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WONDERS

Welcome to Observations, News and Demonstrations of European Research and Science

edited by Peter **Rebernik**, general secretary of **EUSCEA**.

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The project WONDERS was organised by **EUSCEA**, the European Science Events Association, together with **EUSJA**, the European Union of Science Journalists' Associations, and **EUN**, the European Schoolnet.

The project WONDERS consisted of a "**Carousel of Science**", which is described here – and of a discussion game **DECIDE** with rules for the debate and the possibility to upload the results into the internet. Participants of this game were schools in the cities of the participants of the "Carousel of Science" (see www.playdecide.org).
The project was started at a **LAUNCH** event in Berlin and ended with a grand **FINALS** event in Lisbon – both at the capitals of the EU presidencies in this half year.

The project WONDERS was financed by the European Commission, DG Research, Science and Society programme (under the 6th framework programme for the research and technological development), in the call for proposals for the European Science Week.

The project WONDERS was organised in two years, in 2006 and 2007. Here, the project of 2007 is described.

The **authors** are the participants of the "Carousel of Science" and from the General Secretariat of EUSCEA.

Editing and layout by Peter **Rebernik**, general secretary of **EUSCEA**.

THE EUROPEAN SCIENCE WEEK

Science underpins almost every aspect of our lives. Without it, many of the things we take for granted would be unthinkable. But more than seemingly technical acts such as switching on a light to undergoing major surgery, science must be seen as part of our social fabric.

The Eurobarometer survey of public attitudes to Science and Technology clearly shows that Europeans remain optimistic about the contribution of science in addressing the challenges of today, from AIDS to climate change. But they are less certain about the way scientific results are used by policy-makers, and they are very conscious that scientific progress can create new problems. The **European Commission** senses the duty to create the conditions for structured dialogue on science-related matters. The aim is to anticipate and clarify people's hopes and concerns. With an informed and engaged Public, science can fully play its crucial role in boosting competitiveness, enhancing our quality of life and ensuring a sustainable future.

Therefore, "**Science and Society**" programme (under the 6th framework programme for the research and technological development) was created – and one of its many tools was the "European Science Week".

The **European Science Week** set out to show there is more to science than test tubes and Bunsen burners. The emphasis was on promoting lively projects and activities to capture the imagination and show how science - its impacts, uses and applications - is relevant to all Europeans regardless of age, background and education.

Through thought-provoking activities and a pan-European approach, the European Science Week's mission was to create a totally new perspective on science. The emphasis was on showing, rather than telling, Europeans how science and technology affects them, from the simplest gadgets to the most sophisticated satellite technology. Science is above all a quest for knowledge and how it can be used to improve our lives, lifestyles, and our living world.

Having fun with science

But Science Week was more than a 'quest for knowledge'; it was also about having fun.
What has happened to the thrill of discovery? Do we take technology for granted?
These are some of the questions we need to ask in order to shape future science education and, ultimately, policy. Science is all around us - in our mobile phones, in our homes, in the engines that drive our cars - and yet we seem to be no longer amazed, hardly interested and sometimes not even aware of it.

Where's the 'wow' factor?

Science Week wanted to put the 'wow' factor back into science and technology, stimulating interest in scientific research, no matter how simple (or complex) it may be. And young people are the perfect place to begin. If young minds can't be stimulated by the wonders going on around them, what hope is there? Where are tomorrow's scientists and inventors? Science Week wanted to bring the challenges and excitement of the world of science to young people - and the young at heart - around Europe. In so doing, it hoped to rekindle scientific education, and to provide a beacon for the future of science and technology in Europe and beyond.

European Science Week 2007: the last year!

2007 is the last year that the **European Commission** is financing a "European Science Week". Starting in 2008 the "European Science Week" projects will be replaced by a series of projects facilitating the cooperation and networking between science museums, science centres and/or organizers of national and regional events for the development and exchange of ambitious and interactive exhibitions on European research topics.

More on "Science in Society" on http://ec.europa.eu/research/science-society.

More about European Science Week 2007:
http://ec.europa.eu/research/science-society/index.cfm?fuseaction=public.topic&id=616

THE PROJECT WONDERS

"Dynamic Tango", "Liquid Rainbows", "Hand Drawn Holograms", "Granite builds Character"… doesn't that sound strange? Yes and even mores strange: it is all about science, about science in science festivals for just normal people like you and me!

Science festivals? Oh yes, on the streets, in railway stations, in shopping malls. Scientists explain their research in an everyday language, in shows and performances.

There are about hundred science festivals all over Europe, from Waterford in Ireland to Moscow, from Tromsø in the North of Norway to Tavira in Portugal.

Many of these festivals have joined together for a first time ever "European Science Festival", named **WONDERS**, an acronym for "**W**elcome to **O**bservations, **N**ews and **D**emonstrations of **E**uropean **R**esearch and **S**cience".
The main motto of **WONDERS** is "**LOOK CLOSER"**. This underlines the scientific method: not just watch the surface, the first impression, but go deeper, think more about it, all in all: LOOK CLOSER!
WONDERS was designed to inspire European science communicators to work together and to continue this activity in future years.

How did they join? The festival organisers exchanged their science shows in form of a European "**Carousel of Science**": one festival sent science shows to the next festival.

Here, we will tell you about these presentations, which took place in 30 cities in and around Europe, from Oslo in Norway to Jerusalem in Israel, from Moscow in Russia to Lisbon in Portugal.

The project **WONDERS** is the **EUROPEAN SCIENCE WEEK 2007**, funded by the European Commission at the 6th Framework Programme.
EUSCEA, the European Science Events Association, is **the** European organisation for Science Events. Nearly hundred such events have evolved all over Europe, from Cyprus to Iceland, from Hungary to Portugal and more are on their way. Their importance is immense; Science Communication Events are major means of creating interest among the youth, an inspiring dialogue and a basis for future European competitiveness.

EUSCEA was formed to exchange ideas and experiences, to communicate across borders and to develop new ways of organising and marketing Science Communication Events in Europe.

EUSCEA has currently about 70 member organisations in 30 countries. More about EUSCEA can be found on www.euscea.org.





EUSCEA is the coordinator of this European Science Festival:

WONDERS
EUROPEAN SCIENCE FESTIVAL

Projects of the European Science Week 2007

The European Science Week 2007 included the participation of the following European projects supported within the European Science Week Call:

- WONDERS (**W**elcome to **O**bservations, **N**ews and **D**emonstrations of **E**uropean **R**esearch and **S**cience), coordinated by EUSCEA, described in this booklet, consisting of the "Carousel of Science" with an exchange of presentations between 30 science festivals and of the discussion game DECIDE, where schools were invited to discuss diverse controversial issues like neurotransplantation, cloning and others.

- MEYPS2 (**M**obility in **E**urope of **Y**oung **P**eople and **S**cientists in Scientific Culture Context) **-** The project is centered on promoting young people's interest in science, science education and careers as well as promoting general public interest in science; various pedagogical approaches on science communication for citizens and young people; exchange of young people at the transnational level; and use of Art to bring science closer to the citizens.
MEYPS was represented in the **WONDERS** Finals by the Université des Sciences et Technologies de Lille, which coordinates the project, and Université Libre de Bruxelles, which is a partner.

- **SWEETS** (**S**pace **W**eather and **E**urope - an **E**ducational **T**ool with the **S**un) - The project aims to promote and raise public awareness by means of different activities promoted during the science weeks and festivals in 27 countries all over Europe. The project has produced a space weather mobile truck tour, web quizzes, DVDs, a rocket & balloon campaign and a space weather TV movie.
The SWEETS project was represented in the **WONDERS** Finals by the University of Greifswald and by the Portuguese partner, Centro de Astrofísica da Universidade do Porto. The project bus could be visited at the entrance of Pavilhão do Conhecimento - Ciência Viva.

– **Discovery Days –** The main aim of this project is to present the vision for the future operation of museums, science centres and thematic parks and to give to the wider public the opportunity to experience the new technological achievements during their visits in those places.
The Discovery Days Project was represented in the **WONDERS** Finals by the educational organization Ellinogermaniki Agogi.

Carousel of Science

The "Carousel of Science" is an exchange of interactive, lively, personal 2-way-communicating science presentations between different Science Festivals. One festival sends presentations of its own to the next festival, which in turn again sends other presentations to another festival – and so on, until the last festival send its presentations again to the first festival, closing the circle or the "Carousel of Science".

Here, the presentations are ordered according to this "**Carousel of Science**", starting with the presentations of the University of Strasbourg in the West of France, which sent them to Tartu, which is the university city of Estonia. The festival from Tartu, organised by the AHHAA centre, sent their presentations to Dublin in Ireland – and so on, until the organisation of Ciência Viva in Lisbon closed the "Carousel" by sending its self-made holograms to Strasbourg.

01

"Emotions in Motion - Neuroscience Theatre Comedies" > *Strasbourg/FR to Tartu/EE*

Take a team of 14 young French neuroscientists, add a common will of having fun with science, a good quantity of creativity and a drop of talent, shake well… and enjoy an amazing theatre show!

Coming from the University Louis Pasteur of Strasbourg (France), this eclectic group of PhD students under the guidance of Ms Domitille Boudard, all trying to find in their researches new elements to understand how our brain is organised, is regularly involved in Science Festivals in France.
For the WONDERS project, they proposed two shows.

For the Science Festival in Tartu (Estonia, 26-30 September 2007), they performed a show about emotions and their connections in our brain, called **"Emotions in motion".** The actors invite you to take a voyage through time to learn how emotions were considered from Antiquity up to the 20th century – using costumes and multimedia for imagining older times. Next, you discover images of the brain and neuronal networks. You observe how emotions can vary from one individual to another and learn why emotions are so useful. Finally, you see that emotions, although very important, can sometimes trick you. The performances were shown in English and French. Translators assisted in the question-and-answer-sessions after the shows.

For the WONDERS Final in Lisbon (Portugal, 24 November 2007), the group chose to perform a new show prepared for the new edition of the "Fête de la Science 2007".
Five young neuroscientists proposed a dive in the brain when it travels, called "**A Long Journey with Two Neuropeans**".

What about jet lag? Why men and women are not reacting equally in front of a geographic map? How do we understand foreign languages? All these basic aspects of travelling around the world depend on our cerebral capacities, and can be (rather simply) explained by neurosciences.

Whatever the subject, these comedies are accessible for a very large public, since scientific words are explained with funny drawings and images.
But all is based on solid neuroscience researches performed at the University Louis Pasteur.

The content allows learning a lot without pressure, since laughing is the principal activity of the public during the shows!

What first sense does the baby develop during pregnancy?
Touch is its first sense. The foetus [This is the scientific name of the baby before it is born] responds to touch of the lips and cheeks by 8 weeks and to other parts of its body after week 14. The sense of taste may develop by week 12 and that of sound at weeks 22 to 24.

02

"Down with Gravity" > *Tartu/EE to Dublin/IE*

Estonians (a physics student and a physics professor from Tartu University) were presenting the **AHHAA Science Theatre in Dublin**. They did science shows titled „**Down with Gravity**!".
For thousands of years humans have been chained to the surface of Earth by the gravity. And for thousands of years they have dreamed about getting free - in the illusions and in the reality. The show contains both, in order to feed your dreams. Down with Newton! Up with…?

This show was prepared specially for the WONDERS part of the Science Festival in Dublin, Ireland. The show involves a variety of physical effects and principles, all of them somehow competing with gravity:
Illusion of flying: optical reflection in a flat mirror.
Newton's apple hanging on helium balloons: buoyancy, Archimedes principle.
Falling mug: potential and kinetic energies, conservation of angular momentum, friction.
Slow ball: a shampoo-filled ping-pong ball on an inclined plate/: viscosity of liquids.
Flying glass of water: on a rotated tray: rotating frame, inertial forces.
Inverted glass with water: atmospheric pressure.
Helium-filled soap bubbles: surfactants, buoyancy, Archimedes principle.
Bernoulli balls: Bernoulli's principle, static and dynamic pressure.
Levitron: magnetism – permanent magnets, gyroscopic effect,

conservation of angular momentum.
Hot air balloon: buoyancy, Archimedes principle, laws of gases.
Helium voice: density of gases, acoustics – sound production.
Pneumatic helicopter: energy of compressed gases, work of expansion.
Minirocket: ignition and burning of gas mixtures, laws of gases, work of expansion.

Model of a hovercraft: gas pressure, friction.
Heaving a jar of rice: internal friction in granular materials, jamming.

Professor Jaak Kikas, head of a scientific institute (Material Science) of the Tartu University, started the very first Estonian science theatre show in May 1998 with the same experiment, a (Newtonian) apple hanging at the helium balloons.
The legend about Newton and an apple begins the story introducing different flying possibilities. Magnets, gases, mirrors, flames, flowers – even some simple household things as a bottle filled with rice seem to be somehow connected to the human beings´ evergreen dream to fly.

The second day a **Human Chess** was organised during the Science Festival in Tartu. There were 16 small children as pawns, 8 in white and 8 in black dresses-caps, all from a Chess Club. Also there were 8 adults in white… but only 7 in black! No black bishop present! The two international grade chess champions were waiting at their positions. Then Ms. Domitille Boudard, the French team leader (see "Emotions in Motion" from Strasbourg) agreed to enter the game as a bishop. She got a black dress, a javelin and after 2 minutes she was already standing on her place.
Domitille was a very brave and popular chess bishop for all the public. The only problem the contender champions got was that if it was the turn of the black bishops, the game had to go on in English instead of Estonian. Other pieces on board helped the Bishop to find the right square. And: The Blacks won!

After the Irish Science Festival the Estonian team took part at

the **WONDERS Finals in Lisbon.** It was a great honour for the Estonians to **win** two most important prizes there: the **WONDERS** award for "best engagement" and the Ciência Viva special prize.

