicians mentioned are in almost every single case men. This does not mean that representatives of only one of the genders have helped shape Mathematics into the science we know today. A large number of women have also added their inputs and ideas and have assisted in the creation of modern day Mathematics but most, if not all, of these women had to overcome obstacles presented to them by the fact that they were women or even the color of their skin. In this paper we have selected four women mathematicians who have contributed greatly to their discipline and we will present their celebrated work as well as their extraordinary lives.

GOLDEN RATIO

Barla Anastasia, Barla Dimitra, Theofani Ioanna - Myrto, Theofani Maro - Athina,
Pierce - The American College of Greece, Greece

The science of Mathematics with its numerous theorems and propositions plays an important role in several areas of our lives. This is true, despite the fact that we may not always be able to recognize the application of mathematical results every single time we encounter or use them. In an effort to justify this argument we have decided to focus on a particular mathematical discovery - namely the golden ratio - and document some of its applications. The golden ratio, denoted by mathematicians with the symbol φ, corresponds to a particular irrational number. What makes φ unique and deserving of our attention is the large number of instances where we come across it. Indeed, we will demonstrate how the number φ and its properties have influenced almost every aspect of human life for a period of more than 2000 years. Furthermore, in our paper we will present some occasions where the number φ is apparently found in natural circumstances and the heated debate surrounding them.

GAME THEORY AND THE COLD WAR

Paulina Acova, International School of Moscow, Russia

Although the Cold War ended 27 years ago, it had major consequences around the world, some of which still affect the us today. It led to the USSR embarking on capitalist economic reforms, caused the formation of NATO, and the formation of 15 new nations.
In short, had the outcomes of the Cold War been different, we would live in a totally different world.
It is easy to assume that many of the outcomes of the situations during the Cold War were simply coincidences and that there was no way of predicting what the consequences of various events would be. However, this is not the case, as Game Theory played a major role in forecasting the outcomes during the Cold War. This presentation focuses on how so.
The national security policy of Mutually Assured Destruction in particular, was heavily based on Game Theory. Both the USA and USSR acknowledged this and therefore employed top game theorists to aid with decision making. In fact, what if Mathematics could be used to explain more than just the outcome of the moment in which policy of Mutually Assured Destruction became obvious? More importantly, what if it could explain the moment in which the world was, arguably, the closest it has ever been to a nuclear war? This presentation will therefore also look at explaining the final outcome of the Cuban Missile Crisis using Game Theory and the Prisoner's dilemma.

MATHEMATICS IN COMPUTER GAMES

Mayya Mukhina, International School of Moscow, Russia

Mathematics is integral to the functionality of computer games. Without it, the games available to us now would just not exist. How do characters move, or enemies approach other characters in a game? No one suspects what magic lies behind the colourful screens. In fact, one of the most fundamental theorems of all is used to calculate the distance between objects – this is Pythagoras' Theorem. It helps us to calculate a hypotenuse, which can be used to move characters from one place to another. As well as that, trigonometry is used to calculate angles and bearings between sprites.
The code demonstrated in this presentation will show a basic simulation of an original computer game. In the talk, participants will be familiarised with every step of the code including the problem of moving a sprite diagonally, as there is no single function that can be used to do this.
To summarise, without Mathematics, it would be impossible to make the high-resolution games that everybody loves so much. After seeing this presentation and learning the Mathematics of the game, maybe participants will be able to produce their own flawless games. Indeed, the moment the programmer's code outputs as intended, every fibre of their being enters a whole new world, overflowing with joy and pride.

MATHS OR LUCK?

Alexandra Anastassiadou, Andreas Lordos, Andreas Yiakoumis, Christos Antoniou, Petros Vassiliades,
The English School of Nicosia, Cyprus

In this presentation, we will be explaining how one can use mathematics in order to increase the probabilities of winning at popular, traditional and well-known board games. We will cover board games such as Risk, Guess Who and Monopoly - in other words, games which can be won or lost by pure 'luck'. The best strategies are the ones based on mathematics and we are going to prove this by showing how the probabilities of victory can be drastically increased using such methods. We will be using Monte Carlo simulations and other computational algorithms in order to back up our research and claims. Through the presentation, we will show you which regions are the best for controlling in Risk, when the best time is to attack and when to defend and prove it all using mathematics. We will also show you which are the best questions to ask in Guess Who, and prove why they are the most effective. Finally, we will demonstrate which are the best properties to buy in Monopoly. We aim to change the way you approach board games, not just as games of chance but as games of skill, knowledge and strategy.

MATHEMATICS IN MUSIC, POSSIBLE OR IMPOSSIBLE?

Octavio Tristan Penaloza Sanchez, Rosario Castellanos, Mexico

This text is about giving an explanation about the relationship between mathematics and music, as well as the taste I feel for them.
How to answer this question? If you would not know what to answer, I tell you that me neither. Once my parents decided to take me to the Tepoztlan Youth Symphony Orchestra in the state of Morelos, Mexico, which is a community group, at that time I was 8 years old, and I was one of those children who were restless that nowadays they call them hyperactive.
I was looking for what to do, my restlessness had a meaning that I had not yet found, my parents took me to swimming and I did not do it, I went to take kwon do, it did not work, and music, since I heard this last word, wise that a world full of wonders awaited me.
Little by little I was taking pleasure and sense of these activities and without realizing it I was acquiring skill and mastery in both mathematics and music, unnoticed by the close relationship that exists between them. I miss the math since childhood as something that is brought in the blood, well I also help the therapy to which I was sent in which imitated the movement of 14 animals (two of them are my favorites and are the crab and the frog) which I found fun and also had a rhythm.
And returning to focus on the subject, I will talk about some definitions about mathematics and music trying to explain the stratum relationship that exists between them in a peculiar way, the Tavo way, that is, in my own way.

PASCAL'S TRIANGLE

Ivan Ventsislavov Georgiev, Martin Boyanov Stefanov, Sofia High School of Mathematics, Bulgaria

Pascal's triangle is widely recognized model which is the foundation of various astonishing patterns and applications in the area of Algebra, Combinatorics, Probability theory and Number theory. The thesis is presenting history of Pascal's triangle and Blaise Pascal biography, definition, main properties and applications. The properties presented are: Diagonals, Sum of Rows, Exponents of 11, Symmetry and Borders, Hockey Stick Patterns, Square Numbers, Prime Numbers, Fibonacci Sequence, Catalan Numbers, The Star of David, Cube Numbers, Points on a Circle, Sierpinski Triangle. Using Pascal's triangle, three applications have been demonstrated via theory concept and specific examples. These are Newton's binom, Combinatorics and Probability theory. The thesis is giving an overall view on Pascal's triangle theory and applications in a conceptualized and understandable manner.

