Low-cost Science

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THE EUROPEAN NETWORK FOR SCIENCE TEACHERS

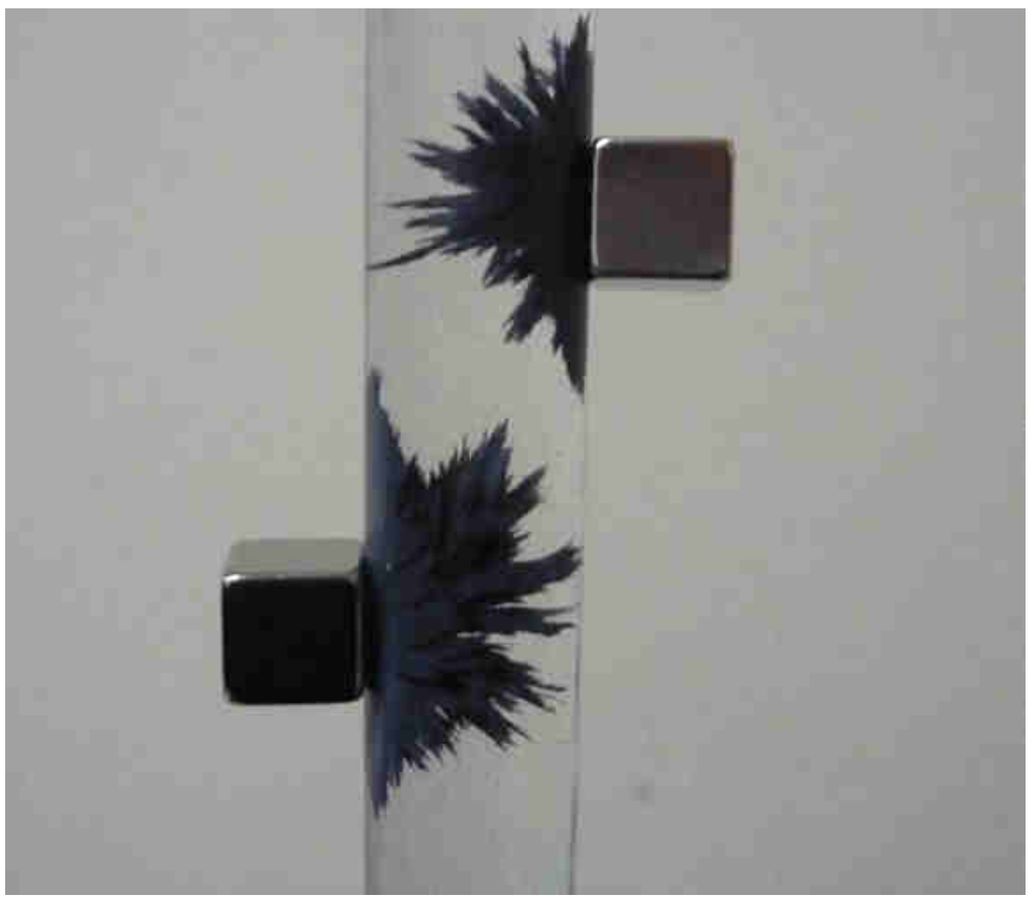
Nikola Karavasilev | Sofia High School of Mathematics | Sofia | Bulgaria

Magnetic phenomena with everyday materials

In our project we demonstrate different magnetic phenomena, taught at school, using low-cost materials.
On our stand, we will show you how to:

- Make the magnetic filed visible to Your eyes
- Build a magnetic cannon
- Prepare a magnetic liquid
- Use the magnetic field for levitation

We have prepared brochures for all the experiments.



On the pictures above, you can see some of our experiments and the students, who presented the project in the National festival.

100% Great!

With our experiments, we will demonstrate you how beautiful physics can be!
We hope to provoke your curiosity to the science!

