

# DIGITAL MAGAZINE

## “Maths and Science Adventure”

2 ISSUE, NOVEMBER 2017

### SPECIAL POINTS OF INTEREST:

- Meeting in Portugal
- Meeting in Bulgaria

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# Erasmus+

# Genius Child Prodigies



Most of us spent our childhoods staring at cartoons over bowls of sugary breakfast cereal, whereas some kids were more focused on things like composing symphonies, performing surgery or getting nominated for the Nobel Prize. The term 'child prodigy' is defined as a young child who has very great ability in something. There have been many child

prodigies throughout history, now here's a list of some of them:

## Blaise Pascal

Born in 1623 in France, Blaise Pascal spent his youth being privately tutored at home by his father. The elder Pascal banished mathematics texts from the house to ensure the boy first focused on languages, but by age 12,

young Blaise had secretly invented his own terminology and independently discovered nearly all the geometric proofs of Euclid. His mathematical genius only grew from there. He had designed and built a mechanical calculator known as the "Pascaline." Pascal went on to publish papers and conduct experiments on everything from fluid

mechanics and perpetual motion to atmospheric pressure.

## Wolfgang Amadeus Mozart

The Austrian-born wunderkind first took up the harpsichord when he was just 3 years old. He composed his first piece of published music at age 5, and by his teen years, he

had already written several concertos, sonatas, operas and symphonies. Mozart and his sister Maria Anna—herself a musical prodigy—traveled widely through Europe exhibiting their talents in royal courts and public concerts. Mozart became one of Europe's most celebrated composers. Before his death at age 35, he wrote more than 600 pieces of

music.

## Pablo Picasso



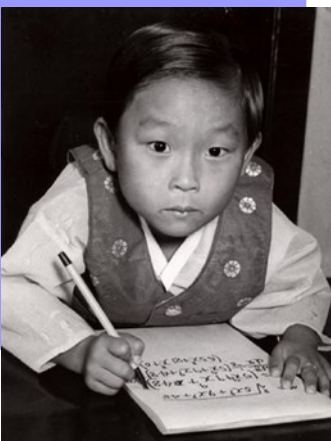
As the son of a painter, Pablo Picasso had a brush in his hand from an early age. The future art legend could reportedly draw before he could talk, and his mother claimed that when he finally spoke, his first words were to ask for a pencil. Picasso made his first oil painting when he was 9 years old. He

nearly made more than 22,000 artworks in his eight-decade career.

## Kim Ung Yong

Kim Ung Yong is thought to be the most Genius Child in the world who was born in 1962, in Korea. He has broken the Guinness book records by the IQ level of

210. At the age of 4 years only he had the ability to read Korean, Japanese, English and German language, also solved complicated differential and integral calculus problems. He finished his university studies, eventually getting a Ph.D. in physics at Colorado State University before he



was 15.

**Priyanshi Somani**

Priyanshi Somani is a mental calculator from India. She started mental calculation at the age of six. At the age of 11, she was the youngest participant of the Mental Calculation World Cup 2010 and won the overall title. She is the only participant who has done 100% accuracy in Addition, Multiplication, Square Root till date in all five Mental Calculation World Cups. She is the winner of

“Pogo Amazing Kids Awards 2010” in genius category.



**Akrit Jaswal**

With the IQ level of 146, a young Indian Akrit Jaswal, who has been called “the world’s smartest boy”. He shocked the people at the age of 7 years, when he did a surgery on a native girl who was suffering from the burns on her hands. He focused his phenomenal intelligence on medicine and became the youngest person to be admitted to a medical university in India (Punjab University), just at the age of 12. At the same time he claimed to be on the verge of

*Gerencsér  
Marietta  
Hungary*

discovering a cure for cancer.



To cut the story short, God blessed some selected people with extraordinary talent. Some people since their childhood are super genius. These kids showed their abilities comparable to highly skilled adults in many specific fields.

Sources:

- [https://en.wikipedia.org/wiki/Child\\_prodigy](https://en.wikipedia.org/wiki/Child_prodigy)
- [http://www.cracked.com/article\\_16266\\_8-child-prodigies-so-amazing-theyll-ruin-your-day.html](http://www.cracked.com/article_16266_8-child-prodigies-so-amazing-theyll-ruin-your-day.html)
- <http://www.history.com/news/history-lists/8-famous-child-prodigies>

# How can we see unseen galaxies?

If you look at the sky, what you will see is a small part of our local galaxy, the Milky Way. We can easily explore this area with our eyes but if we want to look further, we face two big problems, the dust, and the limitations of visible light.

First, we need to know what blue and red shift is. Light spreads in waves and the wavelength defines the colour we see. The longest waves are red and the shortest are blue.

**Blue shift:** any decrease in wavelength

When an object moves towards us, the light waves are compressed and the original colour of the object will become distorted to a bluer one.

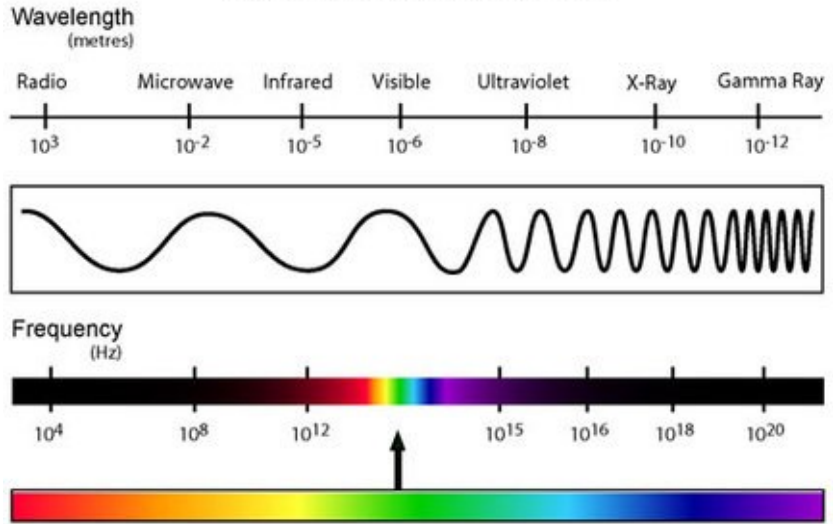
**Red shift:** any increase in wavelength

When an object is moving away from us, the light waves are stretched and the original colour of the object will be-

come distorted to a redder one.

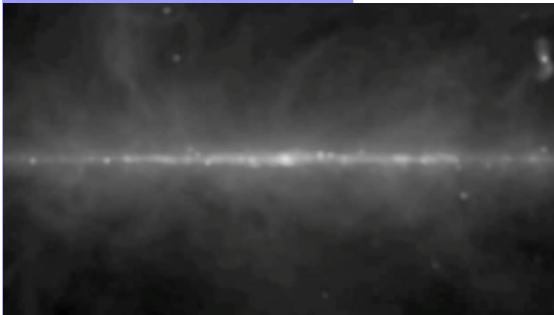
Our universe is expanding so everything is moving away from everything else that means everything appears to be red. The farther and faster the object is the redder it will be. But after a certain distance everything will be shifted into infrared and we cannot see anything at all.

THE ELECTRO MAGNETIC SPECTRUM



The Parkes

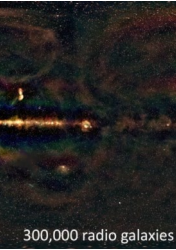
The solution is Radio Astronomy because it can detect even the longest waves. And one more thing, radio waves cannot be stopped by dust. The two big problems we face seem to be solved. But we face another small problem: resolution. The biggest radio telescope



The centre of the Milky Way captured by Parkes

until recently was the Parkes and the picture it could capture was very low resolution and it was black and white.

But the new higher resolution telescope, called GLEAM has just started to operate. It is a 10km<sup>2</sup> telescope in Western Australia.



300,000 radio galaxies



GLEAM view of the Galactic Centre

The GLEAM and the centre of the Milky Way captured by GLEAM

The colours of the image are real, they coloured the lowest frequencies red, the highest frequencies blue and the middle ones green.