03

"Buckyball Workshop"
> Dublin/IE to Madrid/ES

The science presentation which the Irish organisation for "Discover Science and Engineering" sent to Madrid Science Festival was a "**Buckyball Workshop**".

In everyday life we are continuously exposed to a lot of objects of different nature and material compositions. These can be organic and inorganic. Organic are all those made of carbon, hydrogen and oxygen atoms such as all living matter. Carbon is also well known to make inorganic materials; the very common one is the typical pencil tip, made of graphite, and a very expensive one is the sparkling diamond.

Recently, thanks to a continuous effort by scientists to create innovation and new materials a third carbon material was invented. This was called "Carbon 60" (C60), Buckminsterfullerene (short fullerene) or commonly Buckyball because of its shape. The Buckyball resembles and has the shape of an "empty" football with 20 hexagons and 12 pentagons connected to create the most perfect spherical shape. Buckyball has been also described as the "smallest" football where molecules and atoms have the role of football players in this "nano" game. Unfortunately we will need a "nano" television to see this match!

"Carbon 60" or "Buckyball" is also the most advanced material invented by humans and will highly contribute to the next

generation of technology applied to everyday life. Therefore the third millennium will be also called the millennium of "nano" invention!
At the "Discover Science & Engineering"-stand, "future new scientists" learned how a buckyball is made from simple straight straw struts of different colours. The workshop was designed and structured to be

highly interactive and "hands on". Participants were able to keep their finished buckyball.
The children were shown how to construct the buckyball and one assistant was assigned to each table to help the participating children in their own Spanish language.

Discover Sensors

A second presentation was shown during the Madrid Science Festival, called "Discover Sensors".
Sensor technology provides teachers and students with an exciting alternative to the time consuming task of manually logging and observing their science experiments. Instead of using stopwatches, thermometers and barometers, students are using sensors and powerful software to collect and analyse data as they are carrying out their experiments. This provides more accurate readings than the old manual methods and data is collected in a more exciting and easy to understand way.
Students can develop skills in observation, measurement and accurate recording of data. The use of sensor technology stimulates inquiry and investigation and it integrates science and technology into both classroom and laboratory work.

A **buckyball** or C60 is a spherical or ellipsoidal cage made up of [covalently bonded] carbon atoms. It is a fullerene, another allotrope (=arrangement) of carbon, alongside graphite and diamond. C60 is the first fullerene discovered, and is known as buckminsterfullerene, after architect Buckminster Fuller's geodesic domes, which the molecule resembles. Fullerenes, including the buckyball, are extremely strong but relatively expensive to produce and purify. Another variety of fullerenes are nanotubes, which are similar to buckyballs but cylindrical rather than spherical. Fullerenes were first discovered in 1985 by Harold Kroto, James Heath, Sean O'Brien, Robert Curl and Richard Smalley in molecular beam experiments. The smallest buckyball consists of 20 carbon atoms, and one of the largest has 540, though even larger variants are likely to be discovered or manufactured.
http://www.wisegeek.com/what-is-a-buckyball.htm

04

"Labyrinth and Mathematics"

> Madrid/ES to Genoa/IT

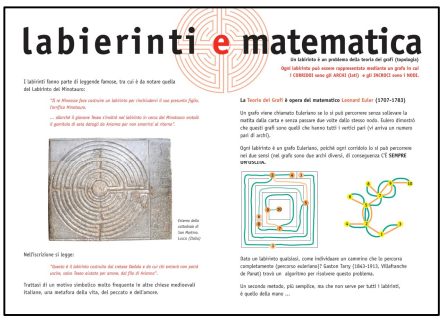
A "mathematical labyrinth" was packaged and re-built at the "Festival della Scienza" in Genoa with a total size of 100 m^2.
The visitors got inside the labyrinth - and in order to get out, they had to rely on some mathematics. It is in fact necessary to solve some mathematical problems and find the "hidden student" who will give a "key-word" needed to get out of the labyrinth. Outside of the labyrinth, other students explain the maths involved in the activity and illustrate some of the famous labyrinths through history.

In the labyrinth, the visitors, besides amusing, have to arrive to the bell at the centre point. To find the exit, they will have to consider, if there is a strategy that allows them to get out avoiding being lost in it. The monitors will help the confused ones to find the correct way.

Along with the labyrinth, visitors could participate in a workshop about topology and other mathematical mazes.

Labyrinths

Certainly the most famous labyrinth of all time is associated with the Greek myth of Theseus and the Minotaur. According to the legend, King Aegeus was forced to pay tribute to King Minos of the Minoans, whose kingdom was on the island we now call Crete. Every year the tribute included seven young men and seven young maidens. Underground far below King Minos' palace at the city of Knossos lay a huge maze. Inside the maze Minos kept a monster called the Minotaur. The Minotaur was a hideous creature that was half man and half bull. The fourteen young people from Greece would be let loose into the maze, where they would become hopelessly lost and even-



tually be eaten by the monster. King Aegeus' son, Thesesus, decided to volunteer as one of the sacrificial victims so that he could attempt to kill the Minotaur. Thesesus was successful. He slew the Minotaur, then used a trail of twine he'd started laying down at the entrance of the labyrinth to find his way out of the maze.

Mathematics and the Labyrinth
From a mathematical point of view, a labyrinth is just a **topology problem**. If we draw it on a flexible sheet, the correct way from entrance to exit is topologically invariant and it stays correct no matter how much we distort the sheet. Modelling a labyrinth is to draw a graph where the edges are the corridors and the junctions among the corridors are the vertices of the graph. Finding the paths, in mathematics, is finding an Euler path, since every corridor can be followed both ways (as a graph both edges are different), all of the vortices are odd, thus there is always an exit.
An **Euler graph** is a path that starts and ends at the same vortex, it follows all of the vortices once at least and just once by every edge. It can be followed without lifting the pencil and passing only once by the same edge. Called Euler graph after Leonard Euler, if there is an odd number of vortices.

Entering the labyrinth
When entering a labyrinth the question is how to get out of it and how to explore it on systematic way, following all of its corridors without missing any, and being sure of getting out. How to success? We could use Thesesus method using a thread, but nowadays we know of better ways only having a little patience.
One of the ways to find the exit is to follow all corridors keeping on one wall, it doesn't matter if left or right. But this rule is only good for labyrinths with no closed circuits. And we are never sure if we could travel it all.

Which algorithm should we have to use to travel it all? **Gaston Tarry** (1843-1913) stated a simple two-rules-method to explore no matter which type of labyrinth:

You must travel every corridor two times, once in each way, placing a mark at the entrance of each corridor and another mark at the exit, so that at the end all of the corridor should have been travelled two times.
In every junction a decision must be taken not to follow back the corridor from where you are coming (unless completely necessary).

To use this rule:
We start at the initial point and we follow any corridor until reaching and end or a new cross.
If we find an end we must go back to the starting point and that path should be mark, since we already would have followed it two times.
If we reach a new cross, we will follow by any of the non marked paths, keeping in mind to mark the corridor from which we come and the one we are taking.

05

"Science and the Argentinean Tango"
> Genoa/IT to Bucharest/RO

Argentinean tango is the focus of the Dynamic Tango event, a show-conference during which the public can look at the popular south American dance through an unusual lens, which is that of physics.

Almost a century ago the Tango started in Buenos Aires. It was born thanks to the fusion and the mixture of various dances. Through times the dancing technique and the music developed and refined a lot.

In this sense it is natural to present specific physics topics (especially *static* and *dynamics of bodies*) along with the evolution of the tango technique. Every innovation in the dance can be easily associated to a theorem, a result or a dynamic variable in physics.

The public is brought inside the curious parallel between this dance and physics and fascinated by the philosophy of the tango, its rhythms, its music, its passion. The participation of the public is guaranteed by the fact that Argentinean tango is a very fascinating and sensual dance and thanks to this element, it is possible to insert relaxing moments within a conference, which aim is to explain some physics principles.

Choreographies
The choreographies are by Giovanni Filocamo and Veronica De

Crignis, amateur dancers who have been dancing together for years and studied with the best Argentinean masters.
Giovanni Filocamo, graduated in Physics, is a scientific explainer and is involved in many projects in collaboration with Genoa Science Festival and University of Genoa.
Veronica De Crignis, graduated in Foreign Languages, has worked as scientific explainer for four years during the Genoa Science Festival. She has been dancing tango for two years, studying intensively with Giovanni.

06

"Dolly and Vasilica"

> Bucharest/RO to Sevilla/ES

In the frame of **WONDERS** Project, the Romanian organisation "Bio-Consult" travelled to the Seville Science Festival with a presentation aiming to familiarise the broad public with basic aspects of molecular genetics and biotechnologies.

The threefold Romanian presentation consisted of 3 parts:

- A film on DNA, biotechnologies and genetics in which the cloning technology was largely explained in a very simple way. The name of the film, "Dolly and Vasilica" was paralleling the situation of a cloned and a naturally born lamb. The last one, Vasilica, is traditional to Romania, since every year, on Saint Basil's (Vasile, in Romanian) day, shepherds are coming to towns with small lambs they call Vasilica, and ask people to touch these small lambs as an omen of good fortune for the New Year. Habits of Romanian shepherds and also the Romanian mountain landscapes were presented, in the film, to the Spanish visitors of the Science Festival.
- A game aiming to teach the audience about DNA structure, genes and genes' conservation among species. The public was invited to make bracelets with pearls mimicking the DNA molecules. Sequences were suggested for the bracelets, starting from different animal species. A text, translated by people from Seville, was explaining the process and showed how close the DNA sequences are among animals and humans, pointing at the fact that we are all "sisters and brothers" on the Earth. As a prize the participants were given a self-made bracelet representing different sequences of a specific gene.

- The very young children, too young for the previously described game, were taught ecological issues such as ecosystems' features. Playing a computer game they were supposed to establish various trophic nets.

07

"Granite Builds Character"

> Sevilla/ES to Mechelen/BE

Report from Seville in Spain:
*"The presentation **Granite Builds Character** was sent to the science centre TECHNOPOLIS in Belgium at the "Carousel of Science" on October 20th and 21st.*
This presentation represented our society in two events: A demonstration in the Katholieke Universiteit Leuven, and a par-

Dolly (July 5, 1996 – February 14, 2003), a female sheep or ewe, was the first animal to be cloned from an adult somatic cell, using the process of nuclear transfer.
She was cloned by Ian Wilmut, Keith Campbell and colleagues at the Roslin Institute in Edinburgh, Scotland.
Her birth was announced on February 22, 1997 and she lived until the age of six.
The cell used as the donor for the cloning of Dolly was taken from a mammary gland, and the production of a healthy clone therefore proved that a cell taken from a specific body part could recreate a whole individual.
More specifically, the production of Dolly showed that mature differentiated somatic cells in an adult animal's body could under some circumstances revert back to an undifferentiated form and then develop into any part of an animal.
As Dolly was cloned from part of a mammary gland, she was named after the famously busty country western singer Dolly Parton.

Vasilica is a pet form of the Romanian word "Vasil" for king – and a special day for Romanian shepherds to celebrate.
Orthodox New Year is also called Vasilica and is celebrated on the fourteenth of January each year.
In some Macedonian villages, young children celebrated Vasilica. Gathered in large groups, children would walk around the village whilst beating sticks and cans together singing "Vasil day, good day, where ever you may be, home you should be". From door to door they were greeted by the man of the house. The children greeted him with the words "Man of the house, may you have good luck today". He would thank the children and give them items such as flour, beans, plums or a token amount of money.
After visiting all the homes in the village the food was taken to a specific home where it was used to cook a feast for the children. Whatever remained was equally distributed between the children to take home.

ticipation in Vlaamse Wetenschapsweek in the Zoo of Antwerp (Anvers) at the Flemish Science Week.
Both events were organized by Technopolis, the Flemish Science Center.
After receiving a warm welcome in which the director of Technopolis showed us their installations at Mechelen, we started to work on our presentation straightaway. We would like to emphasize the enthusiastic reception that the children gave us at the University of Leuven,

as well as the excellent affluence of visitors to the event in Antwerp, which was very gratifying."

The presentation **Granite Builds Character** is a journey not only throughout the geology of granite (litho genesis and magmatism) but also through the environmental and sociological aspects related to the

exploitation of the granite quarries – and what happens, when the quarries are abandoned. Granite, this plutonic rock was the main economical resource of the Andalusian village of **Gerena** (near Seville) at the beginning of the last century.
The materials of the upper mantle of the earth and of the crust are melted by heat coming from the earth's core due to mantle convection currents. This melting forms magma. Magma ascends through the earth crust due to its lesser density. When magma viscosity is low, it goes through the entire lithosphere to appear onto the surface originating volcanoes. However, if magma viscosity is high, magma solidifies quite slowly producing plutons, like granite. The different composition of magma produces different plutonic rocks. A magma enriched in silica (SiO_2), aluminium and potassium solidifies forming granite .
When a quarry is closed down, vegetation reappears and the previous ecosystem is formed again due to the resistance of the seeds, the fire-induced dispersal of seeds and the natural ability of the flora to reappear.

The presentation includes four activities.
The first two activities lead the visitors to understand easily, by means of very simple dynamic models, the geological processes that are required to form granite. The first model uses aluminium scraps in boiling water to represent the convection currents in the mantle beneath the rock bottom of the continents.
In the second model, the formation of plutons and volcanoes are simulated using a burner to heat a glass beaker containing different layers made of wax, sand and water.

The last two activities were two games: *Tangranito*, a puzzle in which the different components of magma, represented by geometric figures, have to be combined to form different plutonic rocks; the other game, *Fénix*, simulates the ecological sequences that take place in nature after a quarry is abandoned.