MATHS AND AUTISM

Alevrogianni Despoina, Karali Anastasia, Mavropoulou Natalia, Papadede Anna-Maria, Skoura Noni, Nea Genia Ziridis School, Greece

Only limited range of people know what autism is. Actually autism presents as a disorder of profound social disconnect rooted in early brain development. A child with autism may appear unaware of his surroundings. He may also fail to respond to the sights and sounds of a social world. Often, with limited speech and language skills, the child follows a different development pattern compared to other children in the same age group. He has difficulty playing with other children and making friends. Alone, the child engages in restricted, repetitive behavior that is hard to understand. On the other hand we all know what Mathematics is. It is the science that deals with the logic of shape, quantity and arrangement. Math is all around us, in everything we do. It is the building block for everything in our daily lives, including mobile devices, architecture, art, money, engineering, and even sports. Though children with autism spectrum disorder often have difficulty with social interaction and communication, they're also much more likely to be savants- to show extraordinary skill in a particular area, like music, art or math. Of course not every child with autism happens to be a math whiz but because of their slightly different brain organization many autistic children show an above-average math skills. In our research we will examine the way autistic's children brain works and how they understand mathematics. Also we will observe some autistic behaviors. We will understand the difficulties that those people face and the 'benefits' they have when it comes to mathematics.

DIDO AND HER PROBLEMS

Giannopoulou Sofia, Grigoriou Katerina, Raptis Aggelos, Taraboulous Zak, Nea Genia Ziridis School, Greece

Dido and her problems…But really who is Dido and what kind of problems could she be facing? Dido was the beautiful princess of Tyros and when her father passed away it was time for her and her husband to reign. Unfortunately. Dido's brother killed her husband and she was forced to leave Tyros traveling all the way to South Africa. Dido is closely connected to the isoperimetric problem (Out of all the closed plane curves of a given perimeter, the circle is the one that encloses the greatest area).The isoperimetric problem is the first maximization problem to ever exist .During our presentation you will be informed about all the details concerning Dido's story and you will see examples of practical application of the isoperimetric problem .We hope you enjoy!

AREA OR PERIMETER OF CIRCLE WITHOUT PI

Daniel Jovanovski, Zoran Acevski, Filip Kostadinoski, Boban Blazevski, Yahya Kemal College, FYR Macedonia

Many students do not like reading text in mathematical statements but numbers and equations. We showed that there is a way to π from the high school math. In this project we combined geometry and algebra. We used a similar method, regular polygons, with Archimedes but instead of long calculations we used simple trigonometry that taught in the high school. We have seen mathematical beauty, infinity and we saw that π can be express as product of two numbers that one of them is a natural number. On the other hand we can calculate area or perimeter of the circle without π. Finally we saw that there is a relation with the number of sides of the regular polygons and digits of π which can be a new progress.

SHADING VENN DIAGRAM WITH GRAPH

Jusuf Xheladini, Amar Ademi, Yahya Kemal College, FYR Macedonia

Shading a Venn Diagram is a pictorial representation of the relationships between sets like union, intersection, difference and so on. We used inequalities to shade the wanted region which is represented by set notations. This project shows a mathematical way for this shading process and also we can express shading Venn diagram mathematically. With these inequalities we can understand which region is wanted just by looking at the inequalities without drawing. We showed that shading Venn diagram is also a mathematical process that can be used for digital learning.

FIGURE-ING A PUNCH

Aggelos Raptis, Lydia Nikiforiadi, Sofia Kotzamani, Malamatenia Karagianni, Anna-Maria Papadede, Nea Genia Ziridis School, Greece

Could someone believe that two extremely different sports such as karate and figure skating have so many similarities? Well… nothing is impossible. In this paper we will examine the forces and mathematical structures, which are the same between karate and figure skating. Pressure, friction and other factors are presented in both sports. However, there are also many differences based on the technique and rhythm of movement. The presentation is based on a TV program, in which Lydia, the reporter, is introducing to the audience the guests, 2 athletes and their coaches, and then they analyze all together through discussion the matching points of these two activities. On the whole, they reach a conclusion stating the connection between them.

PLACE YOUR BETS

Christodoulou Maria, Fousteri Grigoria, Hadjopoulou Tatiani –Rita, Mania Christina-Ioanna, Petraki Maria, Rova Athena, Sotiriou Alexandra, Nea Genia Ziridis School, Greece

Have you ever wondered why your pockets always run dry during a casino night? Have you ever thought about how you can master one of the most popular wagering games of all time? In this presentation, together we will take a look deep into the principles of a game whose roots go back four centuries: the roulette. To begin with, we will be exploring its origin and how it has evolved throughout the years. Furthermore, we will determine the range and variety of ways of betting. In the second part of our presentation, we will be dealing with great minds whose systems and theories have helped crack open the mysteries hiding behind the roulette. Understanding its conception may seem hopeless and it is. However, there is a variety of methods that you can use to improve your game, which will be analyzed and demonstrated. Last but not least, we will uncover how you are being tricked by the casino, which is a corporation whose one and only goal is profit. People seem to ignore the presence of mathematics hidden in the most unforeseen places. Mathematics are the puppeteers of the universe. Utilizing the concept of the roulette, we will be revealing a tiny part of this infinite reality. Let us be your croupiers.

PARADOXES AND HUMAN LOGIC

Pantazopoulos Nikos, Kontostoli Anastasia, Alexandri Lydia, Sideris Stefanos, Nea Genia Ziridis School, Greece

What are paradoxes and how can they be solved? How could a turtle run faster than Usain Bolt? Is it possible 9.9999…. equal to number 10? All these questions have strange solutions and even more strange answers! We are going to try to figure out their meaning. We will examine the way a lot of well-known mathematicians and philosophers thought and what was the result of their work upon paradoxes. We will also make our way into deep mathematical logic. We will observe how humans examine all these data and how they eventually come up with paradoxes. Finally, we will try to think together with our audience and create a paradox of our own. Right or wrong, true or false a paradox is always a great opportunity to test the limits of our thought.

IT'S COMING

Petar Vuckovic, Gymnasium, Kotor, Montenegro

Doomsday. Is it coming? When? Unfortunately we don't know, but we can use pure math logic and possibility to try to work out this still unanswered question. The Doomsday argument, the only empirical prediction made by philosophers, helps us to be at least one step closer to the discovery. On the other side there are a lot of people who think they know what's wrong with this argument but they can't explain it and they are usually misunderstood. Suppose the Doomsday argument is correct, what precisely does it show? It doesn't show that there is no point trying to reduce threats to human survival because we are going to be doomed anyway. One of the factors of this argument are humans. If we try to reduce the risk that any kind of technology will be misused to destroy intelligent life, for example that would reduce the prior probability of Doom Soon! Doomsday argument contains an interesting idea but it must be combined with additional assumptions and principles before been applied to the real world. Everything what we can do till that day is to wait and try to take all advantages of the day! Carpe diem!