As an answer to my question at the beginning, with this technology we can discover tons of un-

This is the full picture...  
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- [wiki/Redshift](https://en.wikipedia.org/wiki/Redshift)
- <https://en.wikipedia.org/wiki/Blueshift>
- [https://www.google.hu/search?q=light+scale&source=lnms&tbn=isch&sa=X&sqi=2&ved=0ahUKEwj6n8fmz5LUAhUFFiwKHTsYCYeO\\_AUIBigB&biw=1857&bih=965#imgrc=5ZjcHTbYNYM73M](https://www.google.hu/search?q=light+scale&source=lnms&tbn=isch&sa=X&sqi=2&ved=0ahUKEwj6n8fmz5LUAhUFFiwKHTsYCYeO_AUIBigB&biw=1857&bih=965#imgrc=5ZjcHTbYNYM73M)
- <https://www.youtube.com/watch?v=nFEgRt2EHlg>

# Graphene – material of the future?

Graphene is an incredible nanomaterial – quite possibly the material of the future.

A single layer of graphene is about 100 times stronger than steel yet extremely flexible.

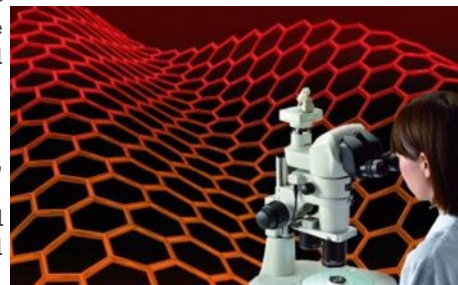
One of the reasons why graphene is so strong is because its molecules are arranged in a hexagonal honeycomb lattice. Well, its electrical and thermal characteristics are very strange. It is about 200 times more electrically conductive than silicon and 10x more thermally conductive than copper. The electrons in graphene move extremely fast and behave very much like photons, which are light particles, with zero effective mass. An important characteristic of graphene is that it is made up of carbon atoms arranged in a hexagonal honeycomb lattice. So in a single 2D layer of graphene, each carbon atom is connected to 3 other carbon atoms. There are 2 electrons in the inner

shell and 4 in the outer shell. Since each carbon atom is connected to three others, 3 of its valence electrons, which are the outer shell ones, are bonded to an electron of the atoms next door. This leaves one last valence electron that is always moving freely, making it super conductive. Graphene would also be amazing used in optical electronics. Technologies that use displays, touch screens, light panels, and photovoltaic cells require a transparent conductor with low resistance and high transparency. Graphene fits the bill perfectly. It's also super strong and flexible so something like a graphene-infused smartphone display wouldn't break nearly as easily as the brittle ones we have. Graphene is a nonrenewable resource. Graphene comes from graphite, which is a rather plentiful resource at the moment, but it won't be for long. What happens when the demand for graphene is so high that graphite ends up

being a scarcity? The price will inevitably spike.

By that time, graphene may be used in almost all electronics that we consume. Those who control the production of graphene products will also control the consumption, development, and availability of any technology that utilizes graphene. Of course, with technologies such as 3D printing we may be able to bypass large manufacturers in the future.

Research on graphene has been exploding and Portugal is actively involved.



**GRAPHENE** The 'miracle material' that could revolutionize our world

**What is it?** Graphene is a one-atom thick layer of carbon arranged in a hexagonal lattice. When millions of these are stacked one on top of another they form graphite, a general constituent of carbon which is found in pencils.

Graphene was discovered in 2004 at the UK's University of Manchester by physicists Andre Geim and Konstantin Novoselov when they created a single layer of graphene using Scotch Tape before going on to receive the Nobel Prize in Physics in 2010 for their work on graphene's unique electronic and optical properties.

Geim and Novoselov's work earned them the Nobel Prize in physics in 2010 and today researchers are in a race to realise its technical and commercial capabilities.

The Portuguese team

# Light and darkness

From a physics perspective, "light" is just a series of particles zooming through space, a little beam of radiation heading outwards in the cosmos. An individual particle of light usually doesn't care whether it's surrounded by lots of other photons,

or whether it is off on its own in the universe, travelling a unique path.

Darkness is usually described simply as the absence of light; this description also works pretty well as a physical description. By this standard, "light" and "darkness" are

just a binary toggle between "radiation" or "not radiation".

The question here is asking if you can have only radiation - only light - and skip the "no radiation" part entirely. If you remove darkness, could you

The Portuguese  
team

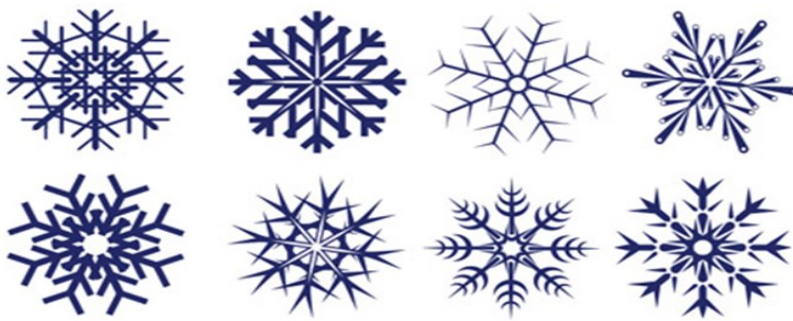
still have light? If you're thinking about darkness and light in terms of a yes/no toggle, then this is perfectly possible. You just hold the toggle at "yes" at all times. The individual light particles won't care that they're not letting "not radiation" not have its times - they're simply travelling forwards. The ways that our universe produces light are also independent on a lack of light nearby. Stars form light as a byproduct of the incredible pressures at their centers, and are most often formed in clusters - with tens to hundreds of other stars forming nearby. New stars only unveil themselves to our eyes by using the light they give off to burn away the dust and gas that hid them in darkness. There are two major reasons for darkness in the universe. The first is to be in shadow. The

physical blocking of light by an object is an easy way to be in darkness. That's all night is on Earth, after all - you're in the shadow of the planet. The second is that the universe hasn't existed for an infinite amount of time. If the universe had already existed for an infinite amount of time, our skies would be brilliant with light both day and night, as the light from every star in the universe streamed towards us, brightening our skies. In that case, the only sources of darkness would be the shadows. In that universe, perhaps we would be asking the question the other way around - is there any darkness without the light? The key to understanding the allure of these tales lies in this one line from the "evil is the absence of God".



# The nature of snowflakes

A snowflake is made of frozen water mixed with dust. It begins to grow when a tiny dust or pollen particle comes into contact with water in the Earth's atmosphere. If the temperature of the cloud is low enough, the water molecules start to crystallise. Snowflakes take variety forms – including triangular crystals, stellar dendrites and other ice shapes phenomena!



There are fourteen unknown forms of ice. The most popular type of snowflake is a hexagonal crystal. The molecules of water in a low temperature arrange themselves into a six – sided form, which is actually hexagonal. As a result, we can observe ice structures with six arms. Every type of snowflake contains certain chemical conception/ invention. It is said that there cannot be found two the same snowflakes. And this is true. Although every single snowflake take on a six – sided shape, the other part of their geometry vary. The shape of such a delicate construction is determined at first by the temperature and humidity when it is being formed. Every kind of those conditions produce thin flakes, branching arms or flat arms. During the growth even the smallest environment difference affects the structure of flake. With decrease of size of the snowflake, the probability of seeing similar snowflake is more common.

Julia  
Gieracha,  
Poland

## Meeting in Portugal

24.04.–  
28.04.2017

What have  
been done?



### Welcoming session, 24.04.2017

On the first day of the meeting we received our guests in the spaces of Eça de Queiros Secondary School, where they were solemnly welcomed by the students of the Professional Course of Organization of Events and the school headteacher, Maria Jose Soares. Student Guilherme Franco of the 12th year played songs by Dulce Pontes, Beethoven and Frank Sinatra.