08

"Have you ever burned your money"

> *Mechelen/BE to Wrocław/PL*

Technopolis® , the Flemish Science Center, is the leading science centre in Belgium. It welcomes some quarter million visitors a year (on a population of 6 million in Flanders), in three languages: Dutch, French and English. The visitors can experiment with more than 280 interactive exhibits, and enjoy the science shows and demonstrations of the 'edutainers'. Technopolis® has a very extended outreach program, with a travelling science truck, a science theatre ("Theatro Bricolo"), a puppet theatre, a science week, a science festival, educational packages for schools, teacher days, girls-only technology clubs, workshops and shows on fairs…

One of these travelling shows was presented in Wrocław, Poland. The edutainer started with a variation on the classical 'three cups' game, where you have to guess under which cup the money is hidden. In this case the cups are opaque beakers. They are shown to be empty, and then the edutainer pours water in one of them. Hoopla, some position changes and you may guess. Nothing in the first, nothing in the second … and nothing in the third! In the third beaker were some crystals of sodium polyacrylate

(the super slurper in diapers), that have soaked up al the water and made a firm gel.
Next item was very Belgium one: a 'patates frites' gun. Take a tube about the diameter of a finger, and press it into a potato, so one end is plugged with a 'french frie'. Poke with a stick through the tube and the potato piece shoots away, maybe a metre, maybe less. Not really impressive. But the real trick is to plug both ends of the tube, and then again push your stick up the barrel of the 'gun'. Now – bang – the potato stick at the other end flies ten metres and more! Why? Between the two plugs air is enclosed. By pushing one plug into the gun, the air comes under pressure and the other plug shoots out when the pressure is higher than the friction.
And then the superlative degree: the 'vacuum bazooka'. Take a tube two metres long and some five centimetres wide (for instance a drainage pipe) and add a coupling for a second tube. Fix the hose of a vacuum cleaner to the coupling. Both ends of your tube still are free. Put a piece of paper to the front opening; it is sucked in place. Now take a container for a roll of film (the container should loosely fit the tube) and shove it up the back end. The container bursts through at the front and flies towards the audience, again some ten metres far! As soon as the tube is plugged at both ends, a vacuum is built, and the air pressure forces the can through the tube and out.

The audience really was startled by this one.
Next came a classical, but still very impressive show: the cola fountain. Put some 'Mentos' tablets in coke or another sparkling drink (we used tonic water) and by a still not completely understood chemical reaction, a lot of carbon dioxide gets loose at the same instant, pushing a fountain out of the bottle.

Talking about carbon dioxide, it also exists as 'dry ice'. Let this 'ice' sublimate (which means that a solid thing turns into gas – without getting liquid in between), fill a beaker with the resulting gas, poor the beaker over a burning candle: the flame goes 'fwwwt' and the audience goes 'aaahh'. In one go, the edutainer proved that carbon dioxide gas is heavier than air, and that it is incombustible. So now you know why fire extinguishers are filled with carbon dioxide.
Talking about fire, **who has some money to be burned**? Put it in a 50/50 mixture of water and ethanol, then light it. A spectacular flame, but the money is unscathed! The ethanol burns nicely, but the water absorbs the heat and the paper never reaches its own ignition temperature (Fahrenheit 451[1] = 233°C). That's why a pancake flambé in a restaurant isn't blackened after the show of the waiter.
But let's cool down a bit, with liquid nitrogen. The edutainer makes a dog from a long balloon, and puts it in a beaker of liquid nitrogen. Oh no, doggy dies! It shrinks completely. Still in a mourning mood, the edutainer puts some flowers in the liquid nitrogen, plays the game 'he loves me, he doesn't love me' while plucking the petals. He doesn't love me! In anger, she throws the flowers down. They break! And in the mean time, behind her back, doggie has come to life again. Applause!

Time to end with a big bang. She pours a bit of ethanol in a large plastic bottle from a drinking fountain, and closes the lid. Into this bottle, two electrodes have been introduced. She couples them to a Tesla coil, and charges them to 100.000 Volts. A spark, and wham! The mixture of ethanol fumes and oxygen from the air explodes and the lid hits the ceiling. The enthusiasm of the audience does the same.

[1] "Fahrenheit 451" is the title of the novel of Ray Bradbury, published 1953. The story takes place under a dictatorship, which forbids all books and burns them – and the temperature to burn paper is 451°F (=233°C). The opposition people try to learn all important books by heart to keep them for the times after. – Of course, the temperature to burn paper depends very much on the composition of the paper, but 200° to 250°C is a good guess.

09

"Mystery of Enzyme Actions - Electric Eel in Your Body"

> Wroclaw/PL to Perugia/IT

Both Polish presentations took place in Sala Cannoniera of Rocca Paolina – an extremely interesting historical structure in Perugia.

The Mystery of Enzyme Actions

All organisms are built of tiny blocks – atoms and molecules. Life is going on because the composition of the molecules is always changing – they convert

one to another. To help this process, special molecules, the Enzymes, exist in all living organisms. At the beginning of the reactions the first molecule structures are called substrates; the final result is called products. Enzymes speed up chemical reactions. Normally, chemical reactions might need heat or give off heat. But enzymes are molecules, which do this work at rather low temperatures.
They work by lowering the activation energy for the reaction and in this way they accelerate the rate of the reaction. Enzymes differ in shapes determining their functions, for example, the enzyme called "Amylase" has a shape allowing it to wrap around starch and cut it up into small glucose units.

The living cell is the site of tremendous biochemical activity called metabolism. This is the process of chemical and physical change which goes on continually in the living organism. Build-up of new tissue, replacement of old tissue, conversion of food to energy, disposal of waste materials, reproduction - all the activities that we characterize as "life."
This building up and tearing down takes place in the face of an apparent paradox. The greatest majority of these biochemical reactions do not take place spontaneously. The phenomenon of catalysis makes possible biochemical reactions necessary for all life processes. Catalysis is defined as the acceleration of a chemical reaction by some substance which itself undergoes no permanent chemical change. The catalysts of biochemical reactions are **enzymes** and are responsible for bringing about almost all of the chemical reactions in living organisms. Without **enzymes**, these reactions take place at a rate far too slow for the pace of metabolism – or at too high temperatures.
It is through attempts at understanding more about **enzyme** catalysts - what they are, what they do, and how they do it - that many advances in medicine and the life sciences have been brought about.

To enjoy the activity proposed to the visitors of Perugia Science Festival by Ms. K. Wachowicz you did not have to be a molecular biologist! It was enough to think of enzymes as of tiny "machines" cutting and joining other molecules in our organisms.
You were not able to see enzymes themselves (they are too small) but you were able to see the effects of their „work" visualised in colourful reactions.

In the first experiment, jelly dissolved in water was placed in two containers. In one container some kiwi juice was added, in the other only jelly. After about 20 minutes it occurred that the jelly without kiwi juice got stiff because of the automatically formed net of long molecule called gelatine. The jelly with the kiwi juice did not get stiff, because the enzyme from the kiwi juice, called Protease, had cut the strings of gelatine. Cooks should be aware of this fact when they add lovely looking pieces of kiwi to the jelly covering their cakes!

Who wants to spit! The next experiment needs saliva.
A dye solution of Lugol's iodine was prepared. Next, several drops of starch (potato flour) were added to small amounts of this solution.
Starch has a shape of a long spring. "Bullets" of iodine are trapped inside and seem to be blue. Adding saliva to starch solution resulted in changing colour of the Lugol's iodine solution. What happened? Enzyme

from saliva (Amylase) had cut the chain and iodine bullets could not be trapped any more.
All experiments could be repeated at home with the use of everyday products – vegetables.

Is there an electric eel in our body?

The theme of the activity was introduced to the audience by Mr. S. Winiarski and Mr. S. Jaroszczuk with the use of Power Point Presentation concerning muscle action and the usage of electric current produced in human muscles.

Electric eels produce high voltage currents (up to 600 Volts) in their muscles. The same mechanism of producing strong electric charge in the eel's muscles is responsible for producing electric charge in human muscles. Human body produces low voltage of about 0,001V (one milli Volt or 1mV). Although the electric current produced in the human body while we flex our muscles is very weak, it still is measurable!

The stand was equipped with an Electromyograph, which can measure the electric voltage of muscles, and a computer workstation with a game.

Children could volunteer. Each got pads on its arms, where the muscles are "thick". These pads

The science behind it all: ***SuperScience***
(a)Superman and the force of Gravity. This part of the demonstration aim at explaining what are the effects of a defined value of the gravity acceleration on our body and actions. Falling objects, jumping balls are used to introduce the idea of orbital trajectories and conservation of energy.
(b) Buzz Light-year: the fear of air pressure and the ability to fly. Some situations in the Toy Story movie are quite good to start talking about what it means to fly or to be in orbit around a planet. The concept of being in orbit is introduced from the throw of objects with an increasing initial speed. The idea of parabolic trajectories and escape speed are the final aim of the experiments. The concept of the low pressure effects on our body is also simulated with a vacuum set used to preserve food.
(c) Flash of the Incredibles and the non Newtonian fluid. In this film, the Incredibles are a family whose young son Flash is able to run very fast. He suddenly discovers he can run over the water. Does a man can do that? Yes, if the fluid is a non-Newtonian fluid such as the mixture that can be prepared with water and corn flour. This kind of fluid shows different reaction to a stress depending on which kind of force is exerted on its surface. If a person runs on it with a sufficient speed this person does not sink. There are other opportunities to observe a run over the water such as the run of the basilisk lizard. If he could talk, he might be able to explain the concept of surface tension.

were connected to the Electromyograph, which recorded the electric voltage produced, when the child flexed its muscles.
The signal coming from muscles was amplified and then muscle work was visualised and visible on a big screen.
Then the players took part in computer game, where cars race - but without the use of a keyboard and a mouse.
They controlled the movement of a car only by flexing their muscles. Flexing the right muscle, moved the car to the right, flexing the left muscle, the car went to the left.

10

"SuperScience and Science Balls" > *Perugia/IT to Reykjavik/IS*

The first presentation from the Perugian team was *SuperScience:* the science discovered in the stories of superheroes from Superman to the Incredibles, and then the *Science balls:* the mathematics discovered exploring the geometry of sport balls tailings. The two presentations are aimed both at looking closer to some common objects and popular stories and to approach scientific subjects such as geometry, physics and chemistry from an original point of view.

SuperScience won the first prize awarded by the public during the final event of **WONDERS** that took place at Pavilhão do Conhecimento in Lisbon in November the 24th.

The twin event where the presentations have been performed is the Researchers' Night in Reykjavik organised by Rannis, the Icelandic Centre for Research, just a week after the end of the Perugia Science Fest.

Is it possible to discover bits of science in superheroes stories? And what does the design of a soccer ball has to do with mathematics?

Both this questions can be answered by looking closer at popular cartoons such as Disney movies like "Toy Story" or "The Incredibles" and using the sports balls with your brain more than with your feet.
The Perugia Science Festival

staff has developed two activities for the **WONDERS** carousel of science: *SuperScience* and *Science Balls*.

SuperScience is a demonstration where short cuts of superheroes movies and superheroes comics stripes are the framework for demos that allow the public to experience for instance what it would be like, if we lived in a planet with higher gravity or with a less atmospheric pressure.

The dialogue becomes even stronger in the activity about the science balls.
In the *Science balls* activity the audience learns which two-dimensional shapes are suitable to build a ball. Topological problems are approached starting from the observation of a ball tailing, pentagons and hexagons are some of the main characters of this workshops but also other shapes such as triangles have a role in this sort of classifying game.

11

"The Pendulum and the

The science behind it all: ***Science balls***
Tailing is one of the main problems that mathematician have been facing for a long time. Which two-dimensional shapes can completely cover a surface? Not all the shapes are suitable for this purpose. The workshops lead the audience in a classification trail where different shapes such as triangle, pentagons, squares and other geometrical shapes are classified non only using the number of vertices and sides but also with their property to tail a surface.
What happens when you consider a tree-dimensional object such as a sphere?

Swing Gallery"

> Reykjavik/IS to Luxemburg/LU

The *Science Circus* was held around the National Museum of Natural History in Luxembourg. Members of the Icelandic **WONDERS** team presented the project there; Ari Ólafsson, physicist, assoc. professor at the University of Iceland, and creator of "The Pendulum and Swing Gallery".

The Icelandic Carousel presentation, *"The Pendulum and Swing Gallery"*, was designed and built especially for the **WONDERS** -project by Ari Ólafsson, PhD. in physics and assoc. professor at the University of Iceland. He was accompanied by Helga Birgisdóttir. The gallery has only been on display at **WONDERS** -venues, first at the National Museum of Natural History in Luxembourg at *Science Circus* in September and then in Lisbon at the **WONDERS** -finals in November.

In 1851 it was well known that Earth rotated: observational evidence included Earth's measured polar flattening and equatorial bulge.
However, **Foucault's pendulum** was the first dynamic proof of the rotation in an easy-to-see experiment, and it created a sensation in both the learned and everyday worlds.
At either the North Pole or South Pole, the plane of oscillation of a pendulum remains fixed with respect to the fixed stars while Earth rotates underneath it, taking one sidereal day to complete a rotation.
So relative to Earth, the plane of oscillation of a pendulum at the North or South Pole undergoes a full clockwise or counterclockwise rotation during one day, respectively. When a Foucault pendulum is suspended on the equator, the plane of oscillation remains fixed relative to Earth. [Wikipedia]

We have all seen, and probably used, pendulums – even though we might not know it. The playground swing and the grandfather clock are excellent examples of pendulums from our everyday lives. Visitors of the "Pendulum and Swing Gallery" learned *when* pendulums move, *how* they move and *why* they move at all.

A simple pendulum is a weight (or bob) on the end of a light weight string which, when given a push, will swing back and forth under the influence of gravity. The beauty of the pendulum lies in the simplicity and stability in the oscillation period. The period depends on the length of the pendulum and local gravity, but is independent of the bob-mass. The grandfather clock is an example of a simple pendulum, but by removing the term "simple" and adding some structural modifications, more colour was added to the motion pattern which evolved with time along fascinating paths.