STUDENT PRESENTATIONS IN SCIENCE

THE FUTURE OF GENE EDITING

Marinos Eliades, Marika Stephanou, Ekaterina Ignashova, The Heritage Private School, Limassol, Cyprus

“Every living thing on this fascinating planet we live in is composed of microscopic structures, called cells.” These were the words of our science teacher, a few years back, when we first became familiar with the concept of cells! Since then, our curiosity for these structures has grown dramatically, thus letting us explore all kinds of new and exciting discoveries. Particularly, a relatively new technique of gene editing caught our attention. This new technique basically imitates the way that bacteria identify viruses and eliminate them, to modify the DNA of humans, animals and even plants. Although this technology is new, it is revolutionary as it will be able to treat different kinds of diseases, which are caused by genetic mutations. This new technology is formally given the name of CRISPR-Cas9 and in its development, it will be a total gamechanger for a vast number of species!

A PICO-SATELLITE EMBEDDED IN A SODA CAN FOR ATMOSPHERIC MONITORING AND TELEMETRY TRANSMISSION

E. M. Buga, W. N. Derscanu, M. Nechifor, S. I. Tanase, Alexandru Cel Bun” College, Gura Humorului, Romania

C. Turturean, M. E. Zagan, D. Tanase, Spiru Haret” Computer Science National College, Romania

In this paper we present results concerning the UV index, temperature, magnetic induction and athmospheric air pressure measuremnets using a pico-satellite embeded in the volume and shape of a standard juice can (350 ml). The pico-satellite consists of an arduino micro-controller, UV sensor, 3-axis accelerometer, temperature and pressure sensors, 3-axis gyroscope, camera, RF commuinication system and a Global Positioning System (GPS). Our device is capable to perform some of the tasks that artificial satellites perform after being launched from a drone, plane or helium balloon from an altitude of 500 m. Once launched it will transmit data using electronic sensors to the ground station. A parachute is also integrated to control the pico-satellite descent rate. An overview of mission requirements, mechanical design, electronic circuit design and the tests results are also presented in this work.

PASSPORT, PLEASE

Petar Vuckovic, Gymnasium, Kotor, Montenegro

The question of traveling through time has always been a problem that bothered me as well as common people while scientists have tried to solve or disprove the theory. That is why I decided to deal with it in this paper. I found out that Ben Tippett, mathematician and physician, recently published a study about the feasibility of time travel. With the help of math and physics, he has created a formula that describes a method for time travel.

It is wrong to divide space into three dimensions, i.e. it should be divided into four separate dimensions which should be imagined simultaneously, where different directions are connected, as a space-time continuum. Tippett, using Einstein's theory, has discovered that the curvature of space-time accounts for the curved orbits of the planets. He thinks that even if it is mathematically possible, it is impossible to build a space-time machine because of special materials that have not been discovered yet.

Tippett’s new mathematical model (TARDIS) is described as a bubble of space-time geometry which carries its contents backward and forwards through space and time and it moves through space-time sometimes faster than the speed of light, allowing it to move backward in time.

My luggage has been packed and I am waiting for time machine!

CARTOONS IN PHYSICSLAND

Maria Kaltaveridou, Daria Kovanova, Diastaseis Private School, Greece

"What would cartoons be like if physics laws were in effect?"
The truth is that all of us have spent hours on watching animated cartoons. We have all laughed with the heroes' blunders. We have all felt anguish while watching Sylvester chasing Tweety orTom chasing Jerry and we have all felt joy while watching Elmer razed to the ground in his effort to catch Bugs Bunny. Innumerable times, we have seen the heroes experiencing complete disaster but in the end, they always came back to their former shape, safe and sound.
No wound, no scar or movements and motion in general, were affected by gravity. We could watch the heroes' thoughts suddenly take shape and acquire entity skills. They could also become completely flat. It seems that for the animation cartoonists no physics law exists.
But what would happen if they followed those laws?

EVOLUTION OF SPECIES AND ENTROPY

Thanasis Bakalis, Stelios Samaras, Sofia Bakali, Christodoulos Karapatakis, Diastaseis Private School, Greece

It is a common misconception that the evolution of life contradicts the 2nd Thermodynamic Law. We argue that such a configured phenomenon as species evolution could not but be in accordance with the laws of physics. The 2nd Thermodynamic Law states that in a closed system entropy always increases. For the purposes of our study, we consider entropy as a measure of energy disorder and we will take into account that thermal energy is the most degraded, disordered, hence highly entropic form of energy. The Earth is an open system which constantly receives solar energy. During this process, while life evolves, living organisms may store energy in an orderly, low entropic way, but at the same time the sun entropy increases, while living organisms and functional ecosystems release highly entropic thermal energy. We may say that in a non-equilibrium system such as Earth, the variable species are the dissipating structures, with the ultimate goal of solar energy degradation to a disordered thermal form. Considering the aforementioned, life is not only compatible with the 2nd Law of Thermodynamics, but also necessary for its application. Despite the various approaches to determine whether evolution has connection with physics, from Boltzmann to Schrödinger and Eiger, there is still one question that arises. Since Earth and the evolving terrestrial life is a non-equilibrium system can entropy really be defined? Or maybe there should be some other parameters to estimate, in order to clarify this long-term debate about life being an improbable occurrence or an inevitable path given the circumstances of its origins.

FUTURISTIC HUMAN VISION WITH LENSES

Tsempis Konstantinos, Diastaseis Private School, Greece

Glasses have already 'invaded' in everyday lives due to the continuous use of technological devices and gadgets, which cause a lot of eye strain. Furthermore, many people are taking advantage of their aesthetic presence and incorporating them into their entire look. However, this eye strain, ends up developing refractive errors on the individuals' eyes. Contact lenses, prescription frames, and refractive surgeries are all together aiming to correct all the abnormalities that are caused from the refractive errors (myopia, hypermetropia, astigmatism, presbyopia, a.o.), thus providing better vision quality.
- Do they address the problem at its roots?
In the future, there is a possibility that our glasses will be adjusting themselves for different purposes of use, for example we will able to focus on an object several kilometers far away, see through solid structures like X-rays, they will protect our visual system from radiations either natural e.g. solar or man-made e.g. nuclear power, e.t.c. Our contacts will send an SMS when our eyes need hydration or the eye pressure is above the set limits.
- How will optics, ophthalmology and human eye system biology develop in the following years?
This presentation will be addressing general informative content about lenses, and refractive errors, and we will all disodiscuss the future of human vision.