The Portuguese  
team





The guests were accompanied to visit the library, cafeteria, future classroom, profs room, laboratories of physics, chemistry and biology, language laboratory, Math lab, drawing, music, theater and computer rooms. After a short tour of the school, the participants gathered in one of the halls, where the head teacher of the school introduced them to the sporting, education system, the problems and the goals we



## 24.04.2017 Using digital technology in education – José Moura Carvalho

On our first day together in Lisbon, on Monday the 24<sup>th</sup> of April, we had a wonderful opportunity to listen to the English teacher José Moura Carvalho. He spoke to us about using digital technology in education. The presentation took about an hour, but it would have been interesting to hear even more about this top-

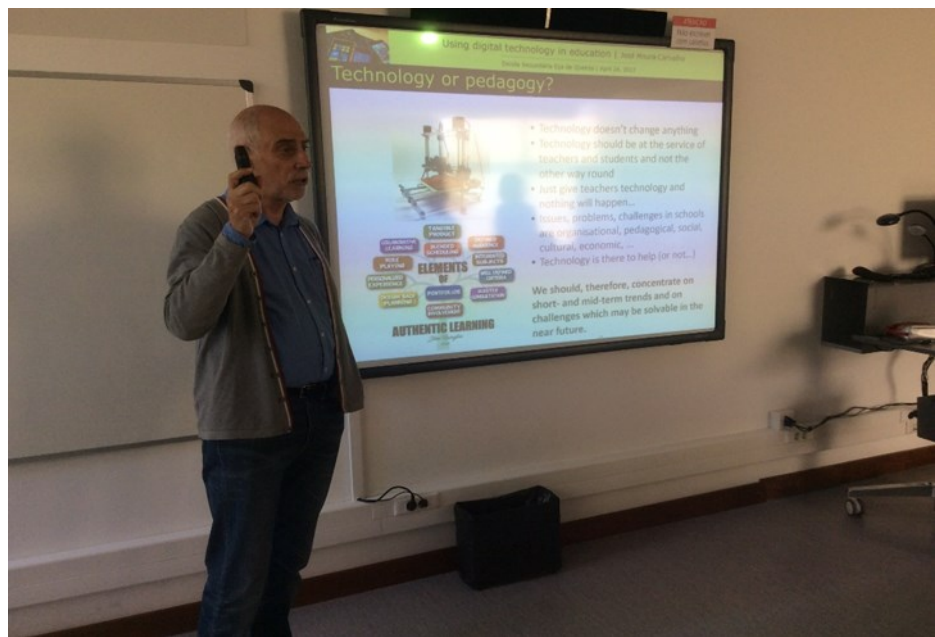
ic. In the beginning we had some problems with the internet. We had to change classrooms a couple of times, before Mr. Moura Carvalho could give his presentation. The lack of internet was a little bit disturbing, but it was fitting with the topic of the presentation. Every

teacher sometimes meets that kind of situations during working days – it is annoying to notice at the beginning of the lesson that one doesn't have internet connection. Teachers must be creative with inventing the “Plan B”, as we noticed also during Mr. Moura Carvalho's presentation.

## The Finnish team

Because of the problems with the internet we had the opportunity to discuss the situation of using digital technology in our countries and schools or upper secondary schools. It was obvious that many countries still don't have enough technology available – neither for the pupils or students nor for the teachers. The biggest problem is economic, because new technology costs a lot. It was interesting to have that kind of discussion and hear about the different situations and conventions around Europe.

The main point of the presentation by Mr. Moura Carvalho was to underline that teachers, schools and governments should concentrate on pedagogy and not only on technology, when we



are trying to increase the use of technology in education. The digital devices don't help with learning if the teachers and pupils or students don't know how to use them effectively.

All in all, the presentation was useful and was catching everyone's attention. The best part is always the moment when the audience gets the possibility to discuss and share their thoughts about the subject. During Mr. Moura Carvalho's presentation everyone had the possibility to do so, which was a really successful choice.

# Edmodo Platform – Workshops with Maria Brites

## Making Teaching and Learning More Effective

### 24.04.2017; 26.04.2017; 28.04.2017

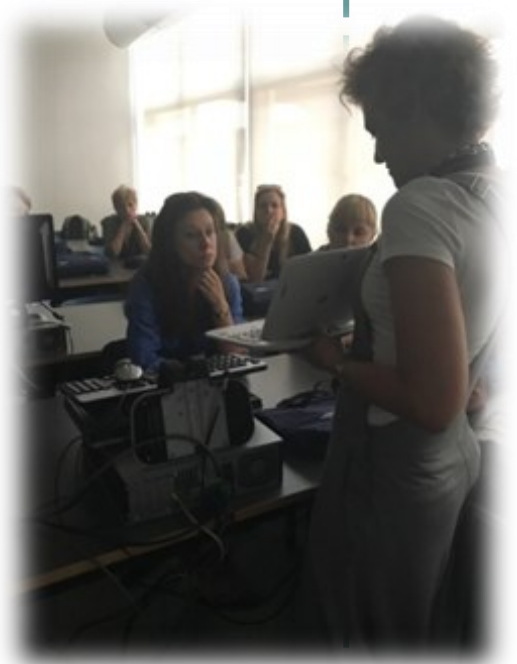
There is hardly a teacher nowadays who doesn't know that it is absolutely necessary to keep up with the latest trends in using technology in education. There are different platforms that promote teaching and learning but none of us, the participants in the M.S.A. project meeting in Lisbon, knew what the free Edmodo platform really was. Several workshops were held by the Portuguese IT teacher Maria Brites in the Innovative learning environment room in Eça de Queiros School.

In the beginning she pointed out the most important advantages of the platform the school has been using successfully for years comparing it to the other existing ones. What distinguishes Edmodo is the fact that it is a closed private learning platform. Students cannot create an account themselves without being invited by their teachers who send them a unique code or without their parents' consent.

What is more, they don't have to provide any information about themselves but their names only. The other benefit is that parents can get engaged in the bringing up of their children by creating an account and viewing their children's activity and progress. And last but not least, the teacher is always present and is able to see everything that occurs in Edmodo.

During the workshops we put into practice all the things Maria Brites showed and explained to us. First, we created an account either by using our email or logging in with our Google account. We learned how to create a group, invite students to it or join another group of teachers. The most important part of it was how to create an assignment, make quizzes and polls. Creating an assignment is not a difficult task. You may do it yourself, load a previously used assignment from your library, select a due date and

time and send it to your students. You may lock it, which means that students cannot submit it after the date or leave it unlocked. They will be able to submit it after



the date but they will be marked less in the grade book. There are a lot of other opportunities: you can send the assignment to more than one group; add a chart or diagram; share a link and even decide when to send it.

Making quizzes was the thing that we enjoyed a lot since we tried this tool ourselves and found out that it was a successful way of checking students' understanding and learning. There are different options to choose from: Multiple choice;

True/False; Short answer; Fill in the blanks. The only thing you have to do in advance is to indicate the correct answer. Everything is automatically graded except for the Short answer. What is more, if you choose to show results, students will be able to see which questions they have answered correctly, which not and what their total score is. You may also use the option "randomize questions" which will help you reduce cheating. And as with assignment you can decide on the due date.



Another powerful tool we tried was making a poll. This is a measurement tool which quick-

ly checks for understanding. Compared to quizzes and assignments, polls are anonymous but teachers receive a feedback of students' engagement in learning.

Snapshot was the other tool we tried and valued a lot. It is a wonderful assessment tool with a lot of options. You can pick a grade, select a subject, search for standards, add a time limit and send. The

most important thing is that you have information about the number of the students who have met the standards and those who are behind since these are marked in different colors. Moreover, you can see the standards that need reteaching, send resources to those students to help them review and study.

As a whole, we realized that Edmodo is a wonderful platform, which helps teachers to get acquainted with their students' learning styles, career goals and progress in studying. Students, on the other hand,

receive an account of their strengths and weaknesses as well as necessary help to achieve the standards. Parents also benefit from this way of teaching for they get fully engaged in their children's learning development.

Not only did we find the workshops on Edmodo platform really helpful, but we will definitely try putting the things we learnt during the project meeting into practice by using the platform in our schools.