The *"Pendulum and Swing Gallery"* contains ready made simple pendulums, a swing, a pendulum on a rotating platform and various multi-tone pendulums. By showing the pendulums in their most simple form the science behind them was easily explained, even to the youngest visitors. Also more complicated pendulums, pendulums that move in different ways and on different speed were shown.

A Foucault pendulum is an excellent example of the simple, yet fascinating, pendulum. The oscillation plane of the Foucault pendulum rotates slowly due to the earth's rotation. The gallery contains a pendulum mounted on the rotation axis of a turntable. It shows the "Foucault effect" on a different timescale. From the outside the pendulum motion is simple, whereas an observer on the rotating table would experience a complicated motion pattern.

"The Pendulum and Swing Gallery" is an interactive experience. Guests were welcome to not only *look* but also to *touch* while they learned about pendulums. Guests were invited to draw a picture of the swings´ movement. A pen was fastened to the swing, and as you moved the swing a bit, the pen started to move and drew a pattern on a piece of paper that was on a small table below the swing. The pattern that appeared depended on how the swing moved and how fast, so that each motion-picture was unique. Children, teenagers and grown-ups alike had a lot of fun making the pictures and took them home as a souvenir.

12

"Bottled Suitcase Solutions"

> Luxemburg/LU to Budapest/HU

Perhaps you had an old great-grandmother who told you about the atmosphere on fair markets in the 19th century. If yes, perhaps she told you also about the alchemists who came to such fairs to show some astonishing experiments where the kids and the parents stood with open eyes when they saw black snakes coming out of small pills.
These snakes where not born out exotic eggs from southeast Samoa, but are the result of a simple chemical experiment where burned sugar is blown up by a forming gas.

The three alchemists from Luxembourg looked like they would come from the 19th century but behind their costumes hide real chemists that show their best chemical tricks and even give explanations about the scientific background.

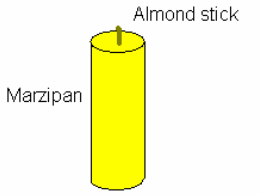
Bismuth is a chemical element that has the symbol Bi and atomic number 83.
This heavy, brittle, white crystalline poor metal has a pink tinge and chemically resembles arsenic and antimony.
Of all the metals, it is the most naturally diamagnetic, and only mercury has a lower thermal conductivity.
Bismuth compounds are used in cosmetics and in medical procedures.
As the toxicity of lead has become more apparent in recent years, alloy uses for bismuth metal as a replacement for lead have become an increasing part of bismuth's commercial importance. [Wikipedia]

The 3 brothers are called Tungsten, Phlogiston, and Bismuth carried their old suitcases full of chemicals to Budapest to the 33 hours non-stop presentations and to the WONDERS-finals in Lisbon. Consistent to his characters everyone showed his scientific specialty.

- **Tungsten** is the most violent of the family. His experiments are the most dangerous, and he doesn't always have the full control of the situation. He mixes e.g. some baking powder to vinegar and gets some explosive projectiles. Be out of his way!!

- **Phlogiston** is the little brother and as you could imagine a dreamer. He admires the fire so much that he even swallows it or burns his money with it. Take care his experiments don't always work out. Don't give him YOUR money!!!
- **Bismuth** is the oldest, the one which keeps them together. He tries to be wise but actually he isn't. His strength is to make things disappear. Mysterious sensorial illusions…

During 35 minutes the people from Luxemburg amazed their public composed of children students and adults with an animation that resembled to a street theatre. They showed everybody that science could also be presented in cylinder hat + vest - dress and not only in lab coat.



Here a "Do-it –yourself" experiment from the three brothers: "Eatable Candle"!

Tungsten, also called wolfram, is a chemical element that has the symbol W (German: Wolfram) and atomic number 74.
A very hard, heavy, steel-gray to white transition metal, tungsten is found in several ores and is remarkable for its robust physical properties, especially the fact that it has the highest melting point of all the non-alloyed metals and the second highest of all the elements after carbon.
The pure form is used mainly in electrical applications but its many compounds and alloys are widely used in many applications, most notably in light bulb filaments, in X-ray tubes (as both the filament and target), and in super alloys.
Tungsten is the only metal from the third transition series that is known to occur in biomolecules. [Wikipedia]

This experiment can be done to frighten parents, to impress working colleagues or to amaze students. Its very simple to do, and you don't need any dangerous chemicals.

Still, **Phlogiston** remained the dominant theory until Antoine-Laurent Lavoisier showed that combustion requires a gas which has weight (oxygen), which could be measured by means of weighing closed vessels. These observations solved the weight paradox and set the stage for the new caloric theory of combustion. In some respects, the phlogiston theory can be seen as the opposite of the modern "oxygen theory". In the modern theory, on the other hand, flammable materials are "deoxygenated" when in their pure form and become oxygenated when burned. However, the first part of the old theory requires that phlogiston has weight (since ashes weigh less), but the second requires that it have no weight or negative weight. [Wikipedia]

<u>What you need:</u>
Marzipan (almond paste); Almond shiver (you find in the baking rack of your supermarket); Candleholder; Lighter

<u>How you do it:</u>
Form a candle-like cone with the marzipan dough; put the almond shiver on top, (it will make the wick); put the self-made candle in a candleholder. If you want colour the marzipan with some food colorant.

<u>How to present it:</u>
Your public should stand at least one meter away. Light the candle with a lighter - this might last longer than with a normal candle. When nobody expects it, bite into the candle and swallow the "wick" with the "wax". Careful !!! Don't burn your tongue with the wick. If you don't want to take a risk, blow the candle out before eating it.

<u>How it works:</u>
The almond shiver contains almond oil. This oil is similar to commercial lamp oil, which is burnable and has a lower burning temperature.

13

"Best Experiments" > *Budapest – Palace of Miracles, HU to Waterford/IE*

33 hours of experiments is not only a scientific, but a cultural highlight and delight! All these experiments can still be seen in videos at http://vod.niif.hu/fizika33_2007/, more about the "Palace of Miracles" in Budapest on: www.csodapalota.hu.
The science event of the Palace of Miracles included a series of physics experiments presented continuously for 33 hours. The event took place in the auditorium of the Palace of Miracles, with 16 performers, partly from the Palace of Miracles, partly from outside, with teachers from the Technical University who present experiments for the studies at the university, physics teachers from different high schools etc. The performers presented from different fields of physics, thermodynamics, mechanics, sounds, the physics of musical instruments, low temperature physics, electricity, etc. The performers changed every 45 minutes on the stage.

In this series were involved the Carousel partners from Luxembourg, too, three people, the 18th century Chemmagic Trio. They presented chemical experiments in the framework of a show.
After their presentation they went out to the exhibition area and to the open air in front of the building, also presenting their experiments for a gathering audience.

The finishing event of the 33 hours experimenting was a spectacular show in the open air, such experiments which could not be presented in the auditorium: thermite flame, exploding a bottle with dry ice, lifting a barrel into the air with 200 litres of water, forming a giant fountain, etc. The Luxembourg group also participated in this final event.

14

"Exploring Irish Science" > *Waterford/IE to Prague/CZ*

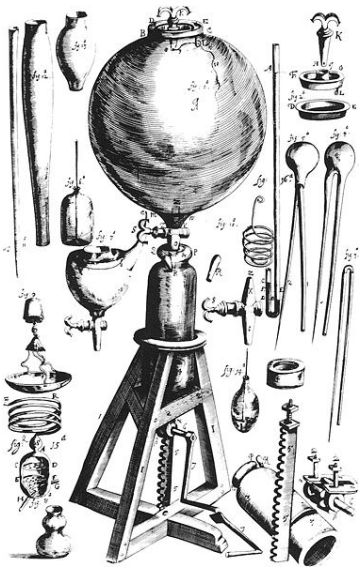
"Discover Science" from Ireland is an interactive presentation for the general public developed and presented by the CALMAST[2] team, which tells the story and work of some historical Irish scientists.

With Google Earth images, the presentation zooms from the home of the audience across Europe and down to Ireland panning around the birthplaces of three Irish Scientists from history. Starting with **Robert Boyle** (1627 - 1691), the presentation sets the scene in Lismore Castle, close to where CALMAST is based. Son of the Earl of Cork, who at that time was one of the richest men in Ireland and Britain, Robert Boyle, through his experimentation and scientific reasoning, became known as "the father of modern chemistry" being famous for his work with vacuums and pressure. The first demonstration is a simple recreation of the famous Magdeburg demonstration from Germany in 1650 where horses couldn't pull apart two hemispheres with a vacuum between them. In the re-enactment volunteers were matched against each other to pull apart two "dent pullers" which can be purchased inexpensively from a hardware store.

The mathematical equation for **Boyle's Law** is:

P * V=k

Where **P** denotes the pressure of the system. **V** is the volume of the gas and **k** is a constant value representative of the pressure and volume of the system. So long as temperature remains constant at the same value the same amount of energy given to the system persists throughout its operation and therefore, theoretically, the value of ***k*** will remain constant.
Forcing the volume ***V*** of the fixed quantity of gas to increase, keeping the gas at the initially measured temperature, the pressure ***p*** must decrease proportionally. Conversely, reducing the volume of the gas increases the pressure.
[Wikipedia]



An electric vacuum pump was used in place of Boyle's manual pump and the effect on transmission of sound, combustion and the volume of a gas were explored. The transmission of sound was shown using a ringing mobile phone in an evacuated vessel. As air is drawn out of it the ringing of the phone gets fainter, until a fuller vacuum is achieved and the audience can see by the vibrations of the mobile phone that it is still ringing but no sound is heard – a simple way to show that sound needs a medium for transmission.

[2] CALMAST = Centre for the Advancement of Learning of Maths, Science3 and Technology, based in Waterford, in the South-Eastern part of Ireland

Marshmallows provide a fun way to show the effect of lowering pressure on a volume of gas. The marshmallows are placed in the glass vessel and the vacuum pump is switched on. As the pressure reduces in the vessel, the marshmallows grow and grow much to the delight of the audience. This is caused by the air bubbles in the marshmallows expanding as the pressure lowers. The bubbles can burst and unfortunately when the vacuum is released and the pressure increases again, the marshmallows shrink, and end up being smaller than they were originally!
This is clearly illustrated by expanding a partially filled balloon in the vacuum (which is closer to Boyles own demonstration using a sheep's bladder!).

In 1851, **George Gabriel Stokes** derived an expression for the frictional force (also called drag force) exerted on spherical objects with very small Reynolds numbers (e.g., very small particles) in a continuous viscous fluid by solving the small fluid-mass limit of the generally unsolvable **Navier-Stokes equations**:

$$F = 6 * \pi * r * \mu * v$$

where **F** is the frictional force, **r** is the radius of the spherical object, **μ** is the fluid viscosity, and **v** is the particle's velocity. [Wikipedia]

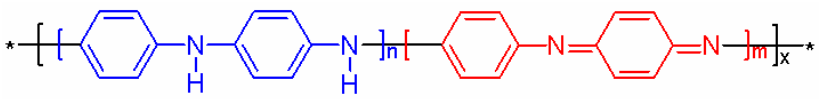
The audience now understands the effects of lowering pressure on a volume of gas so then the effect of increasing the pressure on a volume of gas is explored.
This was simply and inexpensively done using a partially inflated balloon (long narrow type), a 2 litre plastic bottle, a bicycle pump and a valve and connector (from a water rocket kit). A member of the audience is invited to put the partially inflated balloon in the bottle. Not so easy!
The trick is to squeeze the bottle before pushing the balloon in so that the bottle can expand as the extra volume of the balloon is introduced. The connector is placed on the bottle, the valve attached and connected to the bicycle pump. The bottle is then supported on a stand. As the pump is pumped, the balloon gets smaller and smaller as the pressure on the bottle is increased. Eventually the pressure is so high, that the valve is blown out of the bottom of the bottle with a bang.
The audience is startled to see that the balloon has gone. It has been shot out of the bottle by the pressure and as it gets back to atmospheric pressure it grows back to its original size.
This happens so fast that the audience can hardly believe that the large balloon could fit out the small neck of the bottle!
And so the demonstration can be repeated. At this stage the audience understands that as the pressure on a gas is increased the volume decreases and as the pressure reduces the volume increases. It is suggested that there is an inverse relationship – Boyle's Law.

Audience participation is again called on to verify Boyle's Law, which states that the pressure on a gas is inversely proportional to volume, which means again: the more pressure the less volume.
A wide plastic syringe (50ml) is held in place upside down on a stand, expanded to 50ml and the end stopped. A series of 1 , 2 and 3 kg weights are provided. The volunteer is asked to place each of the weights in turn on top of the piston of the syringe. This increases the pressure on the trapped air and using Boyle's Law and simple calculations the resultant volumes are predicted. The volunteer then applies the weights and reads off the volumes occupied by the air in the syringe. The volume readings are then compared to the predicted readings and can be plotted on a graph thus simply and inexpensively verifying Boyle's law in front of the older audience.