THE EIGHTH DAY

Alexander Symeonidis, Diastaseis Private School, Greece

From the beginning of human existence, there has always been a need for a divine and an overwhelmingly more powerful being than us, because of our obsession to understand nature. In many cultures, God is often referred to as “the creator”. But in today’s societies, we’ve mimicked God and become creators ourselves. In 1859, one of the most important books in science history was published with the title “On the origins of Species”, written by Charles Darwin. His book shifted human thought and how our societies and civilizations were constructed. He explained how nature essentially developed itself by chance. But today, we’ve forged that knowledge and become the living representation of a God. With the help of the vast amounts of processing power by computers, we are able to simulate nature and the whole process of biological history. We have created the tools and the methods to simulate the basic principles of the Darwinian Theory. By applying these principles to the computer, we can create software that evolves through time, just like humans and any other species do, making us “creators”. With the creation of the so-called “Machine Learning”, we are creating algorithms and we are applying them to our everyday lives. From processing data and analyzing them to stabilizing the global economy, these algorithms control most of our everyday lives. The main achievement and goal of this presentation is to relate the Darwinian theory of evolution to the evolution of software. If nature is the one that chooses the most adaptive creature to be the one living, what is the power that drives the evolution of algorithms?

THE MAGIC OF COSMOGENY, A NEVER-ENDING QUEST

Georgiadis Doukas, Diastaseis Private School, Greece

The journey began 14 billion years ago… Man’s journey though started when the first men - as thinking beings – asked themselves “why?” and “How?”. Man has always had the need to explain anything existing, moving or functioning around him. That is the reason why he queried “why” and “how”. How was the world created? That is how it all started. Firstly, theologians tried to explain cosmogony on the basis of divine or metaphysical forces. On the other hand, common people, throughout the years, turned to myth-making in order to give explanations about the creation of the world. Further to myth-makers, it was the philosophers’ turn to give their own interpretations. The first attempt of explaining the world creation philosophically was by Thales of Miletus. Plato and subsequent philosophers as well, based their ideas on the qualities and propensities of the four elements. In the meantime, the Enlightenment, research and eventually natural sciences bring to light important results and essential conclusions after a series of great discoveries and inventions. Science and technology therefore, after billions of years, make man’s long lasting journey reach its peak. The dominating theories on the creation of the world are two. First is the theory of the great explosion and second is the one of superstring theory. Finally, how was the world created? What happens with time, place and any other dimension? Are we talking about a restless circular course of beginning and end, creation and collapse? In this essay, there will be an attempt for the most of the above questions to be answered.

INVESTIGATING THE EFFECTS OF E.M. PROBIOTICS

Conn Caomhan Muiris, Con O Meachair, Brownswood, Enniscorthy, Co. Wexford Ireland

As young scientists, we feel strongly that not enough action is being taken to care for our environment. Environmental reports publish that greenhouse gas emissions are on the rise and it was reported this year that many of our Irish rivers are polluted (Irish Times, 2017; EPA.ie, 2017). We witness a society that involves putting high levels of fertilisers and sprays on our land and the cleaning of our homes with harsh chemicals. In our research, we investigate the effects of Effective Microorganisms (E.M.) on Agriculture, on Aquaculture, on Greenhouse gas emissions and on E.M. as a cleaning agent. The project incorporates statistical analysis to investigate the effect of E.M. on plant growth, on Dissolved Oxygen levels in water, and on the reduction of Nitrous Oxide N_2O from fertiliser and animal decomposition. The research examines E.M. as a natural and sustainable solution in the treatment of soil, water, air and in domestic use.

REVERSE CONVECTION

Sana Sasani, Nemooneh Meraj School Zanjan, Iran

Heat is transmitted through three ways: radiation, conduction and convection, and human has chosen the convection method as the most appropriate heat transfer path, from a long time ago. Its reason is that the human is surrounded by a fluid called "air". But this method has a fundamental problem: it is that a significant part of energy is spent on the warming up of the upper air in closed environments, and the heat is transported less to the lower parts. In this paper, an attempt has been made to solve the problem by relying on experimental methods and performing various experiments and using the principles of physics and mathematical methods. By conducting various experiments and expressing the mathematical functions and drawing the corresponding diagrams, we first studied the distribution of heat within closed environments such as buildings, and the necessary measures were taken by examining the obtained graphs and their aggregation in relation to raising the average temperature of the closed environments and the location of the device provided for the creation of convection flow. The height of the installation site was 0.3 meters and 2.7 meters from the floor of the desired location, and as a result, significant savings were made in energy and finance, by installing this device.

PERFORMANCE OF PHOTOVOLTAIC CELLS

Shirel Haibi, Adam Zakheos, Styliana Charalambous, Hadjer Nihat, Desley Gombault, Ellada Mandriti, Souzianna Kiteou, Mediterranean Schools, Cyprus

This project will briefly summarise and explore what photovoltaic cells are and how they react under different conditions. Firstly, photovoltaic cells are made up of silicon, which makes them possible to conduct electricity. They have similar properties to semiconductor devices, therefore at low temperature surroundings they act like insulators and at high temperature surroundings they act like conductors. Since they can act like semiconductors, a negative and a positive face is required, thus when conductors are attached to each face, an electrical current is formed. In addition, shorting a photovoltaic cell, a photocurrent is generated which is proportional to the amount of sunshine, but when there is no connection, the photocurrent is shunted and a voltage is produced. Also, when photovoltaic cells are connected in a series, the photocurrent generated remains at its initial value, proportional to the irradiance, whereas the number of cells connected together multiplies the voltage. Furthermore, when photovoltaic cells are connected in parallel, the voltage remains at its initial value and the number of cells connected together now multiplies the photocurrent. Usually a photovoltaic park contains a variety of such connections, creating an array. Different combinations of such connections help to the controlling of the total output. Bypass and blocking diodes are also included to control the effect of shading or faults. Finally, internal losses, which are mainly caused by the flowing of the current as well as the leakage current, will not be taken into consideration.

MATH IN COMPUTER VISION AND MOMOVEMENT

Neven Lukic, Gimnazija “Fran Galovic” Koprivnica, Croatia

Did you ever notice how non-player characters in game move on their own and wonder why? That is not magic, it’s all done by complex calculations of path finding and sometimes artificial intelligence. Non-player characters, NPCs for short don’t have a “mind” on their own, it needs to be programmed in, that’s the case of artificial intelligence, but sometimes you just need a quick and fast way of getting NPCs from a point to another point, that’s the case of path finding algorithms. If you want something to move it needs to see where it’s going this is where computer vision comes in play. Computer vision allows mainly robots, but also NPCs to get sense of their surroundings by using different sensors, calculations and other methods. I will try to explain how this two methods can be used together to make robots and NPCs move on they own.