The Bulgarian team

## **24 /4/ 2017 Students speak about their experience in using mobile technology**

*During our visit to Lisbon students spoke about their experience in using tablets in the classroom and the benefits of this kind of teaching which is really innovative. They were really honest and told us that at the beginning instead of listening to their teachers they played with their tablets. Later on they realized that they had to attend to*

*their teacher and stop playing with them because otherwise they wouldn't be able to pass their exams. They told us that they can use their tablets to read their e-books and study for their exams. Moreover, they can use them to do some projects, and communicate with their teachers by using the Edmodo platform. They can also use the Edmodo platform to do their homework, do some quizzes and*

*communicate with their teachers at any time. When the students were asked if it was possible to cheat during the quiz they told us that this is impossible because there is a time limit for the quiz.*

*This innovative way of teaching made us realize that our students are natives in technology and not immigrants as we are and for this reason they don't like the traditional way of teaching.*



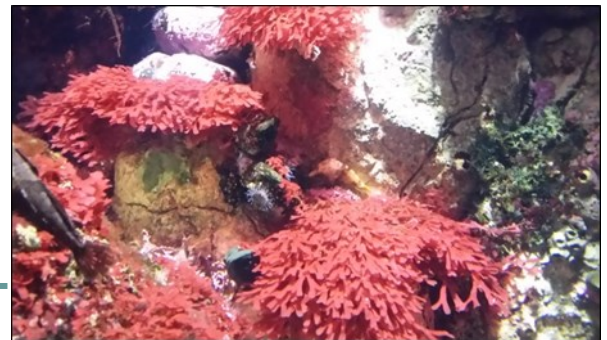
The Cypriot team

# Oceanarium

24.04.2017

On the day we had a chance to visit The Lisbon Oceanarium. It is one of the largest aquariums in Europe. Holding 5 million liters of seawater. There are more than 450 different animal species that coexist in its habitat. This exhibition features terrestrial and marine ecosystems, as well as the temperate, tropical and cold waters of the Earth's oceans. Opened in 1998,

the Oceanarium was the centerpiece of the XXth Century's last World Fair, themed The Oceans. Its building is one of the most interesting in the Park of the Nations. It is situated in the Ocean, and can be accessed by crossing a footbridge. During the 1998 Expo in Lisbon, it was called the Oceans Pavilion.



The Oceanarium has two floors, and everything rotates around a huge central aquarium. On the top floor there are animals that live closest to the water surface, while on the lower floor you'll find creatures that live in the deep ocean.

The largest aquarium is probably the most impressive part of the Oceanarium. There are hundreds of species, including sev-

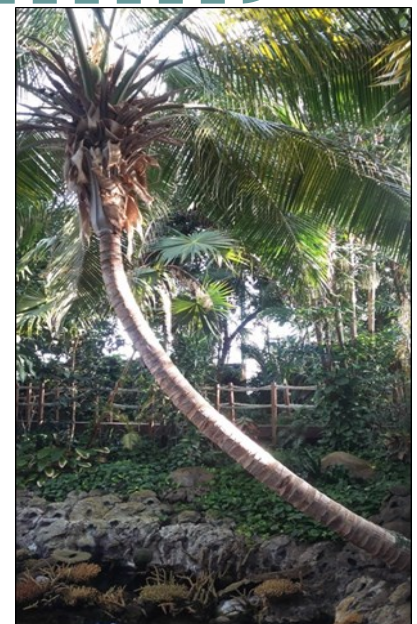
eral types of sharks, sting-rays, manta rays and colorful tropical fish.

In four tanks around the large central tank there are four different habitats with their native flora and fauna: the North Atlantic rocky coast, the Antarctic coastal line, the Temperate Pacific kelp forests, and the Tropical Indian coral reefs. These tanks are separated from the central

tank only by large sheets of acrylic to provide the illusion of a single large tank so the view is impressive.

After spending 3 hours in this amazing place, we learned many new things about life in the oceans. We also had a chance to observe the behaviors and practices of many animals.

Danuta Kowalczyk, Poland



# Bus ride – Lisbon/Cascais/Sintra

25.04.2017

The Portuguese team

Along with the creative atmosphere we had the opportunity to communicate informally. On April 25 we had a chance to visit some of the most important landmarks in the region. These were the

monastery of Jeronimus, the cultural symbol of Lisbon declared by UNESCO to be a monument of world cultural heritage. The monastery fascinates with its architecture and magnificent Manuelino-style or-

nament. In this area there is also the historic tower of Belem - one of the symbols of the city and of the Portuguese power during the age of the Great Geographical Discoveries.



The participants visited the Boca de Inferno "mouth of hell", which is a natural phenomenon

that takes everyone's breath away.

"Here, where the earth ends and the sea begins"

Hardly anyone could imagine that they could see the westernmost point of continental Europe, Cape-Rock, which is a cliff rising 140m above the ocean.



And last but not least we were immersed in the majestic and peaceful atmosphere of the town of Sintra, situated on picturesque hills and surrounded by centuries-old forests, majestic palaces and magnificent parks and gardens. Sintra is one of the first centers of

European romantic architecture and is also known as one of the luxury beach resorts in the country. In the distance, we saw Pena Palace, towering on the top of a woodland hill and unifying three architectural styles - Gothic, Romantic and Manuelin.



There we visited the palace Quinta da Regaleira, impressive with its architecture and its gardens with a unique atmosphere created by fountains, lakes, caves and statues.

The most famous impression was made by the famous "well of dedication" (also named "inverted tower" with its 27 meter spiral stairs, leading to a star with eight rays.)



## School visit “Vasco da Gama” – lower Secondary School, 26.04.2017



The school building same time new and smart-board con- and modern, and the nected to the inter- walls are covered net. The hallways supplies in colored mosaic and the giant meet- are tiles. All this cre- ing hall are spa- at tes a very friendly cious, so they pro- the atmosphere. Every vide a great oppor- classroom has a tunity for the stu-



students ing flowers to pre- 9. In IT labs we saw to so- pare for the upcom- students working in ing national holiday pairs using porta- of April 25, and also ble computers. The sang in our honor. The courtyard has an enormous play- In another class we ground and sports- saw a music lesson. field so older and To our surprise younger students they also greeted as well can find op- us with merry portunities to relax work with merry songs which they and have fun dur- available performed in their ing recess. The com- native language, The school also has a puters and litera- English, and on large auditorium ture (professional their music lessons which, because of and literary). We everyone learns to its good acoustics, visited a first grade play the flute. The is excellent for class where the stu- school teaches pro- holding celebra- dents were color- gramming from age



The  
Hungarian  
team



tions and plays.

In this beautiful and well equipped school everything that is needed for learning is provided for the students. I am sure that they love to come here.



## The Practices of the Future in Today's School 27.04.2017

In today's dynamic classrooms, the teaching and learning process is becoming more nuanced, more seamless, and it flows back and forth from students to teachers. Sharing information and connecting with others — whether we know them personally or not — has proven to be a powerful tool in education. Students are collaborating with each other through social media where they learn more about specific subjects, test out ideas and theories, learn facts, and assess each others' opinions. Educators know they can grab students' attention where they naturally live outside the classroom — the online social world.

This was the reason why the Portuguese Directorate-General of Education (DGE), in partnership

with European Schoolnet (EUN), is promoting the initiative "Learning Labs / Future Classroom Lab. The original Future Classroom Lab was set up by European Schoolnet in Brussels. Its goal is to disseminate to teachers, schools and other educational providers guidelines and resources produced by EUN that support innovative methods of teaching and learning, as well as building a network of teachers to spread the integration of innovative practices at national level. We had the chance to meet Maria Teresa Godinho, Future Classroom Lead Ambassador for Portugal who thoroughly presented the initiative they are taking part in. The Future Classroom Lab created by European Schoolnet, is supporting 30 ministries and

industry partners to help visualise how conventional classrooms and other learning spaces can be easily reorganised to support changing styles of teaching and learning.

The Future Classroom Lab is formed by six different learning spaces. Each space highlights specific areas of learning and teaching and helps to rethink different points: physical space, resources, changing roles of student and teacher, and how to support different learning styles. The areas: create, interact, present, investigate, exchange and develop. Teresa Godinho clearly explained the role of each learning space.