The next Irish Scientist introduced was **George Stokes** (1819 -1903) who came from Sligo in the northwest of Ireland. Stokes had a wide range of interests and is particularly known for his work with viscosity - how easily liquids flow and bodies move through liquids - and this was the area shown in the presentation.
Two long transparent tubes (novelty bubble lamps) are filled with water and (cooking) oil respectively.
Two volunteers are chosen to see how a small ball will fall though the two liquids. Each of the volunteers is asked to drop the ball they have been given

The **Tyndall Effect** is the effect of light scattering on particles in colloid systems, such as suspensions or emulsions. It is named after the 19th century Irish scientist John Tyndall. The Tyndall effect is used to tell the difference between the different types of mixtures, namely solution, colloid, and suspension. For example, the Tyndall effect is noticeable when car headlamps are used in fog. The light with shorter wavelengths scatters better, thus the color of scattered light has a bluish tint. **This is also the reason why the sky looks blue** when viewed away from the sun: the blue light from the sun is scattered to a greater degree and is therefore visible far from its source.
This effect occurs because short wavelengths of light towards the blue end of the spectrum hit the air molecules in the earth's atmosphere and are reflected down to the earth's surface. Longer wavelengths towards the red end of the spectrum are less affected by the particles and pass on through the earth's atmosphere.
The **Tyndall Effect** is more commonly referred to as **Rayleigh Scattering** in introductory physics text books. [Wikipedia]

into the liquid at the appointed time.
At the appointed time, the balls are dropped, and it can be seen that the ball falling through the oil falls slower than the one travelling through the water because of the greater drag force. The volunteers are then asked to retrieve the balls.



It appears that the only way to retrieve the balls is to put their hands into the liquids. The audience get very involved and encourage them to get their arms wet! Unbeknown to the volunteers the balls they have been given are magnetic, making it easy to retrieve the balls!
Viscosity in liquids is further illustrated with three liquids, some narrow glass tubing, three small funnels, three graduated cylinders and three volunteers. The experiment is set up with three glass tubes held vertically on stands and under each is placed a graduated cylinder. A fixed volume of three liquids – water, baby oil and cooking oil is measured out, and at the instruction, the volunteers pour the liquids into the tubes, and the audience watch to see which liquids enters the graduated cylinder fastest. The idea of viscosity is explored and its importance in engineering applications highlighted.

The last scientist to be presented is **John Tyndall** from Carlow (1820 – 1896), who is credited with proposing the idea of global warming, explaining why the sky is blue, showing that germs are present in the air, and developing a method of sterilisation called "Tyndallisation". Tyndall was very interested in dust and the scattering of light by dust.
Darkening the room and using talcum powder and a laser pointer, it is shown that light can be seen when it is scattered by dust. It is also clearly illustrated that light travels in a straight line.
This sets up the next demonstration, again in the darkened room and using a laser pointer. A clear plastic container with a small hole in one side is filled with water causing a jet of water to flow out in a curved path. The laser is pointed through from the other side at the hole and the audience are amazed to see the light curve with the water jet. This curiosity is the same principle that allows light and information flow through fibre optic cables.
A clear vessel with water and flashlight were used to show why the sky is blue and sunsets are red. The light is shone through from the side of the vessel and a few drops of milk are added and stirred in. The light is scattered by the milky water and the water takes on a bluish hue. Viewed through the end the vessel the light is seen as a yellowish red colour representing the setting sun.
This being an appropriate note to finish the show on it only remained to thank the audience in their own language Czech written in fibre optics.

This presentation was able to show the science and also tell the *story of science*.

15

"Rainbow as a Bridge to the Stars"

> Prague/CZ to Jerusalem/IL

During this performance everyone finds out some answers to questions such as: **Can you find Universe in your kitchen? Can we build Sun on Earth? How to touch the Stars? What are they made of? Can we use rainbow to get closer to the Stars?**

It is followed by a short reminder from the childhood when we imagined how nice it would be to run to the horizon and to climb the rainbow up to the stars.

Then Lenka, an astronomer, explains what we can see while looking at the night sky and that the most of the Universe is "Plasma".

Then Matěj, plasma physicist, comes and tells the audience what the plasma is and how is it characterized, where we can see it (with a funny scene including a plasma ball and fluorescent tube, illuminating due to its electromagnetic field).

At that moment Šárka, chemist, comes and offers to use chemistry, able to prepare a new material needed, she also explains the origin of all the elements in the Universe – which are baked in the innermost parts of the stars, then released in the explosions at the end of the star's life. If this explosion is very strong, this star's death is called a supernova – sending all the produced elements into space – to form other stars, planets – and even ourselves – we are made of "star dust".

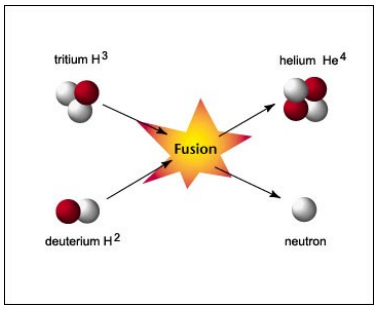
Šárka describes the principles of the polymerization and starts to prepare small presents for the spectators – wooden pencils coated by **Polyaniline** (see formula) – a conducting polymer.

Finally all presenters find out what they have in common – **spectroscopy** that is used in all three branches.

Sarka the Chemist, Lenka the Astronomer, and Matej the Plasma Physicist have done their best to convince their peers that science is fun and adventure, a space for curious and crazy questions, and an amusing quest for answers in nature. Their scientific show called The Rainbow As A Bridge To The Stars, presented six times in the Bloomfield Science Museum of Jerusalem, was full of surprises and of bridge building between the different branches of science.

What is the scientific message in the topic of their presentation? The young scientists wearing colours of the rainbow promised to decipher the meaning, and added even more questions to be explored, such as how to build the Sun on Earth, how to touch the stars, or how to make the rainbow be a bridge even to other exotic worlds than the world of stars.

First of all, why should we want to touch the stars? Because we are curious, that is all. We simply want to know what the stars are made of. Lenka, the astronomer, assures us that it is nothing too exotic, just the common elements: mostly hydrogen, some helium, a little bit of nitrogen, of oxygen, of sulphur, or sometimes even iron. How do we know this without ever going there and touching the stars? This is the secret of the rainbow alias the spectrum. We know the composition of the stars just by looking at their light. Every light is a different mixture of colours. This truth is revealed when the rays go through a prism. A rainbow appears, a different one for each star or lamp, as Lenka is showing in the picture. You can easily do the same experiment yourself, a CD or a DVD is enough to give you beautiful spectra. Or try the method used by the nature, which produces the rainbow in the sky by water droplets.

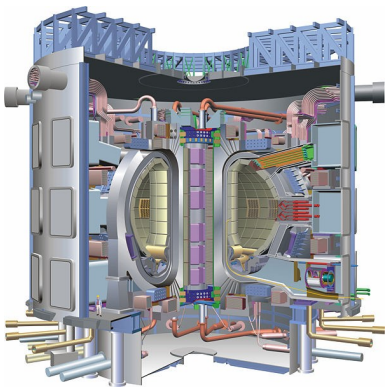


Scientists then draw careful graphs of the observed spectra and are able to calculate which of the humps or troughs in their curves are caused by stellar hydrogen and which by oxygen or iron. And they can even read much more, for example which direction the star is moving and with what velocity.

Why should we want to build another sun? The answer is simple: for energy. In the growing energy needs, we would love to use the same trick as the stars do in order to shine. The trick is called the nuclear fusion and it combines hydrogen atoms (H) to form helium (He). It is not a simple chemical reaction – the chemical reactions only combine elements into molecules, but the stars truly synthesize new elements. The energy obtained this way is much larger, because strong nuclear forces are in play. And this is where the trouble lies in making the fusion happen on Earth.
Extremely high temperatures of hundreds of millions of degrees are necessary to accelerate the particles so that they overcome the electric repulsion and get close enough that their nuclei can interact. The fusion experiments are run in a chamber of toroidal (like a car tire) shape, called the Tokamak (see picture). The hot matter inside is in the form of plasma, just like in stars and also in cosmic nebulae as well as in common devices such as the fluorescent lamps, where the atoms are separated into ions and free electrons. The hot plasma must never touch the walls of the Tokamak tube, which would melt immediately! This is achieved by magnetic fields, and Matej demonstrates one type of magnetic confinement using his coils and metallic pieces.

Physical experiments of this kind need a development of new advanced materials. And this is where the material science and chemistry come into play.

Sarka, our chemist, has shown on the spot some of the vast possibilities of creating materials. By polymerization of the substance aniline, she created polyaniline which is a solid plastic material, but unlike all the



Normally, all matter consists of atoms and molecules, which are electrically neutral, although their part, the electrons and the protons are charged: electrons have a negative and protons a positive charge. But, on the outside, the positive and the negative charge neutralise each other.
When the protons and the electrons are not connected any more within the atoms, but fly wildly around, then we have a "**plasma**". To produce such a plasma, some force must hold these particles away from each other. This can be a very high temperature, which excites them or an electric voltage.

common plastics which we meet in our household, polyaniline is a conductor – „a plastic metal"!

Sarka did not forget about our major theme either: thanks to spectroscopic measurements done in her laboratory, she was able to describe exactly the invisible structure of polyaniline layers on the objects that she gave to the audience as presents. Spectroscopy again proved to be the useful arm reaching not only to the distant worlds of stars, but to the microscopic world of molecules, too.

16

"Meet Math – Miniature Math" > *Jerusalem/IL to Freiburg/DE*

"Do not worry about your problems with mathematics.
I assure you mine are far greater."
Albert Einstein

This mini exhibition from the Bloomfield Science Museum in Jerusalem travelled with two museum explainers to the Science Days taking place at Freiburg Germany.
There themes are:

- **What do lizards have to do with Math?**
- **How many colours will you need to paint a map of the world?**
- **Was Leonardo da Vinci an artist or a Scientist?**
- **Find out about the light side of Math and discover its' richness.**
- **Meet new concepts and ideas of Mathematics that you haven't seen before.**
- **Be challenged by puzzles and riddles.**
- **If you are curious, you will enjoy it.**
- **If you are not, it will make you curious!!**

"Meet Math" is one of the museum's leading and most important exhibitions developed in collaboration with the El Quds University in East Jerusalem and assisted by Città de la Scienza in Naples.
An extensive educational program rich with many different activities accompanies the exhibition, now located at the El Quds University, as its first in-

teractive exhibition. And another version of it of 12 exhibits circulates Israel as part of the museum's outreach program.
In choosing to send this activity our consideration was to bring forth as many different activities related to Math and making it fun, contradicting the widely spread saying "I hate Math". and also showing that with such an exhibition much more can be achieved: crossing boarders, creating new friendships and erasing differences.

Two museum explainers had been sent to present the activity, both very well accomplished in science communication and second degree students of Math Sciences. Ayala Byron, and Denise Hadad being themselves an Israeli and an Arab Israeli represented the spirit and belief of the Bloomfield Science Museum in bringing together the different people living in Israel.

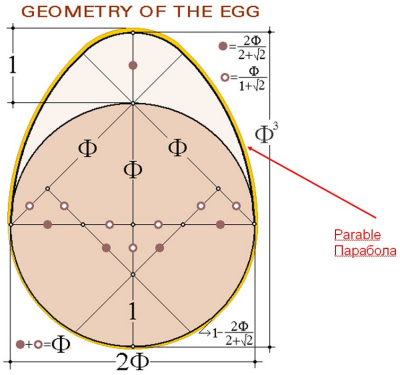
17

"Structures in Nature and Technology" > *Freiburg/DE to Moscow/RU*

It was one of the objectives of this face to face show "**Structures in Nature and Technology"** to show what we can learn from nature to create new technology (bionics). The presentation was interdisciplinary and consisted of a lot of experiments and media elements like pictures, animations and films.

To overcome visitors inhibitions, Mr Patrick Berger (left) and Mr Joachim Lerch from the Science House in Rust, Germany, have been dressed like clowns, scientists with clowns noses; this included many jokes and funny activities.

The show started with a oil-slick experiment. Coloured oil was pressed between two acrylic plates. Then the upper plate was lifted up. Now fractal structures appeared and could be projected by a daylight projector on a screen. The visitors always have been fascinated and motivated by this experiment to stay with the show.



After that the structures have been compared with structures in nature, for example of coral reefs, with the deltas of a Russian river, with blood vessels in our body, with the forms of our brain etc. to draw various conclusion on various aspects. Some of the experiments were focussed on the function of the brain and it's coordination.

In the second part some technical applications of bionics have been presented. A water repellent tie was compared with the clean leaves of the lotus flower. An impressive computer animation showed a microscopic view to the surface of the lotus plant.

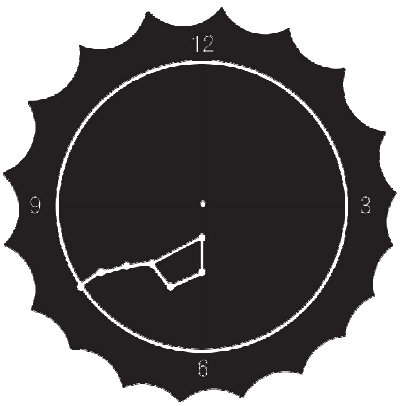
The Bernoulli effect – shown with a spectacular experiment with a balloon – demonstrated the basic principle of buoyant force of airplanes. The audience was asked to blow up about 20 balloons. Then, the clown Patrick put them together and on top of it a transparent acrylic plate of about one square metre. And all of a sudden, Patrick jumped on this plate – and all the balloon just squeezed to each other a little bit, but Patrick stood – amazingly – on this plate held up just by the fragile balloons. Then he asked the other clown, Joachim, to come. Also Joachim jumped onto the plate. All 20 balloons kept quiet. But, then, they asked the audience – and finally about six to seven persons were standing on the plate – and all the balloons were just smiling…

Through the plate, you could see that the balloons formed like honey combs – in nearly six hook perfection to be the strongest!

Later the parable was presented as a very stable construction in nature and in technology (form of an egg, bridges etc.).

The efficient heat insulation of a polar bear's fur and its perfect energy recovery were topics of the next part. The visitors have been very surprised to hear that the skin of the polar bear is black under the white fur. In a discussion we identify the different aspects of the polar bears energy budget and how the hairs can transfer sun light to the skin to warm the polar bear – like fibre optics transport data with light.

Before the end, a short sequence with a quiz happened: the visitors should identify if the shown structures have been artificial or from nature.