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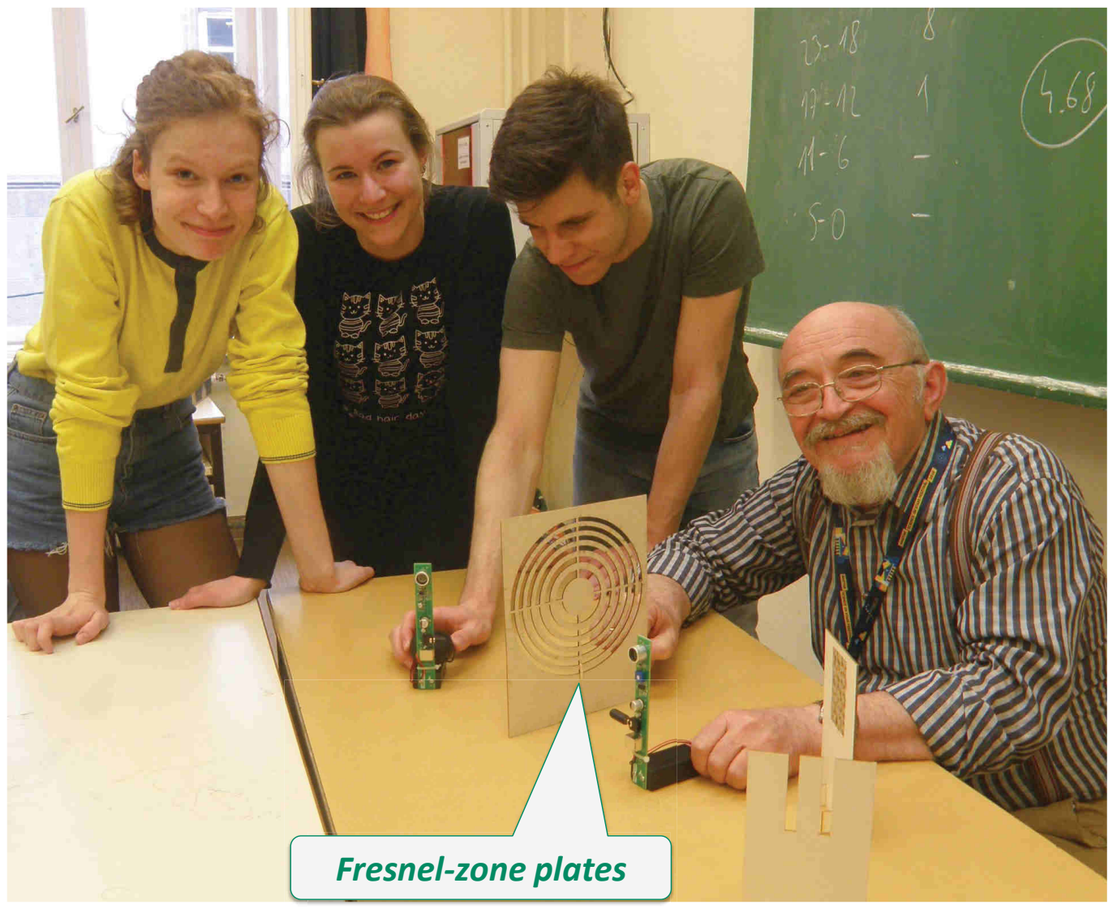