WIND ENERGY

Sofia Savvides, Christos Pantazis, Lucas Giasoumi, Tasnim Derawi, William Preston, Niki Theodoulou, Mediterranean Schools, Cyprus

Wind farms are used to produce clean electricity powering a single home or millions of homes. Wind turbines help pave the way to a clean energy future. Egyptians were pioneers in the discovery of the wind turbine; utilizing wind energy to move boats along the Nile River. Also, Americans used windmills to grind grain as well as to pump water. A wind turbine usually consists of three blades, which is mounted to a sturdy tower usually made from steel. The height tends to be 100 feet above the ground, which allows the turbine to take advantage of faster winds found at higher locations. The way wind turbines behave may be compared to an aeroplane wing since they tend to catch the wind's energy with their blades. The applied pressure on the wings causes a rotor to turn. This phenomenon is called lift. The phenomenon where the force of the lift is stronger than the wind's force against the front side of the blade is called a drag. Combining these two components causes the rotor to spin in the same manner as a propeller.
In this project, we will discuss the various types of turbines that exist and give a more detailed explanation as to how they convert the wind energy into useful electricity. In addition, we will investigate the differences between them. Some examples of the biggest wind farms worldwide will be shown and the reasons for selecting the specific locations will also be discussed.

RAINS ON OTHER PLANETS

Sara Svegovic, Mihaela Matijevic, Gimnazija "Fran Galovic" Koprivnica, Croatia

Rain is falling on the other planets but no quite similar as on Earth. There are some differences between the Earth and other planets. For example, on Saturn there is a diamond rain which falls from his rings directly on his surface. Saturn is the first planet which shows interaction between atmosphere and his rings and main rain effect from rings is that it reduces the density of electrons. This gave the answer to the astronomers on the question why are they recording for years on some places unusually lower percentage of density of electrons. According to study, the Saturn's magnetic field pulls aqueous particles to the planet and that is how it makes rain effect. Rain also falls on the Saturn's satellite Titan, but that rain is methane. It falls once it thousand years and when the spills happen they deposit a few centimetres or even meters of rain. The calculation was based on evidence from aircraft Cassini and probe Huygens which went through Titan's densely atmosphere. On Jupiter, Uranus and Neptune also falls the diamond rain. About 2 thousand tons of diamonds per year and most of them are falling diamonds which diameter is 10 millimetres. But on Venus things are slightly different. Rains aren't "normal" either but it's not that nice as diamonds. Clouds release sulfuric acid which is not great, but that rain never comes to the surface of Venus. Diamond rains, they are cool. But, unlucky, on our Moon, the only thing that can be found is meteors.

THE GYROSCOPE

Adonis Mikeou, The G C School of Careers, Nicosia, Cyprus

The gyroscope, a spinning device used in measuring and maintaining orientation and angular velocity, has also been produced as a toy since 1917. Similar apparatus to it dates back to as far as 1743. This project is about the mathematics and physics behind its *"unusual"* motion. When spinning, instead of falling to the ground it spins about its pivot, appearing to *defy gravity*!
Through in-depth analysis of its motion one can identify the reasoning behind it and use that to see how it allows for its wide use in modern machinery such as mobile phones. What is most impressive though is how the concept can be used to explain an even broader motion in the universe itself! Have you ever wondered *why* the planets stay in orbit around the sun and not collapse towards it? Tune in to find out.

A TRIP ACROSS THE SOLAR SYSTEM

Sofronis Michael, Anastasia Constantinou, Antria Nicolaou, The English School of Nicosia, Cyprus

In this presentation, we will be heading on an adventure across our solar system. Before leaving for our expedition we need to calculate the amount of resources we need to make the two way trip, such as the amount of fuel, food, water and oxygen. Then, we will be calculating the amount of energy we will need to leave the atmosphere and Earth's orbit. This trip will be very long and when we eventually arrive there, we will be exploring whether or not Pluto is a planet. A subject debated amongst astronomers for decades will be finally settled using mathematics.

CONQUERING GRAVITY

Polina Abrosimova, Margarita Mordvina, Nikita Ivanov, International School of Moscow, Russia

Over the last century, humanity has managed to achieve the inconceivable: it constructed behemoths that defied gravity and conquered the vast plains of space. But what was the obstruction that impeded humanity from escaping its own planet for so long? Well, as the British scientist Isaac Newton discovered in 1687, the answer was gravity - the fundamental force that shaped the planet Earth. Since the latter half of the 20th century, scientists from all around the world have been working on a reusable space launch vehicle that could surpass Earth's gravitational field. On September 17th, 1976, the OV-101 was finally constructed; this was a breakthrough that eventually lead to the space shuttles we have today. In comparison to its modern counterparts, such as the 'Dream Chaser', the OV-101 substantially trailed behind in terms of on-board equipment, launching equipment, living condition etc.. However, the launch of the OV-101 marked the transition of humanity into a new age - an age of space discovery and exploration. In our presentation, we will carry out several calculations such as: determining the constant of proportionality; the exit velocities from the earth's surface and the exit velocity from low polar orbit, as well as resolving the forces that act on the rocket as it climbs into orbit. By doing so, we will explain several of the many requirements that are needed for a rocket to be launched into space successfully.

A QUANTUM BRAIN?

Apostolou Era., Dimitrakopoulou Athina. Dimitrakopoulou M., Gennaraki Garyfallia, Minaretzi Fani, Mpakella Aikaterini, Karalekas Ioannis, Koumpi Olga, Koudigkeli Geogia, Safarika Eleftheria, Sapounaki Ioanna, Syrigou Kassiani, Pierce - The American College of Greece, Greece

In high school science textbooks, the most frequently used model for the atom is the Bohr Model. The inconsistencies of the Bohr Model, De Broglie matter waves, Schrodinger's equation (and his cat!) and Heisenberg's principle of uncertainty contribute to the evolution and acceptance of the current model of the atom, the quantum mechanical (QM) model. Although physicist Richard Feynman stated in 1964 that "he thinks he can safely say that nobody understands quantum mechanics", it is in the human nature to grasp what seems impossible. Many concepts of the QM model (e.g., particle-wave duality, quantum superposition and quantum entanglement) are counter-intuitive. But is this due to some human cognitive inability or is it an inherent obstacle in nature? Abbott highlighted that human perception has limitations in his famous "Flatland" whereas Heisenberg's principle of uncertainty supports the inherent aspect. Despite the major scientific and technological progress, we are still trying to understand both the QM model and the human brain. Interestingly, many researchers propose that quantum processes may also happen in the brain. Quantum entanglement is a phenomenon that might underlie neural processes. If this holds true, then could it also be true that the brain can engage in two or more thoughts at the same time by quantum superposition? And since quantum computers belong to reality, then could it be true that designing a quantum computer to work as a quantum brain could lead to human-like intelligence in computers?
In the present article, we will elaborate on these subjects.