18

"Scientific Questions"

> Moscow/TU to Göteborg/SE

The workshop consisted of the following exercises:

- Personal scale: lets count your personal time in your mind
- A task to decide "How long do different animals live?" by a simple matchbox puzzle
- Showing and explaining and discussing the video: "Power of 10" – sizes from the smallest to the largest
- Time in the Nature and in Society (trees and humans)
- Time that comes from stars
- Everyday conciseness with a self questionnaire analysis: gender and age differences

- Who am I ? A dialogue between participants
- Making toys for the new-year trees

How long do different animals live? And who is faster? Who is warmer? Why do we do something before thinking about how to do it? What do we know about ourselves? And – is more important – what we still don't know?
These are the questions that were asked to people – children, families and even experienced scientists - guests of the M. V. Lomonosov Moscow State University presentation. The most

difficult is to study simple things, like life, like time. Is it possible to find answers on these questions by simulation games?

The workshops started from super simple experiences and hands-on exercises and experiments and continued in presenting a scale for different perceptions, dimensions and with an outlook for life span and time scales. To find proper time scale for our human needs we need to "touch and play" with time. One of possibilities for humans is to be abreast of the time - to be coherent in the context of evolution.

All participants were given an opportunity to listen to their inner time, to walk (!) along the time arrow from formation of the solar system and earth to

nowadays and back – to touch global history time, to try to define time with help of the special **Nabokov Umbrella** and Charles's Wain (Ursus Major) and see how local time comes also from the stars. As you can see from the turning umbrella, the star constellation called the Big Dipper turns around the polar star (in the middle) once in 24 hours. This is a clock, which can be watched from more than the Northern half of our earth.

Participants tried to think about biodiversity phenomena and practice, about time defining by trees – dendrochronology (counting the years by counting the rings in the trees, which have been cut down), to make a clear concept about perceiving the world around ourselves and possible risks, about knowledge and understanding.

The Russian presenters brought with them the first Russian set for training in decision-making for sustainable development "**The Green Backpack**" (EcopolisPress, Moscow, 2003). It consists of 20 interactive toys, games and interactive posters, some of them made by Russian students. All volunteers could play a terrestrial ecosystem card game "Island", simple "matchbox" eco-games on everyday ecology – "The Risky Life", "Who lives longer?", "Silence and Sound", "Electromagnetic Fields around us", "Who is faster?", "Who is warmer?", "pH in our Life".

They also offered an opportunity to try modelling with the help of a special "**Ecological constructor**" set.
Together they solved different puzzles, made exercises on the significance of reaction speed, on trying to make "impossible" figures from paper, on 3-dimensional perception, on seeing differences between illusions and facts.
The most engaged participants and "winners" received the simulation game "Island" and other Moscow Science Festival souvenirs and science toys.
The presenters tried to make participants not to trust too much their senses, but to explore and investigate the world around and in us with their brains. Together we were building a kind of bridge between our knowledge and acquiring understanding.

Odours can do more than simply give people memories of images or sounds. This is because our nasal organ is in direct contact with the system where our memory and our emotions are centred. That is why odours are often connected to moods.
For example, when you have been experiencing a stench all day, your temper will be very bad, but when you arrive in a forest you often feel peaceful and calm. Because of these effects incense packages often have an inscription that tells you how the specific scent will affect your mood.
Each person has a different odour, just like each person has a different fingerprint. According to a recent theory a person's odour can be linked indirectly to a person's unique genes. The genes of the immune system determine the composition of bacteria on a person's skin. The bacteria decompose sebum from the sebaceous gland to fatty acids. Through this process each person receives a unique composition of fatty acids, which determines its odour characteristics.
[http://www.lenntech.com/odour-information.htm]

19

"Can you find a partner by the smell" > *Göteborg/SE to Sofia/BG*

Can you find a partner by the smell?

Yes, of course.

The scent of a partner may be important just as well as his or her looks, wits, intelligence, clothes or smile. But it seems reasonable to keep a sceptic position towards the commercial "pheromone perfumes" that are said to increase a person's sexual attractiveness.

This is the main message of the Swedish presentation in this year's WONDERS European Science Festival.

The Swedish scientist, Carl von Linné, or in Latin **Carl Linnaeus**, born 1707, was celebrated throughout the world in 2007.

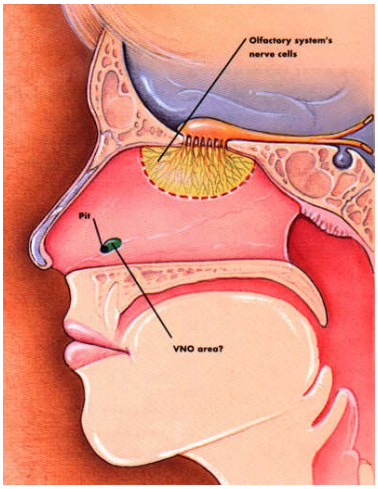
Linnaeus most important contribution to the scientific world is of course the "Systema Naturae", where he introduced a completely new way to categorize animals, plants and minerals.

The first edition was published in 1735, the last in 1770, and the system of Linnaeus is still used today. But he also categorized smells, and his list of odours from 1756 looks like this:

- *Spicy(pleasant)*
- *Balsamic (pleasant)*
- *Musky (intermediate)*
- *Garlic (intermediate)*
- *Goaty (intermediate)*
- *Horrible (unpleasant)*
- *Nauseatic (unpleasant)*

This scale, from pleasant to unpleasant, has turned out to be a common way to classify odours – most people describe smells in those terms. But it should be remembered that this classification is culturally acquired; the newborn baby makes no such distinctions. Smells are different to the baby, but it adds no value to that, no degree of "pleasantness".

Now then, do we find our partners by the smell? And what about the pheromones?
The odourless pheromones were first described at the end of the 1950's as a group of substances that is secreted and transmitted from one individual to another one of the same species. These substances have been shown to change the behaviour of the receiving individual. Among other things, it may influence the perception of other individuals' attractiveness as partners.
It is however important to emphasize the research at that time did not concern human beings. For many years, scientists have believed that this function was of no or little use in humans – contrary to other vertebrates where it is most important. But recent research suggests that human beings also sense and act upon the detection of these pheromones – but so far no one has been able to find a pheromone that would increase the sender's attractiveness as a sexual partner.



A Sixth Sense?
Human beings detect smells and scents through the nose and the olfactory system. A young person may detect over a million smelling substances that they can learn and react upon. Also, the pheromones are received through the olfactory system, the skin and, at least in some mammals, an additional organ called the "vomeronasal" or Jacobson's organ. Studies about the **human vomeronasal organ**, however, have concluded that it has no function in human beings.

Some studies during recent decades include tests where women have been asked to smell men's t-shirts and choose the most interesting one. Other tests have been done to see if the behaviour is changed when people are exposed to pheromones. One example of the latter is the work done by the WONDERS presenters Mats J Olsson, Uppsala University, Francisco Esteves, ISCTE, Lisbon in Portugal, and others regarding mood changes as a result of exposure to androstadienone, a pheromone that is a strong candidate for carrying information between human beings. Their studies indicate that the mood – the feelings – in a test group of people became more open, social and focussed after having been exposed to pheromones.

The conclusions so far are:
>> There are some evidence and indications in favour of pheromones having an importance also for humans
>> There is absolutely no evidence supporting the idea that pheromones would increase the sexual attractiveness.

Other important messages of the presentation:
Our choice of partners may well be influenced by the scent. But it is also to a large extent affected by what we see, clothes, looks, interests and a number of other factors.
Some studies suggest that human beings may respond to chemical signals from other people.
The pheromones research illustrates an important aspect of scientific work: "we don't really know…". It is all about getting new knowledge. There is a number of ideas that are being studied, and what we know so far may only be a part of the entire picture.

At the International Science Festival Göteborg, where the subject was first discussed, through a series of talks of scientists, there was also an interactive part connected to a research project, where visitors were asked to fill in a form regarding five odour samples, two of which were pheromones. In Bulgaria, the interactive part consisted of an illustration of the "pleasant-unpleasant" scale and of how difficult it can be to distinguish to similar but still different smells (male and female perfume was used). Visitors were also invited to try to detect a pheromone sample. At the finals, the presentation was considerably shorter and the interactive part further reduced to a

simple test for recognition of male and female scents.

20

"How Hard it is to be a Frog in the Time of Global Warming" > *Sofia, BG to Essen, DE*

Imagine you were among the visitors of the German national science week "Wissenschaftssommer 2007". Despite the really hot summer in Essen you decide to enter the festival's tent attracted by the motto "ABC of humankind" and the central topic: "Human Languages".

Unexpectedly you hear a monotone frog croaking and few steps inside you can read an announcement under the title "The Amazing World of Frogs or How Hard It Is to Be a Frog in the Time of Global Warming":

"Do you understand what the frogs near Froschdorf are croaking about? Because the Bulgarian batrachologists from the National Museum of Natural History already can, and they suggest to look closer and to listen to the War(m/n)ing croaks coming from the United Marshland. Zoologist, biotechnologist, e-journalist and a philosopher will provide you with a simultaneous interpretation from the globally threatened animal language (Frogian) into four human languages: two still alive and kicking (English and German), one almost alive (Bulgarian) and the one in the future (Ding-a-Dang-Dongian). Meanwhile, some of you could become the next Fro-Schumacher winning the Paper Frog Race".

If you ask the team 'What's croaking on here?' they would tell you that even in Bulgaria the mere fact that a multimedia presentation is dedicated to someone's anniversary guaranties a real disaster in catching participants' attention.
And it really matters also that it is the 300th Anniversary of Carl Linnaeus – the scientific genius who introduced species' systematic and taxonomy and a strang motto was 'God created, Linnaeus organized'.

However, the paper frog (origami) making is good bait in order to angle for innocent children and parents from the high people flow and to prepare them to listen to the short story about frogs and their life cycle (metamorphosis), as well as to swallow the scientific fact they are a now globally threatened group of animals. About two-thirds of the 110 known harlequin frog species are believed to have vanished during the 1980s and 1990s. The 'bullet killing frogs' is the disease-causing fungus *Batrachochytrium dendrobatidis* which infects the amphibians' extremely thin skin, but 'climate change is pulling the trigger'.

> There are 17 amphibian species that inhabit the territory of Bulgaria. They include 12 frog species from five families and five salamander species from the family Salamandridae. The most recently discovered species is the Edible Frog which was first registered in 1966. Some of the most common species include the European Green Toad, Yellow-bellied toad and Marsh Frog. [Wikipedia]

But how is it possible to save somebody from drowning if you cannot distinguish him from floats and if you cannot understand that he is not crying for love but for help?

That is why the scientists are not so keen on the paper frog production but rather on analysing even the slightest differences between species. This is also the case of the current research of the National Natural History Museum in Sofia which are part of the Amphibians Monitoring Survey Program.
Usually it is easy to distinguish frogs – just look closer on their pictures and you can find their distinctive features: a yellow spot here or a birth-mark there. Sometimes it seems that only a DNA-analysis will help to distinguish between frogs who look the same.
Once you have the information and imagine two almost identical sentences in a text written with only 4-letters alphabet (the amino acid bases), it becomes easy to see nonconformities which prescribe different features through proteins encoding. However, there is far more easier and inexpensive way to distinguish frogs: just record their croaks and look at the sonograms of the voices in order to differentiate the species – and look at the female frogs how they react.

Probably maybe scientists only know that these small and 'insignificant' animals "speak" or croak in different languages just

as humans do, and they are disappearing unnoticed just as small and 'insignificant' mother tongues are dying every single night.
And BTW, the year 2008 will be the "**Year of the Frog**", declared by the Amphibian Ark[3].

[3] The Amphibian Ark (Aark) is a joint effort of 3 principal partners: the World Association of Zoos and Aquariums

21

"Discovering the Deep Ocean" > *Berlin/DE to Athens/EL*

During the last years there has been a strong confluence of deep-ocean technological developments with the current needs and future requirements of deep sea scientific research. On their sea-going expeditions MARUM researchers make use of the deep diving vehicle MARUM-QUEST. This remotely operated vehicle is equipped with different camera systems. Since its first successful dives in summer 2003, the MARUM-QUEST has recorded more than 1,500 hours of video material of the deep sea.

During the WONDERS event some of the "Best of…" video material was presented. It covered dives in up to 4,000 metres of water depth in the Atlantic Ocean, the Gulf of Mexico, and the Mediterranean, and showed deep sea phenomena like mud

and asphalt volcanoes, gas hydrate fields, and black smokers – as well as the fascinating life forms linked to these phenomena.

The video material has already been widely used in the science communication efforts of the MARUM: as promotional material, on exhibitions, and both in national and international TV documentaries.

Diving down – How to build and to test an underwater glider

As part of their educational efforts MARUM and the University of Bremen successfully run a "School Lab" and organize very well attended exhibitions for kids. Like in the school lab during WONDERS, kids were invited to build their own underwater glider. Both supervision by experienced personnel and the necessary material was provided. The kids were able to build their underwater gliders within about 20 minutes. Thereafter they could test the diving capabilities of the vehicles in a small, water filled basin.

By communicating with the kids during this process, insight was gained between modules 1 and 2. That is to say that the kids took over the role of a marine junior researcher and by doing this gaining insight into state-of-the-art marine research.

22

"Wearable Computers, Intelligent Sensors – InLoT system" > *Athens/EL to Copenhagen/DK*

The partner of WONDERS was the German-Greek School, situated between the city of Athens and the Athens airport. This innovative school sent the developed InLot system to the Danish Science Communication event on 23-24 of September and also to the WONDERS Finals (November 19-25) in Lisbon, Portugal.