The future classroom allows the students to plan, design, and produce their own work - for example, a multimedia production

or a presentation. In the Create zone, simple repetition of information is not enough: students work with real

analysis, teamwork, and evaluation are important parts of the creative process.

challenge of the traditional classroom setting is getting all students actively involved; technology enables each and every pupil to contribute. Solutions vary from individual devices like tablets and smartphones, to



knowledge-building activities. Interpretation,

The teacher can use technology to enhance interactivity and student participation in traditional learning spaces. One



interactive whiteboards and interactive learning content.

In the Interact zone, learning involves both teachers' and students' active engagement.

encouraged, allowing the students to become accustomed to using online resources, and familiarising themselves with the principles of eSafety.

The students of the classroom of the future will need a different set of tools and skills to present, deliver, and obtain feedback on their work. Online publication and sharing are also

Encouraged to discover for themselves students are given the opportunity to be active also

participants rather than passive listeners. In the Investigate zone, teachers can promote inquiry- and project-

based



learning to enhance students' critical thinking skills. The flexible furniture supports this concept, and the physical zone can be reconfigured quickly to enable work in groups, pairs, or individually.

the ability to collaborate with others. The teamwork takes place while investigating, creating and presenting. The quality of collaboration is composed of ownership, shared responsibility and decision-making process within groups. ICT can help to create a richer way of

Future classroom learning places much importance on



communication and collaboration. The Develop zone is a space for informal learning and self-reflection. Students can carry out school work independently at their own pace, but they can also learn informally while concentrating on their own interests outside of the formal classroom settings both at school and at home. The school encourages its students towards true lifelong learning by acknowledging and validating informal learning.

Maria Teresa Godinho pointed out that Policy-makers, industry partners, teachers and other

education stakeholders regularly come together in face-to-face training workshops and strategic seminars to develop visions for the school of the future and strategies on how to realise these. Dissemination of the innovative methods attracts more and more teachers to develop their own ideas about 21st Century Learning and the effective use of technology.

The unique and inspiring learning environment along with the presentation made by the Portuguese Future Classroom Lab Ambassador challenged us to rethink

the role of pedagogy, technology and design in our own classrooms.

The Bulgarian team



## ***27/4/2017 - Attend flipped classroom lesson – Anélia Gurova***

*During our visit to Lisbon we attended a flipped classroom lesson by Anelia Gurova. By using flipped classroom students became teachers and were responsible for teaching their fellow students.*

*The teacher told us that she divided the classroom into groups the day before and gave them different topics about the lesson that she should teach them. Students had to pre-study their topic at home and then prepare a*

*presentation and a game by using Kahoot for the next lesson. Each group presented*



*their topic to the class and during their presentation the teacher asked them questions in order to see if they had studied*

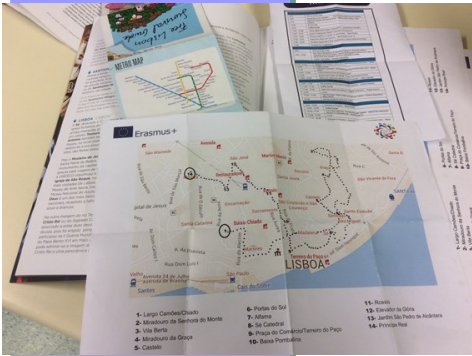
*properly. After the presentation the whole class answered a test (quiz) in Edmodo platform, their teacher prepared to see if they had learnt what their fellow students had*

*taught them.*

*The Cypriot team*

# Visit the Saint Jorge Castle and the old city Lisbon - António Quaresma

27/04/2017



On Thursday, the 27th of April, we had a whole afternoon planned for visiting the old city of Lisbon and its cultural treasures. Earlier we had visited Belém, the part of Lisbon where the Portuguese explorers had set off for their expeditions and where the famous tower of Belém and Monastery of Jeronimos are located, and Sintra, the

nearby town filled with castles and palaces in a rough mountain terrain.

António

today. It was Antonio who had been giving us a bus tour in Belém and Sintra earlier, but for today he had something different planned for us.



famous lifts in Lisbon.

Our trip started in the rich and modern part of the Lisbon, Chiado. We arrived there on metro, and while waiting for our guide, we had some ice-cream from the local shop. This was next to one of the

After António arrived, we walked to the edge of Chiado, to a plaza called Largo Camões. There we enjoyed another very typical Portuguese treat, the vanilla custard pastries



Quaresma, the history and arts history teacher of the school we were visiting, was to be our guide

called "Pastel de across the river.

Nativity scene



On the



Nata". From the plaza we took the old tram all the way to our next stop - Miradouro da Senhora do Monte.

This stop was the highest point of the hill Graça, gifted with a perfect view of the surrounding city. From the lookout point you could get the best view of the Castle of Saint Jorge, but it also had a very nice view on the Cristo Rei sanctuary

same hill there was one of the oldest Churches of Lisbon. The church had fallen down in the great Lisbon earthquake 1755, but the holy seat had stayed intact. It was the oldest part of the church, dating from the 12th century, and it's visited by pregnant women regurlaly, with the hopes to get the blessing of Saint Mary for their children. The church also had a

carved from stone, dating to the 13th century.

Our next stop, after a brief walk down the narrow streets and leery walkways, was the Castle of Saint George. This castle was conquered from the Moors by Afonso Henriques, the first King of Portugal, during the second Crusade in the 12th century. The castle was later dedicated to the dragon-



slaying Saint George in the 14th century. The old and yellow castle walls, along with its moat, towers and inner courtyards, really did give an authentic "Game of Thrones" - feeling. Antonio gave us a lot of nice information about the castle and its surroundings, and he guided us to a walk on the castle walls. He explained the meaning of the black & white flag seen next to the Portugal's flag. The flag was originally the flag of Saint Vincent, which later became the flag of Lisbon. The black color comes from the saint's favorite bird, crow.

we were accompanied by an Australian woman Alex, a cousin of Antti Pekkala's wife Julia. We enjoyed drinks at the plaza and continued our way down the hill.

The district that we had just entered was called Alfama. It's and streets. We stopped in to taste the local drinks, António's treat.

Portas do Sol was our next destination, a plaza just a 2 minute walk down the hill of the Castle. At this point of our trip

the oldest district of Portugal, which hasn't been destroyed by the great Lisbon earthquake.

Because of that, lot of the streets are very narrow We admired the old houses and the building style, with lots of narrow corridors



As we continued our Journey, António told us a great deal about the tiles that could be seen everywhere. After the expeditions to Brazil, there was a great deal of wealth and items being brought from the new land. The ships had to be filled

with something both ways, so that the ships wouldn't tip over during the long journey. Ships were filled with riches on the way to Portugal, but they were filled with clay on the way back. This created the tradition of making clay tiles in Brazil, decorating the tiles with beautiful hand paintings. The clay tiles proved to be quite a good protection for the houses, so the houses were

houses with decorated tiles. As the sun had started to set, we walked past a



Catholic cathedral, called Patriarchal Cathedral of St. Mary Major, or just simply: Sé. The

Palace courtyard before the great earthquake. We continued to walk on the promenade that started from there, teeming with people, shops, and groups of University students dancing, playing and singing, in hopes to get some money from the passers-by. We stayed and listened to their show for a little while before moving on.

The Finnish team



covered with them, inside and outside. Later on, when Brazil gained its independence and a lot of people started moving back to Portugal, they brought the tradition of covering their

Cathedral of Sé was bold and massive, and we took a lot of pictures of it in the slowly setting sun. Next step on the way was the Praça do Comércio, a big commercial square, that used to be a

The part of the city where we were walking was called



Baixa Pompalina. All the architecture in here was very uniform, and the streets were planned in a tidy grid. This was all due to the great earthquake, which had collapsed all the buildings in there. The reconstruction of them was done the same

way, to make less planning and to speed up the construction work.



Our walking con-

tinued through the Rossio square, where we got to taste another typical Portuguese drink. Ginginja was a cherry drink, that the bullfighters would drink on the morning of their grand fights. After getting souvenirs we made

our way to a funicular, called Elevador da Glória. The lift took us up the hill to another great viewing point, Jardim São Pedro de Alcântara. The place gave us a last great view on the setting sun and the beautiful city.