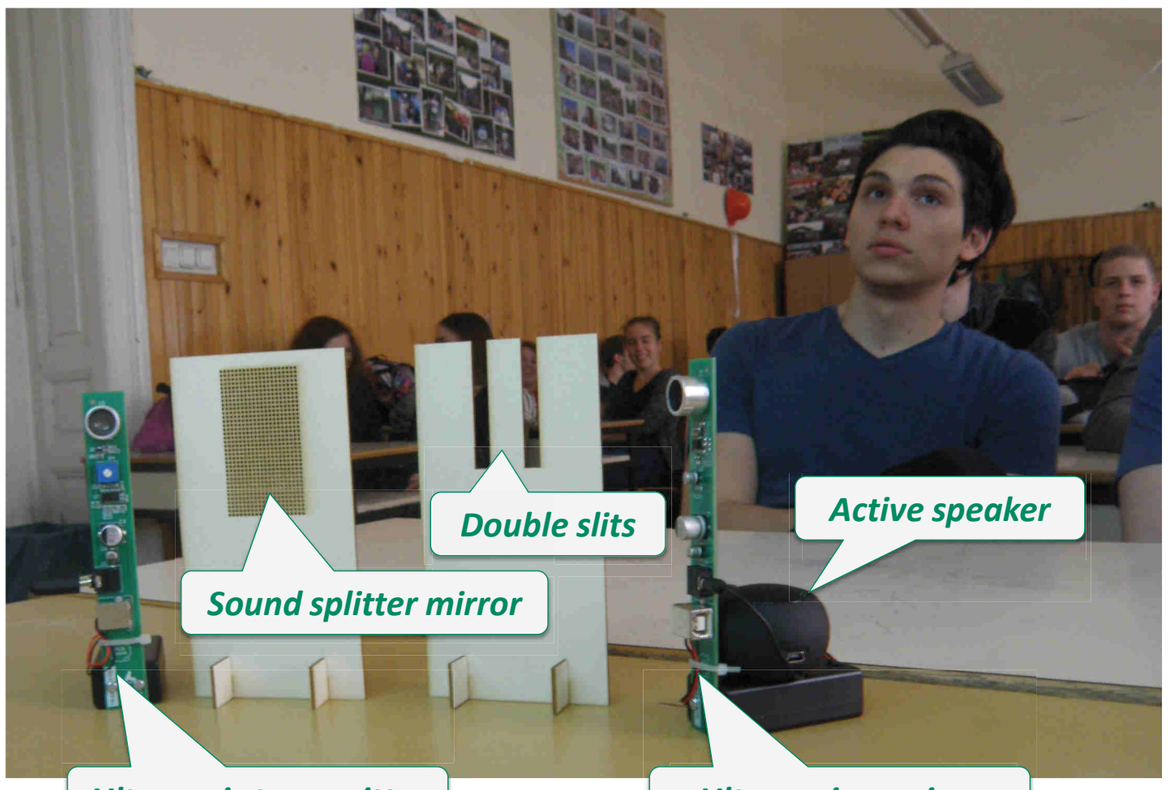
K. Piláth |ELTE Trefort Ágoston Secondary Grammar Laboratory School| Budapest | Hungary