The InLot system consists of wearable computers and intelligent sensors that will be used for experimentation, data collection and storage. The system introduces innovation both in pedagogy and technology. The proposed technology allows for science centre's visitors or high school students
(when in school) to use their every day life experiences as the field where they will conduct sophisticated experiments and thus will deepen their understanding of the science concepts involved. The system represents an integrated effort to reconnect science teaching and understanding with real life of visitors/students. The InLoT system reveals to users hints of the magic aspects of physics and natural sciences while at the same time extended the capabilities of the school science laboratory much beyond its conventional borders.

Within the framework of InLoT, wearable computers and intelligent sensors will used for experimentation, data collection and storage. The system is the main outcome of the "**In the lab of tomorrow**" (InLOT) project.

(WAZA), the IUCN/SSC Conservation Breeding Specialist Group (CBSG), and the IUCN/SSC Amphibian Specialist Group (ASG).

Science deals with the study of nature and the world around us, so teaching science cannot be separated from daily experiences resulting from students' interactions with the physical phenomena. The connection of tangible physical phenomena and scientific problems provides students with the ability to apply science everywhere and not only in specially designed experiments under the laboratory's controlled conditions. Wearable computers and intelligent sensors have been developed so that they are used by students to experience their every day activities in the context of science experimentation, data collection and constructing knowledge about phenomena and laws of physics.

In the framework of WONDERS a series of wearable sensors and devices were presented. Participants had the opportunity to perform and design their own experiments with the available devices.

23

"CSI Agent" *> Copenhagen/DK to Ljubljana/SI*

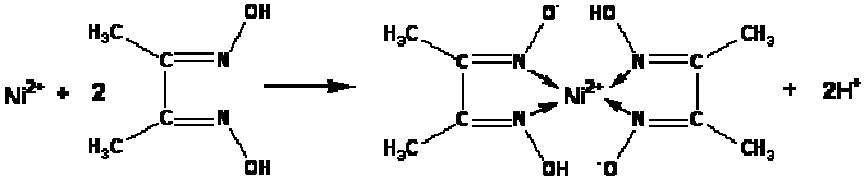
The Danish activity "CSI-agent" presented by the Faculty of Science, University of Southern Denmark, participated in the 13th Slovenian Science Festival which took place in the centre of Ljubljana.
The show was about how forensic science works.

Blood type analyses
Everybody has a blood type. The most common blood type classification system is the AB0 (A, B and zero) system discovered by the Austrian Karl Landsteiner in the early 1900s. There are four types of blood in the AB0 system: A, B, AB, and 0. Your blood type is established before you are born, by specific genes inherited from your parents. We can use a test to decide which of the blood types A, B, AB and 0 the suspect's have. The blood type is kind of a tag, which sits on all blood cells. These tags cause coagulation, when a specific type of antiserum is added.

Fingerprint
A fingerprint is an impression of the friction ridges of all or any part of the finger. Fingerprints or "dermal ridges" are necessary for grip. If the skin on our fingers was completely smooth we would have a hard time keeping a grip on anything, especially if it is wet or our hands are sweaty. The scientific basis behind friction ridge analysis is the fact that friction ridges are persistent and unique. Friction ridges are formed during fetal development where their unique characteristics emerge due to genetic and epigenetic factors. Even identical twins do not have the same fingerprints.
The material or area, where one would suspect fingerprints are easily brushed with carbon powder or metal powder. The fingerprint is transferred to paper by using tape and is easily compared with the suspect's prints.

Nickel detecting
The reason why we have this experiment in the lab, is because we find a silver jewel on the crime scene and one of the suspects is allergic to nickel…. the rest is up to you.
A drop of the dimethylglyoxime solution and a drop of ammonia are added to the cotton stick, which is then used to rub the metal object. If the cotton stick turns red, nickel is present in the metal.

Theory
Dimethylglyoxime creates a red molecule when reacting with nickel(II)ions:



Doping detections
A urine sample was found on the crime scene. It appears to belong to one of the suspect's athletes. A positive doping test would provide this suspect with a motive for killing the victim. If the urine contains a sugar-like drug used for doping the sample will change colour from a bluish green to an orange colour, when Fehling's fluid I and II is added.
RCHO + Cu2+ (blue) → RCOO- + Cu2O (orange)

24

"Vesselograph – Diagnosing by Your Finger" *> Riga/LV to Barcelona/ES*

Scientists of the Institute of Atomic Physics and Spectroscopy at the University of Latvia in the capital Riga explores new methods for health monitoring and improvement,. The presenters offered an insight in the principles and methods used by Latvian scientists in finding quick and effective ways to help people and raise their awareness about their health.

Dr Erts' Vesselograph uses simple physiological principles to produce complex information and diagnosis.

The visitor has two sensors (probes) put on each finger of both hands, and the machine

measures differences in blood pulsations between hands.
The sensors (probes) emit radiation into the under-skin tissues with blood vessels and collect the signal about the blood volume pulsations and the machine converts it to digital signals with working frequency of 220.5 Hz (222.5 full swings per second) to be presented on

screen.

Our human body is almost symmetrical, so data provided by both sensors should be similar.

If it is not, there is a possibility that the visitor has some kind of problem in her/his blood vessels – maybe a clot, a thrombus or something like that. If the difference is considerable, the machine advises the visitor to see doctor.

By using this machine, one can do fast primary cardiovascular assessment and early screening. Vesselograph is easy to extend, and it also can use wireless technology for data gathering from sensors. In this way the machine truly unlocks the possibilities of the *BlueTooth* standard. This time the presenters measured differences of blood pulsations between hands, but this device can be used to test other parts of body - earlobe, forehead, forearm and, notably, legs.

"Optical Dermatologist" is a device that uses laser ray to "read" spectrum of human skin. First, laser light causes skin to fluoresce, and then it analyses any specific reflections. This method is uninvasive and takes as little as 20 seconds to complete.

Healthy skin reacts to laser light in certain ways, and the changes in spectrum are predictable in a way that this physiological principle can be used as a base for new approach to skin health monitoring. Although skin spectrum of people living in different places

The Vesselograph has a screen, and the way on-screen drawings from measured body parts are made is called photo-plethysmography. It is a method for measuring changes in volume within a certain organ or whole body, and the data is collected optically, by using sensors.
Specialists can observe differences in signal amplitude themselves, but the machine is programmed to calculate the result – healthy blood vessels or not – itself.
Comparison of photo-plethysmography signals are taken at different body locations - middle fingertips (both hands), forehead and carotid artery.
If the differences are considerable, then this picture might give a warning about problems with blood-vessel system.

in the world slightly differs, the general pattern of fluorescence of healthy skin is similar, so – few seconds of laser light, few looks at the computer screen, and our specialist will tell you all you ever wanted to know about your skin.

Renārs Erts and Alexey Lihachov, the creators of these machines, are researchers at the Institute of Atomic Physics and Spectroscopy. It is a multidisciplinary research division at the Faculty of Physics and Mathematics, University of Latvia in Riga. Both scientists are experts in medical physics.
Although they have plenty other ideas how science can improve human life, their message to the world is clear: Take care of your health, and we hope that our machines will produce pleasing diagnoses only.

25

"Gaudí, Art and Science" > Barcelona/ES to Budapest/HU

Explanation: When designing buildings, the architect Antoni Gaudí applied the knowledge and observations of both nature and gravity forces. Besides, he was an innovator in using materials and in transforming them. The workshop in Budapest started with a 20' CD-ROM with images of one of the most outstanding constructions of the Catalan genius: *La Pedrera,* providing general explanations about its most important features. It was followed by the participation of attendants in the construction of three types of arches used throughout History: Romanesque (round), Gothic (pointed) and "Catenary", a discussion about which arch will remain firm after removing the buttresses and why, the visible result once the buttresses were removed, and some final conclusions.
This workshop was organised by the FCRI Science Communication Team and performed in Bu-

$$y = a \cdot \cosh\left(\frac{x}{a}\right) = \frac{a}{2} \cdot \left(e^{x/a} + e^{-x/a}\right)$$

dapest by: Belén López and Dolors Grillo.
Gaudí noticed that many structures are composed of special "ruled" surfaces, that is, curves made of straight lines after being "moved" in the space, frequently found in living beings, mountains, defining what it is called **ruled surface**, focused on some surfaces: Helicoid, hyperboloid and hyperbolic paraboloid. Gaudí translated them to architecture, as well as other architects in the 20th century.

Likewise, when designing buildings, Gaudí observed the gravity forces and the principles related to the Catenary. A **CATENARY** - http://en.wikipedia.org/wiki/Catenary - is the shape of a hanging flexible chain when supported at its ends and acted upon by a uniform gravitational force (its own weight). If the Catenary is turned upside down (see picture) it becomes the ideal curve to shape an arch with a useful peculiarity: it is stable by itself.

There's a magnificent example of it in the Gateway Arch[4] in the city of St. Louis (USA).

In our workshop three kind of arches used throughout history in architecture can be built: round Romanesque arch, pointed Gothic arch and Catenary arch. It can be seen that both Romanesque and Gothic arches need buttresses to counterbalance the lateral thrusts of

the arches to stand firm.

The Catenary arch, on the contrary, does not need buttresses,

since the gravity force and the lateral thrusts counterbalance, thus allowing it to stay firm by itself.

26

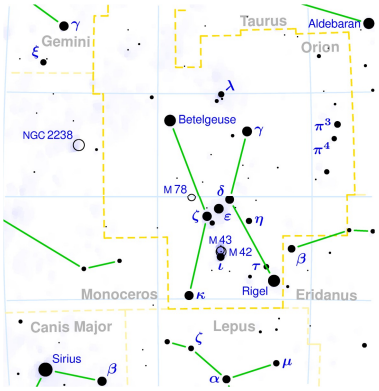
"Astronomical Playground" > *Budapest/HU to Nottingham/UK*

The first event of **WONDERS** took place in Nottingham, UK, at the **National Science and Engineering Week**. The Hungarian **Society for Dissemination of Scientific Knowledge (TIT)** from Hungary sent an „Astronomical Playground" as a presentation. The two presenters were two astronomers: **Ms Kinga Lorencz**, the director of the Budapest Planetarium, which is owned by the TIT and **Mr Zoltán E. Kovács**, the director of the Planetarium in Kecskemét.

ASTRONOMICAL PLAYGROUND
Have you ever WONDERed why the Moon changes its face?
Did you know that the Moon can steal the Sun?
Do you want to be a part of the Milky Way or see how a rocket works?
We invite you to our Astronomical Playground to LOOK CLOSER and receive all these answers.
You may also test your manual skills and even
take home the Earth, the Moon and the stars in your pocket.

1.: **Observe the constellation Orion** (from ages 4 to 99). The Orion nebula is one of the best investigated site of star formation. On a blue balloon drawing the characteristic structure, after instructions about when and which direction, children can point the Orion constellation on the night sky - sometimes in the year it can be done before bedtime. The balloon makes always happy the older children too.

2. **Star peep show** (not only for adults) this is a model made of pebbles and threads to show that stars in one constellation



can be in very different distances, explaining the meaning of the light-year, and the hugeness of the astronomical distances. This was a great amusement for everybody.

3. **Earth Moon models** - from pebbles and threads children can make a similar model of the Earth Moon system. They can this take home in their pocket.

4. **Earth Moon game:** Two children can show to the others. One is the earth, other the moon, rotating and moving around. With the help of a pocket light and a beach ball they can make the phases of the moon, lunar eclipse etc.

5. **Why and how the Sun became a star** this is a game with many participants.
In the introduction there is a Sun Earth model from pebble and a beach ball is shown with accurate proportionality of the real sizes and distances. Then begins the BIG FUN! With many participants with different roles.
Coloured hats show the different particles, which makes the all game very exciting. The best actors can take home the caps for remembering the particle physics and fusion.

[4] By Eero Saarinen and Hannskarl Bandel

a. Couples are protons (red cap) and electrons (blue cap) making hydrogen atoms. In a proto-star (forming star) they collide and falling apart. This collisions make energy in forming stars and can make children excited, too.
b. In the recent SUN there are heat forming processes - cups with other colours inside.

Colliding electrons and protons can make neutrons, and helium atoms, too. If neutron is formed from proton, a neutrino is born, too. The neutrinos run quickly, as they are very light, they are ejected from the Sun. Electrons and positrons are colliding so vividly, that they annihilate each others (watch out!) and there are gamma quants born. Photons can be X-rays, infrared, ultraviolet, depending on the processes.
This is getting complicated in written form, but is simple when we really are playing. It is very important to get at least four kind of colour for the hats, but with some detective work on the internet everybody can get affordable bulk retailers. The children are getting happy and run around. But this is definitely another experience than sitting and listening to a presentation.

27

"Floating rainbows – Exploding milk" > *Nottingham/UK to Oslo/NO*

The activity which the UK team from Nottingham Trent University took to Oslo involved several fun demonstrations about colour changing materials asking the children to identify the colour of a substance and then predict what the colour would be after they manipulated it. In most cases the results were very surprising!

For example, there was a chemical reaction that changes colour when it reacts with oxygen, so when the liquid is poured it changes from yellow to green to red to yellow! The team asked the children the colour of the material as it was and then and what colour the material would be after the experiment.

The other activities were "Exploding Milk" and "Floating Rainbows".

"**Exploding milk**" involves adding food colouring to full fat milk and then adding detergent to see the colours mixing. Older children will understand that the colouring breaks the surface tension and the detergent goes further to break down the fats.

For "**Floating rainbows**" a piece of card is placed under water then a drop of clear nail varnish is added, this then splits to reveal rainbow colours and the card is lifted off to catch the rainbow.

These activities worked very well for the kindergarten children who saw them in Oslo and

also for the slightly older children. The team was also very busy when they took the activities to Lisbon for the final event – there, the activities went down well, and visitors were looking forward to trying them out at home.