ENLIGHTENING LIGHT: THE DOUBLE-SLIT EXPERIMENT

Safarika Eleftheria, Pierce - The American College of Greece, Greece

Perhaps one of the most famous optics experiments was the Double-Slit Experiment, which sought out to scrutinize the true nature of light, and was implemented by British physicist Thomas Young in the early 19th century. Since there was a major contradistinction going on between physicists all around the world concerning light's nature, Young's intention was to study the phenomenon of light diffraction, but also proved light's wave nature. Our intention is to present Young's original experiment, and explain the interference pattern we saw as its result, giving details about how it was caused. Furthermore, we demonstrate its latest version, throwing single photons or electrons, one at a time, on the double slit, and explain single particle interference according to the Copenhagen Interpretation and the Many Worlds Interpretation. Within this context, we analyze concepts such as the wavefunction, superposition, quantum uncertainty, complementarity, and multiverse, which are fundamental notions of quantum physics. We conclude that this experiment was indeed a scientific breakthrough. The Double-slit experiment along with the photoelectric effect, proving light's particle-like nature establishes the radical theory of light's dual nature. Extending, we pose the questions of where the boundaries between classic and quantum realms lie, and why macroscopic objects made of particles which, individually, obey quantum rules, behave classically. Finally, we deduce that to fully understand quantum physics is something impossible, unless we broaden our already formulated perspective of the world.

STRUCTURE, PROPERTIES AND FUNCTION: THE QUEST FOR MATTER'S MINIMAL PARTS

Siotis Aris, Pierce - The American College of Greece, Greece

In their early stages, almost all scientific fields go through a phase of classification of the various elements that they study which is based on the conserved properties of these elements. For example, "Genus" in Biology or "Elements" in Chemistry. As the fields progress the basis of these properties and classification is understood as being due to the relatively stable combination of certain entities that constitute the minimal parts of matter specific to each field. These minimal parts would be "Nucleotides" for Biology, "Nuclei and Electrons" for Chemistry etc. If we break up these structures we pass from one scientific field to another, from Biology to Biochemistry to Chemistry to Physics. In this sequence, the energy required to break up the structure at each level is smaller than the mass of the constituents involved at that level. However, if we want to explore even smaller scales, Heisenberg's uncertainty principle implies that the energy required to achieve this becomes equal or even greater than the mass of the constituents. Have we therefore reached the end to this sequence? Are the minimal parts of the so called "Standard Model" of the world (i.e., Quarks and Leptons) truly "fundamental" or "elementary" or should we expect another level of structure on an even smaller scale? Does it make sense to think in terms of structure and constituents beyond a certain scale?

A HAND FOR EVERYONE

Francesco Brescia, Francesco Scerbo, Liceo Scientifico “Luigi Siciliani”, Catanzaro, Italy

It is known that disabled people find difficulties every day,even in the simplest situations.This project is focused on a restricted part of disabled people:lack of the hand due to accidents or malformations.The difficulty for these people is not only the lack of a limb,but also the difficulties in facing up the costs of expensive prothesis. In order to resolve this problem it has been realized a prototype of an economic prothesis,accessible to most people.The project can be divided in 2 parts:Hardware,Software. Hardware making started from a hand digital model used as input for a 3d printer and realized with plastic material (PLA). The prototype works as a marionette, some Nylon threads pass through fingers and through the entire structure of the hand in order to connect itself to 5 servomotors. The prototype can be interpreted in a straightforward parallelism with a real human hand anatomy: the printed hand is the structure, the Nylon threads are the tendons, servomotors are the muscles.
The most important element of the project is an economic muscolar sensor (Myoware Muscle Sensor), which can amplify the electrical signals which comes to the muscles,causing a contraction.
The Software is managed by a microcontroller, created in Italy, Arduino. The software utilizes the muscolare sensor as an INPUT, in order to generate an OUTPUT: every time the sensor finds one contraction, the Arduino shield drives simultaneously the 5 servomotors which, pulling the Nylon threads, make the hand close, with another contraction the hand can come back to the originary position.
The result of this project is a hand prothesis which costs a few tents of euros, and can be used by everyone in a simple and effective way.
This project can be considered first step towards the demonstration that it is possible to ease disabled people’s life in a simple way,with reduced and accessible costs.

THE MAGIC OF COLOURS: BEHIND "CHROMADEPTH" 3D VISION

Annarita Battaglia, Marzia Gidaro, Giulia Perri, Ada Polizzi, Francesca Torchia, Francesco Scerbo, Liceo Scientifico “Luigi Siciliani”, Catanzaro, Italy

Over the past few years, thanks to the application of digital technologies to the creation and transformation of images, 3D vision has developed significantly, not only as regards film industry, but also as regards virtual reality. In this presentation, we want to suggest a 3D technique, called Chromadepth, easy to use and based on the physical phenomenon of refraction. By means of chromatic dispersion, we can get from 2D images to a 3D effect, that can be made more evident by the use of specific glasses. After introducing physics of light refraction, presentation highlights “selective refraction” as the source of Chromadepth -3D impressive illusions. During our presentation, the interaction with the audience, provided with glasses, will allow us to show both the potentialities and the limits of Chromadepth technology.

NEWTON VS EINSTEIN

Christodoulou Maria, Fousteri Grigoria, Hadjopoulou Tatiani –Rita, Mania Christina-Ioanna, Petraki Maria, Rova Athena, Sotiriou Alexandra, Nea Genia Ziridis School, Greece

As the title implies, we shall be dealing with an unprecedented battle of minds. In one corner, we have the remarkable Isaac Newton, the father of the fundamental laws that permeate our universe. In the other corner, we have a man who needs no introduction, whose theories have shaped the path of scientific progress, Albert Einstein. It is with great respect that we present to you the names of these masters of physics, who have left their mark on every scientific textbook and article. The first matters we will be tackling are Newton’s Laws of Motion. More specifically, we will be examining his principles of momentum and their applications in daily activities. Continuing, we will be time-travelling two centuries into the future, to Einstein’s era, in order to discuss his Special Theory of Relativity. Finally, the climax of our presentation will be a duel between the two physicists, concerning the concept of gravity. On the one hand lays Newton’s Law of Gravitation and on the other, Einstein’s General Theory of Relativity. Even though the two are examining the same topic, they are looking upon it from a different point of view and this has been majorly important in the evol ution of science. We may never know who will be the last man standing, but at least we can question it together. Will you join us?

THE NOISE OF SOUND

Andrianopoulos Odysseas, Barakos Nikolas, Daskalothanasi Lydia, Kansou Angeliki, Mixalopoulou Elisavet, Nea Genia Ziridis School, Greece

What is the first thing that comes to mind when you hear the word ‘sound’? Most people associate sound only with the sense of hearing, but there is a lot more to it than meets the eye. In reality, sound exists in a great many forms in our everyday lives, and to put it succinctly, it is in correlation with physics. In our paper, we will attempt to explain the different applications of sound. We will start our presentation with its characteristics and then we intend to analyze the assistance it provides to medicine, architecture, music and other fields. Taking it one step further, we will move on by focusing our attention on resonators and speakers and how they can be constructed. We will set out to explain the necessity of sound in our lives in an original and yet intriguing way using humor and interaction with the audience. Science is all around us, even in the most unexpected places that our minds cannot reach. It would be significant to mention what the famous musicologist and acoustician, Pierre Schaeffer once said ‘Sound is the vocabulary of nature’. Therefore, here we are asking you to let us guide you through the paths of this one-of-a-kind experience and take your existing knowledge to a whole new level. So, will you give us your permission?