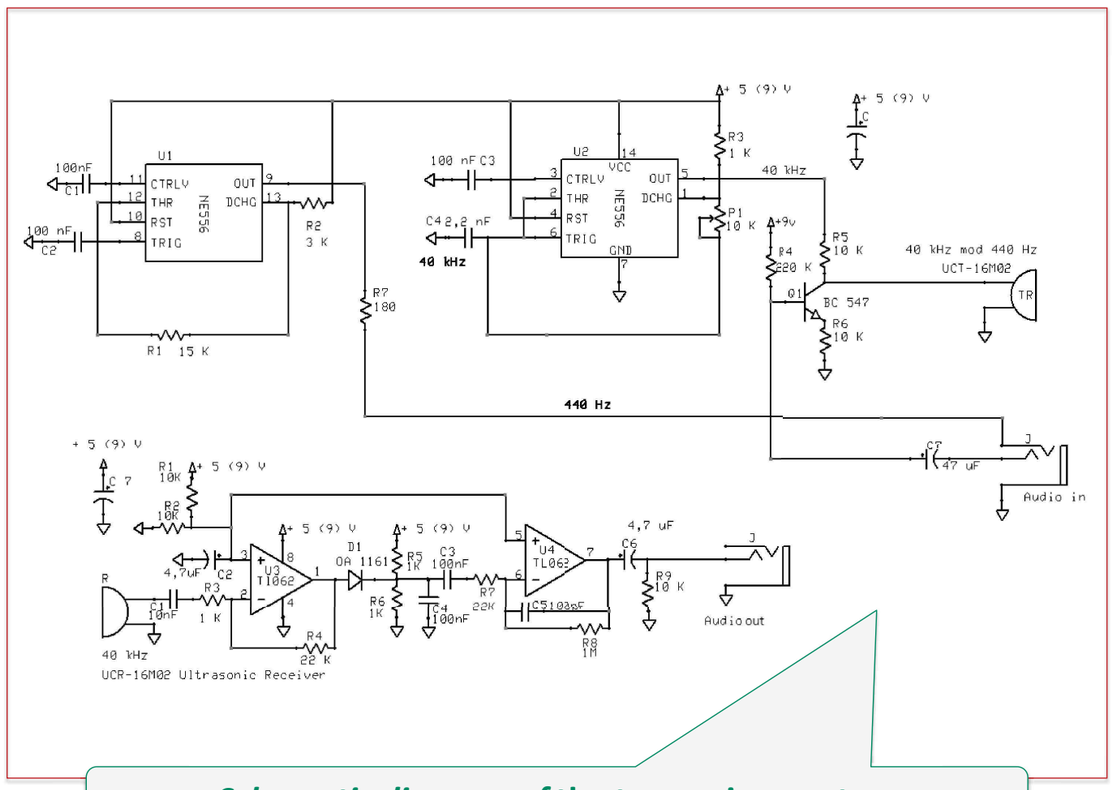
Physics Experiments With ultrasound

Using amplitude modulated technic

I developed and built an amplitude modulated ultrasonic transceiver system that use a low cost distance measuring sensor pair. These sensors operate at a frequency of 40 kHz. The carrier signal (40 kHz) is modulated with audible tone (400 Hz) signal. In the receiver site after the demodulation we get hearable sounds that use a computer speakers system. Since the device produces 0.85 cm wavelength sound wave in the air. This wavelength is an ideal tool to demonstrate interference experiments.







Schematic diagram of the transceiver system

This method helps to demonstrate the Lloyd's mirror experiment, or Young's double slit experiment in ultra sound range. But it also helps to demonstrate a Michelson-interferometer, or an A4-sized paper engraved Fresnel-zone plates which will allow the focusing of ultrasounds.

The results of these ultrasonic experiments can be made hearable with a small active speaker.

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Tatiana Kravets | Educational complex «Gymnasium HEART» | Kharkov | Ukraine

An innovative approach to health-preserving activities of the physics teacher in the educational process

Teaching physics is an exciting rewarding arena where every day an educator shares the fascinating concepts of physics to a room full of young and inquisitive minds. Although it's no use to deny many challenges ahead.

The given pedagogical innovation is to help teachers to feel confident in the classroom as well as keep students motivated and preserve their health.

This innovative approach to improve learning includes:

* dynamic breaks in physics lessons;
* topic verse to improve learning;
* helping students to learn the current study the course subject;
* providing students with a long-term memorization of the previously passed subject material.

That is, innovation is realized practically in the form of topic verses.

It's essentially ***UNIVERSAL*** and can be applied ***without problems*** by teachers in all educational areas.

1. Let's straighten! Don't fuss!
We're in nirvana – close your eyes!
Just imagine: Archimedes sits in a warm bath
2 thousand 2 hundred 40 years since have passed.