## Innovative teaching and learning with tablets - Attend classroom lessons in Chemistry lab – Anélia Gurova

**28.04.2017**

During our Erasmus + project we had occasion to take part in a very interesting two-part chemistry lesson. In the beginning we were watching the practical part of the chemical lesson. Students had to check if the substance gave an acid or basic reaction using litmus paper. They checked two substances. The first experience concerned sulfur solution that made litmus paper red. That proved clearly that sulfur solution gave acid reaction. The second substance that was checked was calcium solution. After preparing this agent, students found that litmus paper became dark blue. That proved that calcium solution



gave basic reaction. We were watching students work, they were making notes and saved the results on the computer file.



After one hour all teachers could see the results of the students' work. Two groups of students present their work conclusions using PowerPoint presentation and short movies made during their experiments.



We were delighted of the high level of their work and presentation. All the conclusions were presented in a very clear way. We have learned a lot during these lessons.

Danuta Kowalczyk, Poland

## ***USEFUL WORDS AND PHRASES IN PORTUGUESE***

Bom dia! = Good day!

Bom dia! = Good morning!

Boa tarde! = Good evening!

Boa noite! = Good night!

olá! = Hi!

obrigado = Thank you/ boy

obrigada = Thank you /girl

sim = Yes.

Não = No.

Desculpa = Sorry.

De nada = You're welcome.



# Meeting in Bulgaria

## 16-18 October 2017



“On the first day we visited 54<sup>th</sup> St Ivan Rilski School. We were welcomed with bread and salt – a traditional Bulgarian greeting ceremony. Beautifully dressed kids danced for us in the school foyer.

The host school did not put on a show. They let us come in and see what a normal day looked like. “



clay pots. And we were really impressed by students' works of art displayed on the walls.

We also visited the IT rooms. The students there were introduced a new technique of digital drawing. They demonstrated fantastic skills.

We really enjoyed our morning at St Ivan Rilski School. We are extremely appreciative of the time that host teachers spent to show us around, explain their pedagogy and answer our questions. It was great to see the flexible learning environment in action. What we saw was surprising, fascinating and challenging.

The Bulgarian Team



First we visited a peer-to-peer lesson about tobacco. The lesson was lead by an 11-grade school girl who presented the topic to 7-graders. Both the students and teachers took part in a Kahoot survey. We were surprised by some amazing facts about tobacco production, child labour and the impact it has on our lives.

Then we were shown round the school. We observed some beautifully arranged classrooms, tried some of the facilities in the gym. We even made our hands dirty in the art studio where we tried to make



## Sightseeing Sofia - 16.10.2017

*We had the opportunity to communicate informally and visited the most important museums and attractions of Sofia on Monday, the 16th of October.*



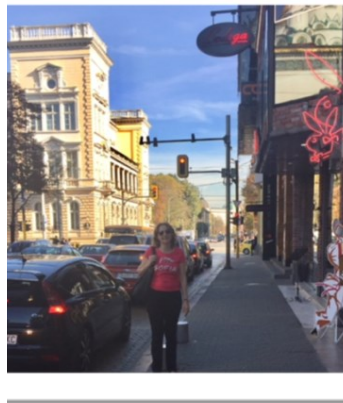
*Sofia became the capital of Bulgaria in 1879 but the history of the city dates back some 7000 years making it one of the oldest cities in Europe. Its name comes from the Greek word "Sofia" which means wisdom. We could see many old buildings and old streets that are preserved to tell the story of the city.*

The Roman Rotunda /the church "St. George"/ is the oldest preserved structure which still serves its original purpose in the Sofia city. To the east lie excavated foundations of the Roman settlement of Serdica. Nowadays the church is a museum protected by UNESCO. Today **St. George church is the oldest Eastern European Orthodox church**, as well as it is the second oldest building in the entire city with really dramatic history.

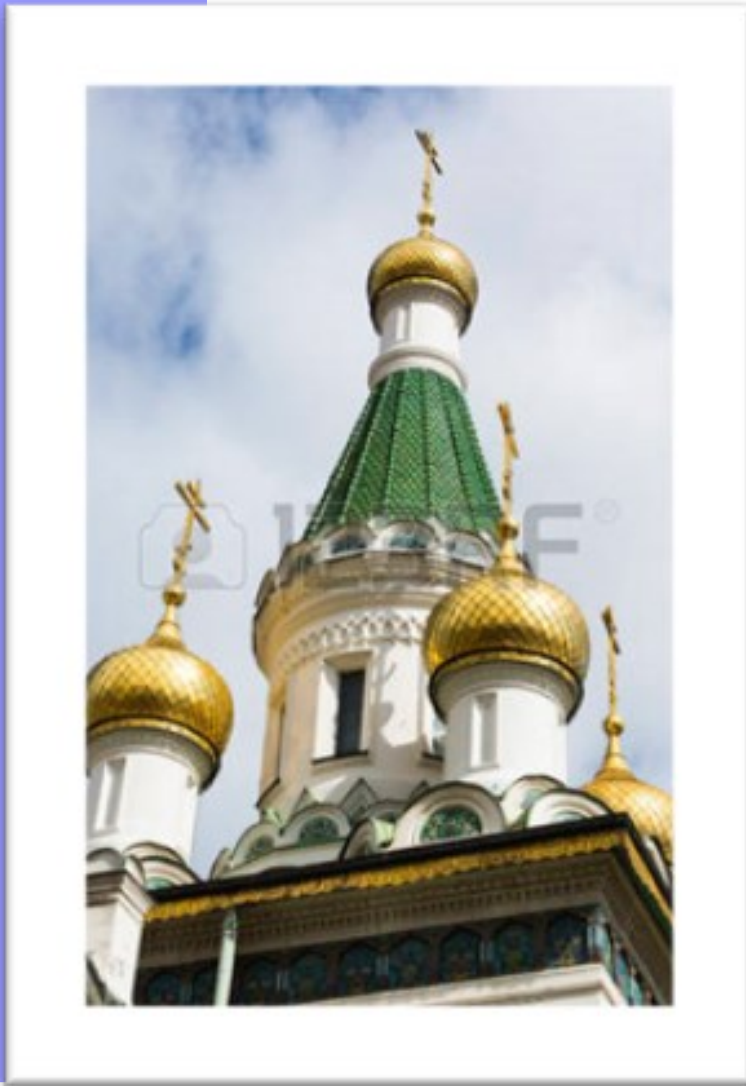
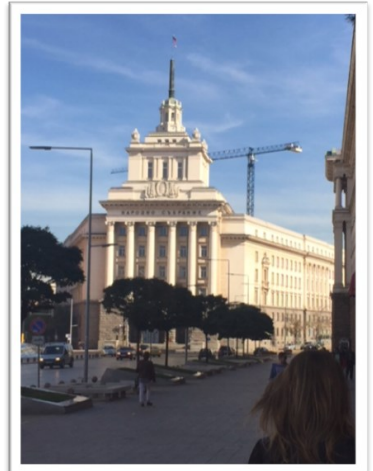
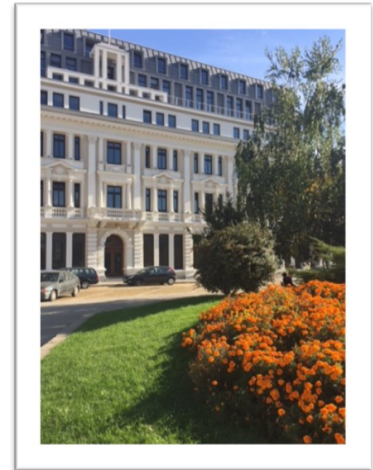


**St. Nicholas the Miracle-Maker**

**Walking down 'Tsar Osvoboditel' street you will see the beautiful gold domes of the so-called 'the prettiest church in Sofia'. Its high dome, surrounded by four smaller domes, all made of gold harmonize perfectly with the roof of the church which is cov-**



**ered with green majolica tiles.**



**The Former Communist Party House**

**The former Communist Party House /Bulgarian: Partien Dom/ is now used by the National Assembly of Bulgaria. Today the building is mainly used as Government offices and the splendid Sofia Hall is occasionally used for charity concerts.**

**The Portuguese Team**

# Visit to the interactive museum of science "Muzeiko"

17.10.2017

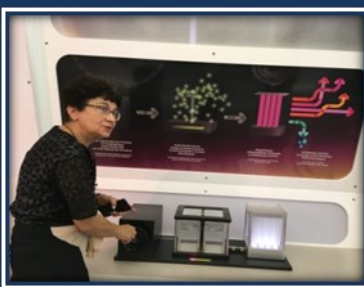
On the second day of our meeting in Bulgaria the program included a visit to the interactive museum of science "Muzeiko".