The team from the UK came from CELS, the Centre for Effective Learning in Science CELS aims to create a new image for the subject within the Higher Education and schools communities as:

- **Relevant** - using best practice in educational research to design better ways of teaching science.
- **Accessible** - increasing the number of science students and supporting the learning of local science students.
- **Achievable** - providing a significant new national resource base for science teaching.

Based on their excellent record in teaching science within Higher Education, and the University's nationally recognised widening participation activities, they have created a centre to develop and trial new approaches to the teaching and presentation of science within both communities.

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29

"The Jelly Man Code"
> Oslo/NO to Paris/FR

DNA-molecules carry the instructions of how all living creatures on earth are made. The information is written in a universal genetic language using only four chemical compounds which we humans refer to by the letters A, T, C and G.
When the letters are put together in combinations of three they form a code known as the genetic code. All living cells can read this code and follow the instructions to make proteins, which carry out different tasks in the cells.

To illustrate the genetic code and build our own DNA-molecule we will use "jelly men"[5] in four colours. It is actually quite easy to write with only four letters when you have a code to follow. Groups of children/youngsters will be instructed in the "jelly man code", partly by posters, partly dramatized. Instead of writing the genetic code, each participant will build their own three or four letter word using "jelly men" to illustrate the DNA-code.

This summer, almost 100 kg of the Norwegian candy "jelly men" arrived in Paris.

Their mission was to teach ***French schoolchildren about "le code ADN" as a Norwegian contribution to the WONDERS French festival Paris Montagne.***
Many Norwegian children have been learning about the jelly man code during the Norwegian festival "Forskningsdagene" during the past years.

Jelly men are convenient to use showing how the genetic code works, since the jelly men come in four different colours that can illustrate these chemical compounds.
The method shows how it is possible to "write" a code, just

based on four different letters, exactly as the human gene works. It is actually quite easy to write with only four letters when there is a code to follow.

An English version of the jelly-man code can be downloaded from nysgjerrigper.no/pdf-filer/jellymancode/fil_view and you can read more about the code from http://www.nysgjerrigper.no/Artikler_Engelske/1130324487.91.

"Wanda Wonderful"
> Paris/FR to Lisbon/PT

The French performance is called Wanda Wonderful, "**Ursule Fabulle**" as the original French title, more information here : http://atomes.crochus.free.fr/spectacles/Ursule.htm.

Short description of the "Wanda Wonderful":

- A 30 sq. meters stage, dressed in black, a few objects here and there…
- A clown appearing for a 50 minutes one-man-show…
- A stage manager who, as a supporting role, is in charge of music and sound effects…
- A sparkle of colours and laughter…
- Spectacular and counterintuitive scientific experiments…
- A grand finale…

Wanda Wonderful is even more: a researcher intervening after the show for a Q&A as well as to explain the phenomena that haven't been grasped right away. Or, if not possible, a brief recap explanatory card which goes through the various experiments led by the clown.

This show was chosen for several reasons.

First, this show matched the requirements of the "Carousel of Science" Quality Criteria. It used "Novel ways of presenting", "unusual formats, unusual means or presentations", and moreover it gave "rigorous scientific background" through handouts explaining experiments presented.

[5] Norwegian candy, but available in nearly all European countries.

A 30 sq. meters stage, dressed in black, a few objects here and there… A clown appearing for a 50 minutes one-man-show… A stage manager who, as a supporting role, is in charge of music and sound effects… A sparkle of colours and laughter… Spectacular and counterintuitive scientific experiments… A grand finale…

Wanda Wonderful just put her little dog Globule in what she thought to be a Jacuzzi. But despite the smoke, it appears to be cold liquid nitrogen, in which Globule disappears, as the air it contains contracts itself. Don't worry! Globule will live as soon as she will take him out of his freezing bath.

Trying to kill a disturbing mosquito, Wanda Wonderful discovers that she can make coloured flames through spraying metallic salts on fire. Will she be able to kill the mosquito? Come and see Wanda Wonderful, and you will know it!

A flying ball! Only with a hair dryer! And everybody can do it at home! Children love when Wanda Wonderful makes her table tennis balls levitate, thanks to what physicists call "the Bernoulli effect". The same one that makes planes fly!

30

"Hand Drawn Holograms with Hands-on Physics" > *Lisbon/PT to Strasbourg/FR*

This activity was designed to present holography and other physics topics based on hands-on strategies for school science. Experiments with low cost materials for classroom activities were performed in order to explore topics related with holography and physics, such as diffraction, interference, colour, waves and 3D reconstruction and projection. Some image processing techniques, such as pin-hole photography, stereoscopy and holography were actually performed by the public. A popular example was building a hologram by etching grooves with a pin on a plastic CD case, in such a way that an hologram of a simple object was obtained. Participants could then take home their own hand drawn holograms.
This activity was developed by the University of Aveiro and was presented during the *Fête de la Science*.

A Murder at the Museum
A forensic scientist has been murdered during a reception dinner in her honour! Pieces of glass were found on his clothing. After having interrogated most of the people present at the meeting, you learn that the victim had a strange habit: she only drank through glasses made of Pyrex.

Science is good for health
Meter tape
1. Measure yourself around your chest and mark the value.
2. Take a deep breath and measure it again. Calculate the difference between the two values.
Hose
1. Fill in a 5L large bottle with water and turn it down, without spilling, into a bigger water recipient. Now put the hose inside the bottle and blow into it after taking a deep breath.
2. You can measure how much air you had inside by making the difference between 5L and the water left inside the large bottle.
Thin hose
1. Proceed as you did previously with the hose, except you must change it for a thin one and take a deep breath.
Smokers and non-smokers have different abilities when breathing. When you smoke, little amounts of air remain in your pulmonary alveoli. That's why a smoker breathes a smaller amount of air than a non-smoker.

A murder at the museum
What do you need?
A glass bowl; small pieces of glass; small pieces of Pyrex glass; vegetable oil (for cooking).
How to do it?
1. Place 50 ml of vegetable oil inside the glass bowl.
2. First, place inside a small piece of glass. Be careful not to cut yourself! Look what happens.
3. Add the small piece of Pyrex glass and look what happens now. It's gone!
We can distinguish one object from the other by their refractive index, which has to do with the speed of light when it travels through that object. When the light crosses from a medium to the other, its speed changes due the different structure of the two materials, causing a deflection of its path.
The vegetable oil has the same refractive index as the Pyrex glass, so there is no change in the light speed as it crosses from one medium to the other. Therefore, we get the idea of an "invisible glass".

The kitchen as a lab
What do you need?
1 corn bag for popcorns; 1 recipient to make popcorns in the microwave.
How to do it?
1. Put into the recipient enough corn to fill but leave some free space because the corn is going to grow.
2. Put the recipient into the microwave, during 3-4 minutes in the maximum power.
3. Apply salt at your own taste.
Voilá, you have popcorn!
The corn for popcorns is made mainly of starch and water, and when the water inside the corn is heated, it turns into vapour. The vapour pressure increases and "pushes" the external layer of popcorn. This layer stays intact until the internal pressure reaches 9 times the air pressure. When it reaches this level of pressure, it blows up, freeing the starch that was inside.

Could it be that the pieces of glass found on the suspects clothes are made of Pyrex glass? Use the refractive index to solve the case!

Science is good for Health
The activities are preferably made in collaboration with paediatric hospitals and paediatric wings in general hospitals. Science is the basis for a series of hands-on activities related with health subjects and with the prevention of accidents, as in the following example.
It is possible to register differences between people about how much air each one breathes. Do smokers breathe in less than non-smokers? Let's find out!
We propose three different methods: using a meter tape, a hose and a thin hose.

The Kitchen as a Lab
Cooking can explain science.
"Let's make Popcorns!" was one of the proposed challenges.

The activities were presented by a team from the Education Department of Pavilhão do Conhecimento – Ciência Viva. **Hand drawn holograms with hands-on physics**

Try to hand draw your own hologram!
In order to observe the holographic image, place a light source (it can be sunlight or an overhead projector) in front of the acetate sheet. In a plane behind the sheet you will observe the holographic image of your original paper sheet drawing).

This activity was developed by a team from the Physics Department of the University of Aveiro, which represented Ciência Viva on WONDERS, and won the Prize for science communication for the newest science at the WONDERS Finals.

Hand drawn holograms with hands-on physics
What do you need?
A compass with two metal spikes (or a protractor and a pin), a black acetate sheet (glossy), a paper sheet, a pencil and a sticky tape.
How to do it?
1. Start by drawing a simple image on the paper sheet.
2. Use some sticky tape to hold a piece of black acetate above your paper drawing. Now pick an opening angle on the compass that will allow you to place one of the spikes on the paper drawing and the other on the black acetate sheet.
3. Select one point on the drawing and place your compass there. Now gently scratch the surface of the black acetate sheet with the other spike of the compass. (If you are using the protractor and pin, place the protractors' centre on your desired point of the paper sheet and use the pin to gently scratch the black acetate along the outer surface of the protractor).
You've just coded the first point of your drawing on the acetate.
4. Repeat this coding technique for all the points of your drawing. Remember that the compass's opening angle must be constant, in order to maintain the proportions of the drawing.
5. In the end you will have a scratching pattern that contains the information of the drawing to be projected - this is your hologram.
For more information, please visit the activity webpage: www.cienciaviva.pt/projectos/wonders/hologramas.asp.

Data for further reading and contacts

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The members of the WONDERS project's consortium are three organisations:

- **EUSCEA** – www.euscea.org – European Science Events Association, bringing together nearly all European science festivals, science week or science days.
- **EUN** – www.eun.org – European Schoolnet, a network of European schools
- **EUSJA** – www.eusja.org – European Union of Science Journalists' Association, a combination of national networks of science journalists.

The project WONDERS was controlled by a coordinator, EUSCEA, and by a Project Management Team, consisting of personalities, who were and are responsible for national or local science festivals.

- **Mr. Mikkel Bohm,** DK, director of the Danish Naturvidenskabsformidling, former president of **EUSCEA** – responsible for the **Carousel** of Science and of its presentation at the **FINALS**
- **Ms. Ana Noronha,** PT, project manager of Ciência Viva, - responsible for the **Finals** in Portugal, where all the shows were presented
- **Mr. István Palugyai**, HU, president of **EUSJA** - responsible for the moderation of the Group Dialogue Games **TALK** and principal advisor on media support including electronic media
- **Mr. Peter Rebernik**, AT, director of PHAROS International, general secretary of **EUSCEA**, **Co-ordinator** of WONDERS - responsible also for the **LAUNCH** Event and for the WONDERS website www.wonders.at
- **Mr. Jan Riise**, SE, one of the founders of the Science Festival in Göteborg, Sweden, - responsible for marketing support and for the Carousel M**anual**
- **Mr. Karl Sarnow**, BE, from the European Schoolnet **EUN** – responsible for all school affairs and contacts and for the organisation of the Group Dialogue Games **TALK**
- **Ms. Annette Smith**, UK, director at the British Association for the Advancement of Science and president of **EUSCEA**, - responsible for the **Evaluation** of the whole WONDERS project and for general quality control

THE WINNERS of the FINALS:

A jury selected the „Best" of the presentations during the Finals in Lisbon, Portugal. The "winners" were:

(A) Prize for the Most Innovative Ideas for Science Communication – "The jellyman code: making DNA-molecules from jellymen", from Forskningsdagene - Norwegian Science week.
(B) Prize for Science Sommunication for the Newest Science – "Hand Drawn Holograms", from Universidade de Aveiro, Portugal.
(C) Engagement Prize - "Down with gravity!", from Science Centre AHHAA, Estonia.

A special prize was decided by the public, by about 3000 visitors, who were asked two give grades between 1 and 10 to two simple questions:
>> How much did you learn at this presentation?
>> How much fun was this presentation?
The two grades were added. Therefore, a presentation receiving 20 points were the best.

The public choose and here the "winner":

(A) Public's prize – "SuperScience - Discovering sciences in super heroes stories", from Perugia Science Fest - Psiquadro, Italy.

And the host, Ciência Viva, assigned Portugal young people, who worked at the Pavilion, where the Finals took place, to choose also their most favourite:

(B) Ciência Viva Prize - "Down with gravity!", from Science Centre AHHAA, Estonia.

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"Labyrinth and mathematics" > Madrid/ES to Genoa/IT
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"Have you ever burned your money" > Mechelen/BE to Wroclaw/PL
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"The mystery of enzyme action - Electric eel in your body" > Wrocław/PL to Perugia/IT
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"Superscience and Science balls" > Perugia/IT to Reykjavik/IS
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"The pendulum and the swing gallery" > Reykjavik/IS to Luxemburg/LU
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"Best experiments"> Budapest, HU to Waterford/IE
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"Flight – paper airplanes & helicopters - rockets" > Waterford/IE to Prague/CZ
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"Rainbow as a bridge to the stars" > Prague/CZ to Jerusalem/IL
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"Meet Math – miniature math" > Jerusalem/IL to Freiburg/DE
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"How hard it is to be a frog in the time of global warming" > Sofia, BG to Essen, DE
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"Wearable computers, intelligent sensors – the InLoT system"> Athens/EL to Copenhagen/DK
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"Vesselograph – diagnosing by your finger" > Riga/LV to Barcelona/ES
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"Gaudí, Art and Science" > Barcelona/ES to Budapest/HU
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"Astronomical Playground" > Budapest-TIT/HU to Nottingham/UK
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"Floating rainbows – Exploding milk" > Nottingham/UK to Oslo/NO
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"Wanda Wonderful" > Paris/FR to Lisbon/PT
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"Hand drawn holograms with hands-on physics" > Lisbon/PT to Strasbourg/FR
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"To finish, we'd like to say

that we are so grateful to everyone

who had worked hard to make possible

our **WONDERS.**

Participating in this European project

has been a splendid experience and

had helped us to ***LOOK CLOSER***

to science and people."

[from Sevilla/ES]

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