WAVES CAN SAVE THE WORLD

Nicola Votino, Dante Zollo, Francesco Piccolo, Francesco Tinessa, Fernando Ferraro, Federico Cotroneo, Liceo Scentifico G. Rummo, Benevento, Italy

Due to our careless and often irresponsable behaviour we are permanently damaging our habitat. Many claim that our planet is dying mainly because of the growing harmful effects brought about by pollution. Although pollution has a great variety of causes, it’s obvious to all that one of the main ones is our unscrupolous and persistent use of non-renewable resources. Moreover these resources are not unlimited, consequently sooner or later they will run out. But despite these evident drawbacks they are still much more used than renewable source, such as solar power, bio energy or hydro-electric energy. According to statistics only 19.2% of the world energy consumption comes from renewable energy sources which are environmentally friendly and generate clean energy that has no negative effects on our planet. However, these resources are often too expensive which in part explains why they are not so commonly used yet.
Among the various types of renewable energies the one we think is more interesting to talk about is ocean thermal energy conversion (OTEC). This energy is produced by hi-tech machinery that exploit the differences of temperatures between the marine surface and the ocean's depths to generate electric energy.

PHYSICS IN EARTHQUAKE SAFETY

Luca Vito Iuliano, Fabio Loprete, Gianmarco Nicoletta, Mariateresa Sanseviero, Vincenzo Italia, Concettina Gaccetta, Liceo Scientifico “Luigi Siciliani”, Catanzaro, Italy

Our project concerns the role of physics and maths in earthquake safety. We chose this topic because our country is a particularly seismic area. In 2016 the earthquake caused 299 deaths in Central Italy. Although it is impossible to predict earthquakes, it is now possible to prevent them thanks to isolators. They work thanks to the physical principles of harmonic oscillator and pendulum. We are going to explain how this physical laws and mathematical equations are suitable in understanding how to dampen seismic waves. Furthermore we are going to talk about some examples in the world where these systems of isolators are used (for example Taipei 101). In conclusion our aim is to explain the importance of physics and maths in the prevention of damage of the earthquake to buildings and in our safety.

WORKHOPS

WS1 TECHNOLOGICAL ACHIEVEMENTS IN PARTICLE PHYSICS

Professor Evangelos Gazis, National Technical University of Athens, CERN

There will be given 4h talks and presentations of the CERN advanced technology about:
1. Accelerators and Detectors Technology
2. CERN contributes to the Big Data
3. Future plans of CERN after 2030
4. Medical Application from CERN's Technology

WS2 USE OF VIRTUAL REALITY IN MAKING MATHEMATICS REAL AND PHYSICAL

Professor Tomaz Amon, President, Center for Scientific Visualization.
A biologist producing educational virtual reality software

In the last years at www.bioanim.com we have developed a technical framework for making learning of natural sciences more interesting and faster. It is based on immersive 3D virtual reality worlds which combine the artificially modeled objects with the 3D scans of the real objects that are brought into the virtual reality space. So the user can freely move in the space and get a much richer understanding than by just watching a video or reading a book. In our software environment we would now like to address the common mathematical problems that are difficult to understand in a classical way (the proverbial saying is that mathematics is difficult to learn...). The students will be able to study selected topics in the virtual reality, changing the mathematical parameters in real time and observing the results. This will increase the understanding of geometric skills and spatial understanding. In such an environment it will be fun to learn and experiment with the geometric objects. Students will actually see three dimensional objects which are typically represented as the paper illustrations. So complex spatial understanding can be achieved better and faster than with traditional methods. While relatively simple geometric primitives and operations will suffice for the intended audience of age 10 to 20, the methods of creation will be both intuitive and instructive since we are interested in simple construction tools that expose the underlying process in a comprehensive way. The whole process will include the components of gamification so that the user will be able to choose whether to proceed like a scientific explorer or instead play an edutainment game. In a further step this would also appear in the augmented reality.

WS3 TRAIN YOUR BRAIN

Anastasia Solea, Pupils of Pythagoras School, Cyprus

Brain teasers are a brilliant and fun way to train one's mind and improve his/her thinking capabilities. There is a huge variety of brain teasers out there, ranging from mazes and jigsaw puzzles to logic and math problems. The purpose of this workshop is to introduce the participants to this variety and give them directions as to where to find more material to train further.

WS4 ARE LINES STRAIGHT (FORWARD)?

Justyna Szpond, Pedagogical University of Cracow, Poland

It is a very classical subject of mathematics to study arrangements of lines and their properties. In this workshop I will make an introduction to combinatorial methods in geometry. There will be plenty of examples illustrating the general ideas and patterns. The participation does not require any prior knowledge. A set of color pencils might be helpful.

WS5 GEOMETRY OF A FINITE SET OF POINTS

Tomasz Szemberg, Pedagogical University of Cracow, Poland

This workshop is intended for teachers and students from grade 6 on. I will present in detail a model of a geometry which uses only 9 points. There will be various collections of points considered. Some collections exhibit properties which resemble in a striking way properties of lines in a plane, some other of circles and so on.

WS6 MATHEMATICS AND CREATIVITY: AN APPROACH USING DIGITAL STORYTELLING

Anna Alfieri, Liceo Scientifico “Luigi Siciliani” Catanzaro, Italy

Studying mathematics leads to a scientific view of reality. Inventing and telling stories, leads to an empirical and imaginative view of reality. If we are solving or calculating any mathematical task, we never use thinking of in terms to tell a story. It might be that we occasionally tell a ‘mathematical’ story while teaching, but the stories usually concern the most famous mathematician’s life or a problem formulated like a story. This, however, is an impoverished view of the potential of stories in teaching and learning mathematics.
In this work, I’d like to show how we can render mathematics more accessible to students, as well as more engaging: if we can use our creativity some mathematics concepts become the protagonist of a story made by digital storytelling.
During the workshop, the following steps: what a story is and how to create a story, how to use a digital tools to create a story (Powtoon, Moovly) and which mathematical concepts are concerned will be presented.
In particular cosine function and graphs, Gaussian function and Dirac delta function, fractals, matrices and affine transformations are protagonists of three stories made by students, during a classroom activity based on mathematical models and storytelling. The main goal was to improve a mathematics knowledge based on creative and non-standard processes.