The exposition is located on several floors. The ground floor provides a large number of "hands on" activities and tools aiming to boost the curiosity and imagination of very young children about the natural world. They can get acquainted with the structure and composition of different rocks and minerals, they have the chance to smell various types of wood and to learn about the age of

trees, they can try the long jump and compare the strength and flexibility of their legs to those of various wild animals. The second floor is aimed to engage young learners with more profound information and various activities related to astronomy, physics, the world of computers, the functions of satellites. We, the teachers of the partnership explored the museum with great interest and enthusiasm. We enjoyed the possibility to try various tasks and activities in the company of our partners from

various European countries. We believe that children and students in Bulgaria have a wonderful chance to explore the wonders of the natural world and to learn about various achievements of science in a relaxed, enjoyable and inspiring setting.

*The Hungarian Team*



## Visit to the Children's Centre

17.10.2017

Our visit to the Children's Centre was one of the highlights of the trip to Bulgaria and indeed stands out in our memory as one of the most colourful life experiences! It was located within walking distance from the school and upon arrival, we were struck by the beauty of the building with the orange-white umbrellas at the entrance, creating an out-in-the-open ceiling of colour. This wonder of colours dominated the interior of the building as well. Our delightful hostesses informed us about how the centre is indeed an 'umbrella' for the Arts. They described the purpose of the centre and we were impressed by their very warm welcome

and great hospitality. The centre's aim is to develop the creative potential of children outside

hibitions and competitions. This centre, alongside 6 subsidiaries in Sofia, supports the personal



school hours and to give development of children  
 them the opportunity for and is under the auspices  
 personal and creative ex of the Ministry of Educa-  
 pression through tion in Bulgaria.  
 certs, performances, ex-





There are a number of different clubs at the centre such as artwork, musical instruments, singing and dancing, all taught by highly qualified professionals. A lovely surprise awaiting us was a demonstration of the acting and vocal skills of the 'Sparrows' - a group of teenagers at the centre

who have become well-known in Sofia and have created something of a tradition. They are very talented young performers and we were impressed by their confidence and abilities. The beautifully decorated interior of the building was original and inspiring, creating a

comfortable and pleasant environment where the children, from elementary to high-school age, can create, socialise and 'find their place in society'. The Children's Centre was truly a place to remember!

The Cyprus Team



## Dances at "Site balgari zaedno" and dinner at "Hadjidraganovite kashti" restaurant

In our 3-day project meeting in Sofia,



Bulgaria, we had some evening program planned as well. On top of our busy daytime activities, we had a restaurant evening planned for both Tuesday and

Wednesday.

On Tuesday the 17th of October, we had dinner in a restaurant **Site balgari zaedno**. This restaurant was within a walking distance of our

Pictures of some happy teachers



hotel and Natalia Boteva took us there. The place was quite cosy and had a nice big space at the center of the dinner hall. We sat down in the

largest table of the restaurant and started looking at the menu.

The radio was playing some traditional music as we were waiting for our food, so Natalia went to show how to dance to his music! Her example got some of us to join her in this dancing. We danced for a few songs, having breaks in between, while waiting for our food.

The food, just like in most of the restaurants around here, was big and plentiful. The typical Bulgarian food appeared to be moderately spiced pork and beef, with fatty and tasty sauce and a big side of salad and vegetables, with a lot of white cheese either blocks or grated.

Finally, when our tummies were full of tasty Bulgarian dishes, we departed the restaurant. Antti and Elina joined Hristo to have a few after drinks at the city center, while the others returned back to the hotel.

The next evening, after our long day trip to Koprivstitsha, we had another restaurant evening. This time we were very close to the hotel, just a block away, in a restaurant called **Hadjidraganovite kashti**. The restaurant had a very traditional and working class-feeling to it, starting right from the entrance. This place was

again, like the previous one, a very Bulgarian one, from the decorations to the quality and especially quantity of food. We sat down to the big table in the corner of a side-room. Even being this much secluded from the rest of the restaurant, it was still very busy and obviously very liked restaurant.

After ordering our food and having some traditional house-brewed wine, we were just chatting away, talking about the past 3 days of activities. We were shocked, once again, by the large proportions of food. As last evening, the food was very typical Bulgarian food, meats and vegetables with lots of white cheese.

Towards the end of the dinner, three men, each with their own musical instrument with them, came to the room to play something for us. They were very talented, and they all played not only Bulgarian music, but also a song from each participating country, except for Finland. All these songs even had lyrics to them, so the experience was truly exceptional! After finishing the food, some of us bid farewell, for some of us had to already leave Bulgaria very early in the morning.

Antti Pekkala, Finland

# The trip to the museum-town – KOPRIVSHTITSA

18.02.2017

During our Erasmus + project we had an occasion to spend a very beautiful, sunny day in a very interesting town Koprivshitsa. The museum – town located at the heart of Mount Sredna Gora, is surrounded by greenery and lovely mountain scenery.

In the morning we arrived in the town by a small bus. From the bus windows we could see a beautiful view. I've heard that Koprivshitsa looks as if a town frozen in time. It is true. When we were walking around the quiet cobbled streets surrounded by high stone fences and the colorful facades of the Bulgarian Revival style houses, I got the same feeling. There was fantastic atmosphere. Around us we could admire the quiet yards and the creaking wooden floors of the lavishly decorated traditional houses.

Among a lot of the most famous examples of local architecture we saw Oslekov House, the house of the revolutionary Georgi Benkovski and the native house of revolutionary Todor Kableshev. We visited the historic building - Bulgarian school. It was the first school in Bulgaria divided into classes.

Later we had a rest in one of the restaurants, where we tasted the



specialties of the Bulgarian's kitchen.

It was a very interesting trip, which I'll never forget.

Bożena Szymańska-Pakos,  
Poland



## MATERIALS FROM THE MEETING IN FINLAND

### Amathsing race part 2.

Amathsing race - the mixed group of the students' competition

#### PART 2

Checkpoint 3 – Queue to the airport

#### Instructions for the guide

The guide reads out loud (and shows out what is to be done at the same time):

*In this checkpoint you will use your logic and math skills. Each team will form 2 queues, in which you will answer 8 questions. The point of the question is to calculate or guess which number comes next. The first three team members will know the way the next*

*number is calculated. I will give you a number to start with, after which the first player will say the next one, second player will continue to say the next one, and the third player will say the next number. After this the fourth player will have to say the next number, even though that player wasn't told how to calculate the next number.*

*For example, I would show the first three players in the queue this calculation (näytä esimerkkilappua, jossa lukee +2). Then I would say the first number, 5. After that the first player would calculate  $5+2$  is 7 and say out loud "seven". Then the*

*second player would say 9, and then the next player would say 11. After this the fourth player would realize, that the next number is 13..*

*If the team does this correctly, then they get 1 point. If any of the team members get their number wrong, then they will not get a point. After each question the first player in the queue goes to the end of the queue.*

*We shall start. Remember, once I show you the paper there should be no talking!*

**CHECKPOINT 3 – Queue at the airport**

Aloitysluku	Näytettävä sääntö	Oikea jono
8	-3	5 2 -1 -4
2	+7	9 16 23 30
1	$\times 2$	2 4 8 16
5	$\times 2$	10 20 40 80
225	$\times 2$	450 900 1800 3600
10	$\times 5$	50 250 1250 6250
0.2 (zero point 2)	$\times 5$	1 5 25 125
96	$\div 2$	48 24 12 6
81	$\div 3$	27 9 3 1
2500	$\div 5$	500 100 20 4
2	$\times 4$	8 32 128 512
33	-7	26 19 12 5
33	-9	24 15 6 -3
3	$\times 4$	12 48 192 768
3	$\times 2 + 1$	7 15 31 63
4	$\times 2 - 2$	6 10 18 34

Checkpoint 4 – Cooling down

Instructions for the guide

The guide reads out loud (and shows out what is to be done at the same time):

*In this checkpoint your thermodynamical skills will be put to test. I will give each team a thermometer. The challenge here is to control the temperature that the thermometer shows. Depending on the challenge you will have different equipment to control it. There are 3 challenges, and the winning team of each challenge gets 3 points. If the other team is very close to the winning team, they can get 2 points as well.*

*Although you must be clever and innovative with your methods, I must ask you to be*

*very careful with the thermometers. Don't hit them with anything or squeeze them too hard, they're made of glass which can break easily! If you do break your thermometer show it immediately to me. Breaking it gives you minus five points, but if you don't show it after you break it, then you will be disqualified from the race.*

*The first challenge is to cool down the thermometer as cold as you can in 5 minutes. You may use anything provided here in this class, except for this snow or ice. You may for example use this glassware, these chemicals, or the taps to get some water. The team which has it colder by the end of the 5 minutes, will win. You may start.*

*The second challenge is to get the thermometer even colder.*

*The idea is the same, but this time you can use this snow and ice provided. You have 5 minutes, after which I will check again which team got colder. You may start.*

*The last challenge is the opposite. You will have to heat up the thermometer to 30 degrees. You can use all the equipment as in the previous challenge. This time there is no time limit, the faster team to show me the thermometer that is over 30 will be the winner. You are not allowed to start any sort of fire! You may start.*

The white team will go to checkpoint 3

and the blue team will go to checkpoint 5

Antti Pekkala, Finland

## Physics demonstrations

### Checkpoint 1

#### Supermagnet and tubes

One person in the groups reads this out loud:

In this checkpoint you will test out how the supermagnet will work in 2 different tubes. There is a cardboard tube and a copper tube on the table and in a white bag there is the supermagnet. It's powerful, so be careful with it, there is plenty of steel to get it stuck to, or electronics that it could mess up.

Everyone knows that the magnet can be attached to metal. This doesn't apply to all metals, only iron. You can check it by touching the

magnet with a steel ring and then touching the magnet with the copper tube. Check the copper pipe that it does not attach the magnet. Don't put it inside the tube yet though!

First you can check that gravity still works – drop the magnet on the floor to see it drops normally. DONT LOSE IT!

Then try to drop it through the cardboard tube – still drops normally.

Next you can drop it in the copper tube. What happens now?

Take a video on your phones or tablets on how the magnet goes through the tube.

Make sure you can see the difference in between dropping the magnet in the

cardboard tube and the copper tube, and that you can see the magnet from the top when dropping it into the copper tube.

Let all the members of the team see how the magnet goes through the tube.

Using a speedwatch on your phones, measure the speed of the magnet inside the tube. The tube is 1 meter long.

The phenomena on why the magnet goes through differently is called electromagnetic induction. The falling magnet induces a current into the copper tube. The current opposes the magnet field caused by the magnet, and forces the magnet to slow down.

**Checkpoint 2**

Flying stick and electrostatic field

One person in the group reads this out loud:

This machine is called Flying stick. It produces a positive charge on its end. The Charge is the same kind of static electricity you make when you comb your hair or remove a woollen shirt. This charge attracts water, because water molecules are polar.

When the flying stick touches the light aluminium foil, it causes all extra negative charge to be removed from the foil. When the foil doesn't touch the stick anymore, it stays positively charged, while the stick will become completely positively charged again.

Because 2 positive charges repel each other, it causes the foils strings move away from each other, and away from the stick. When applied carefully, you can use the stick to levitate the foil!

Take a video where you can see the stick attracting water.

Take another video where the stick causes the foil to levitate.

Everyone can try to levitate the foil, BUT BE CAREFUL, THE FOIL IS VERY FRAGILE.

**Physics demonstrations – Checkpoint 3**

Candles and thermal

energy

One person of the team reads this out loud:

In this checkpoint we demonstrate some tricks with candle and matches.

First, light up the candle in the holder with the matches. Let the candle burn, and you will notice the metal turbine at the top will start to spin. Why?

Measure the speed of the turbine at its top speed in rounds per minute.

Next we will use the snuffer, the long stick with a metal cup in the end. You will use the snuffer to douse the flame of the candle. As soon as the candle is snuffed, remove the snuffer, and you see a line of smoke coming from the candle. This smoke is full of particles that will burn very quickly. When the smoke is continuous from the candle to the air, we can use the line of smoke to light up the candle again!

When you douse the candle, you will have to be quick! Have a fresh match lit up and ready, when you use the snuffer. As soon as you remove the snuffer, bring the fire to the smoke trail close to the candle. If succesful, the candle should be lit up! This might take multiple tries, but it is possible.

Try to catch a video of the smoke lighting up the candle.

The next trick is to be done with the matches and a bottle. Cut only the

brown ends of 4 matches, and put them in the bottle. Fill up the bottle completely full of water, and close the cap. Leave as small amount of air inside the bottle as possible.

After that squeeze the bottle as hard as you can! This should force the pieces of the matches to sink to the bottom of the bottle instead of floating.

The material in the match tips is very poureous, leaving some air trapped in them. When squeezing the bottle, the air pressure (of the very little amount there is air in the bottle) grows very high, causing the poureous match tips to sink!

Take a video of the matches sinking when squeezing the bottle.

**Physics demonstrations – Checkpoint 4**

Mechanical physics

One person of the team reads this out loud:

In this checkpoint we will do 2 tricks.

The first trick is to take the string with heavier and lighter weights in the ends and hold it like in this picture:

The weight in the picture is the heavier one.

What happens when the weight is released?

When you let go of the lighter one, it will start swinging towards the center, and the heavier one will fall straight down. But the string that is between the finger and the lighter weight gets shorter, as the heavier weight falls down.



This causes the lighter weight to go faster, and if done right, swing over the finger! So, instead of falling on your toes, the falling weight stops, because the string goes around your finger.

Take a video of a successful try.

The second part of this checkpoint is to spin a gyroscope. Take a small amount of string and roll it around the gyroscope's axis. This is done by pushing the string through the hole in its axis, and then rotating the gyroscope until the string is around the axis.

Next you will pull the string away from it very quickly, making the gyroscope spin!

Once it's spinning, you can try how well it can be balanced on top of a finger for example. Take a video of the gyroscope spinning.

**Physics demonstrations – Checkpoint 5**

**Resonance**

One of the teams reads this out loud:

In this checkpoint we will play some sounds and discover what resonance means.

Resonance is a phenomenon, where a vibrating object makes another similar object to vibrate as well. For example, there are metal rods attached to a metal plate. When you vibrate one of the rods, the other rods of the same length will start to vibrate as well!

Try this with both of the plates and with different rods. Take a video of this.

The resonance can be done with tuning forks as well. Both of these tuning forks have the frequency of 440 Hz (hertz). When placed next to each other, so that the wooden boxes have the open ends against each other, they will make each other resonate.

Hit one of the tuning forks with the rubber hammer. After it starts making a sound. Touch it to make it silent. Can you still hear the sound? The noise comes from the other tuning fork that plays as well, because of the resonance!

You can even try to see if the resonating tuning fork will make the original tuning fork to resonate as well: After the

first one makes the sound and is silenced, silence the second one too. Can you hear the sound of the original tuning fork playing?

Next we will discover the phenomena called "Beat". Beat means that the 2 frequencies played at the same time will interfere with each other, increasing and decreasing the amplitude at intervals.

This requires us to change the frequency of one of the tuning forks. Place the white blocker on one of the tuning forks, tighten it, and then hit both of the forks with the hammer. Can you hear the waawaawaawaawaawaawaaw aawaa sound?

The blocker changes the frequency of the tuning fork a little bit, but not too much. This allows the beat to be heard.

Try to change the place of the blocker to change the sound. Can you make sounds like wawawawawawawa and waaaawaaaawaaaawaaaawaa aa?

Take a video of the resonance of the tuning forks and of the beat. Make sure that you can hear the sounds on the video.

Antti Pekkala, Finland



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