WS7 THE MATH-GAMES METHODOLOGY: HOW TO LEARN THE BASICS OF MATHEMATICS BY PLANNING GAMES

Roland Schneidt, Volkshochschule Schrobenhaisen, Germany

The European Erasmus+ Project 2015 to 2018 "Math-GAMES - Games and Mathematics in Education – Compendiums, Guidelines and Courses for Numeracy Learning Methods Based on Games" will help to answer the questions:
How can we reduce the number of people, who cannot count and calculate, to promote social integration and participation into our society?
How can we increase incentives in education by using games?
How can we offer tailored learning opportunities to individual learners by using games?
During the workshop Math-GAMES the Co-ordinator of the project Roland Schneidt will explain the project and the material, which can be downloaded for free from the website and which will help the teacher to use a methodology based on games www.math-games.eu
In addition, an example is discussed of how to use a selected game in the classroom to learn how to calculate. The workshop is aimed primarily at teachers who want to get to know the MathGAMES methodology. However, interested students may also participate.
As the MathGAMES project has not yet been finalized, the workshop participants' experiences and opinions can be incorporated into the results of the project.

WS8 ALGEBRAIC EQUATIONS WITHOUT DERIVATIVES

Sava Grozdev, VUZF University, Sofia

Properties of functions are discussed on the base of the intuitive concept of their continuity. The properties are applied to several algebraic equations, which are solved without using derivatives. The workshop is suitable for the first grades of high school students.

WS9 INTRODUCTION TO THE INVARIANT CONCEPT

Sava Grozdev, VUZF University, Sofia

A discovery activity is proposed that allows students to become familiar with the content of the invariant concept. Several examples are considered. The workshop is suitable for 5-7 grade students.

WS10 TELESCOPING SUMS

Sava Grozdev, VUZF University, Sofia

Several examples are considered for summation of fractions using the telescoping method. The workshop is suitable for the first grades of high school students.

WS11 MATHEMATICS IN THEATRE: QUAD AND CONSUMING SPACE (SAMUEL BECKETT'S QUAD PLAY AND GRAPH THEORY)

Ozan Evkaya, Atilim University, Ankara, Turkey
Gizem Gurer, Ankara University, Turkey

The purpose of this workshop is to study the mathematical background of Quad play, which is written by famous playwright Samuel Beckett, with the help of Graph Theory in Mathematics field. Quad is a post-dramatic play which has experimental movements originally for 4 people/players.
Quad workshop will consist of two sessions. First session is to be played with 8 participants physically. Participants do not have to be involved in drama or acting before. This session will be led by Gizem Gürer from Theater department (40 min.) Second session is a discussion part for physically trained Quad and Graph Theory together. With the basic principles of Graph Theory, new alternative combinations will be created by the workshop group. This session will be led by Ozan Evkaya from Mathematics department after giving some definitions. (40 min.) At the end of the workshop, a-five minute short play will be ready to shown.

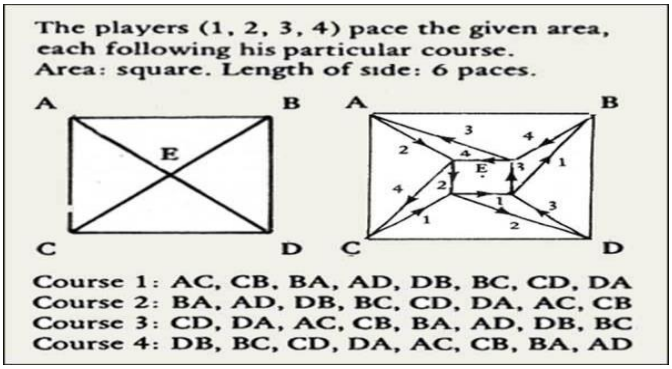

Figure 1. Stage Direction for Quad Play by Beckett (Beckett, 2010:9)

WS12 THE MATHEMATICS CUISINE

Gerovasileiou Antonia, Dimitropoulos Emmanouil, Kopaila Iliana, Diastaseis Private School, Greece

Who of all of us who teach mathematics have not heard questions such as:
- Why do I need mathematics? Why do I have to learn mathematics?
Within the context of teaching mathematics in schools this subject is seen as strict and hostile by the students.
However the interactive teaching of mathematics through a plethora of games can introduce students to this “unusual world”.
Studies have shown that children who integrate mathematical games into their everyday lives develop skills such as the ability to solve practical problems, end exhibit, a better understanding of aesthetics, logic and geometry.
The “cooking” of mathematics is an attempt to show its interactive side and to prove that through the use of games it is possible to improve the relationship between children and mathematics.

WS13 MATHEMATICS THROUGH GAMES

Mara Grasic, Osnovna Skola, Braca Radic“, Koprivnica, Croatia
Ksenija Varovic, Osnovna Skola Fran Koncelak, Drnje, Croatia

We will introduce mathematics in a different way, through games. Games are one of the most thrilling ways of learning and also one very familiar to children. They are the natural way to learn. Games are activities for one or multiple people used for amusement and leisure. Learning process is more successful and positive attitude and self-esteem are developed if games are used. Game significance lies in its power of developing mutual cooperation and interaction as well as removing all social and cultural barriers.

Through this work shop students will develop their mathematical competence, creative thinking and imagination in an interesting and dynamic way using games. They will face challenges and will be stimulated to developing creative ideas. Activities will be carried out through work centres organized by numbers. Students will go through centres in pleasant ambiance, solving mathematical crosswords, matching mathematical cards, playing social games with mathematical elements…

The goal of this workshop is to achieve a higher degree of productive learning and develop student's interest, intellectual curiosity, and positive attitude towards mathematics.

WS14 AN INTRODUCTION TO THE FINITE STATE AUTOMATA

Vasilis Stavropoulos, Dr Kostis Andriopoulos, The Moraitis School, Athens, Greece

Computers are nowadays a part of our daily life, due to the radical technological advance. However, we cannot answer this simple question: “What is a computer? “ The reason we cannot answer it with ease, is that their operation and design are extremely complicated. Therefore, the study of such complicated computational systems is difficult. However, we can understand their basic principles, and their logic, through the study of restricted computational models. Such models are the finite state automata.
The finite state automata are a simple representation of computers with extremely limited memory. Despite their lack of memory, they are really useful, as they have many applications in the design of algorithms. Also, the operation of many powerful computational systems is possible thanks to the usage of finite state automata!
In this workshop, we shall detect examples of finite state automata in our daily life, learn the basic points of the Automata Theory and **design in groups** automata to be used for various daily problems, such as the automaton of a toll gate or the automaton that describes the behavior of a Pac- Man ghost.

WS15 LEARNING MATHEMATICS WITH RUBIK’S CUBE

Karol Gryszka, Pedagogical University of Cracow, Poland

This workshop is intended for teachers and students from grade 9 on. I will present a mathematical model of the Rubik’s cube. Some properties of face rotations will be transferred to general algebraic operations and other related terms. We will use them to find the solution to the puzzle and explain how to use such approach to solve similar puzzles.