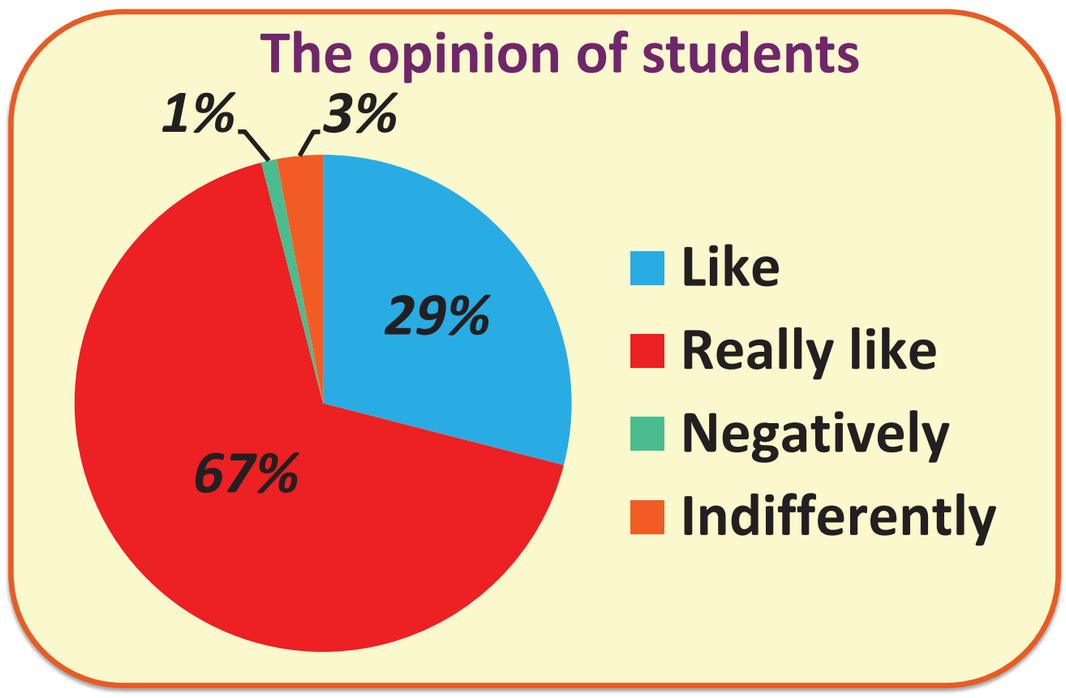
2. It's nice to sit, but let us think ...
Stand up and like the Greek let's blink.
We wonder if it really makes sense:
the water level visibly descends.

... ...

5. Put Your right arm up and hold that pose.
Say the Greek letter «*ρ*» –
that seventeenth letter everyone knows.
Put Your left arm up and hold that pose again.
Say the English letter «*g*» –
it's in physics one of the main.
Put the palms of the hands to the head –
Say the capital English letter «*V*» –
about it in the textbook may be read.
We didn't play the fool –
without these letters
it's difficult to learn at school.

... ...

8. Knowledge is power, so we
always must keep this PRINCIPLE in mind
because it's the law for all mankind:
«The buoyant force is
equal to the product «*ρgV*»
and always pushes vertically upwards» –
don't twist (!) these famous words.



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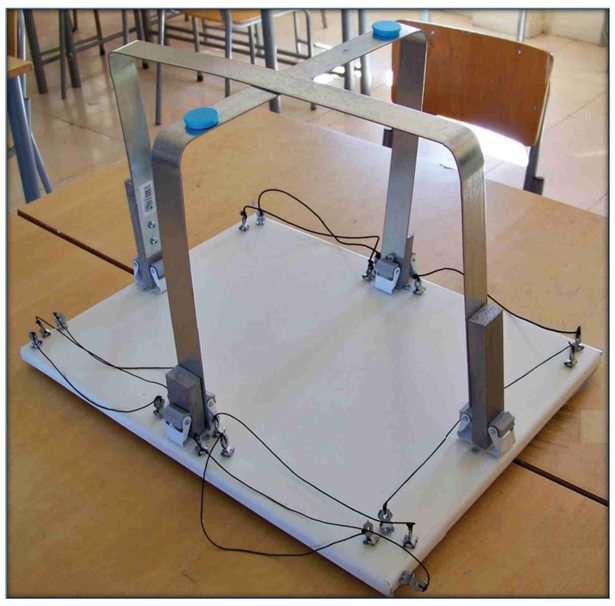
Antonis V. Ktori | Archaggelos Gymnasium | Nicosia | Cyprus

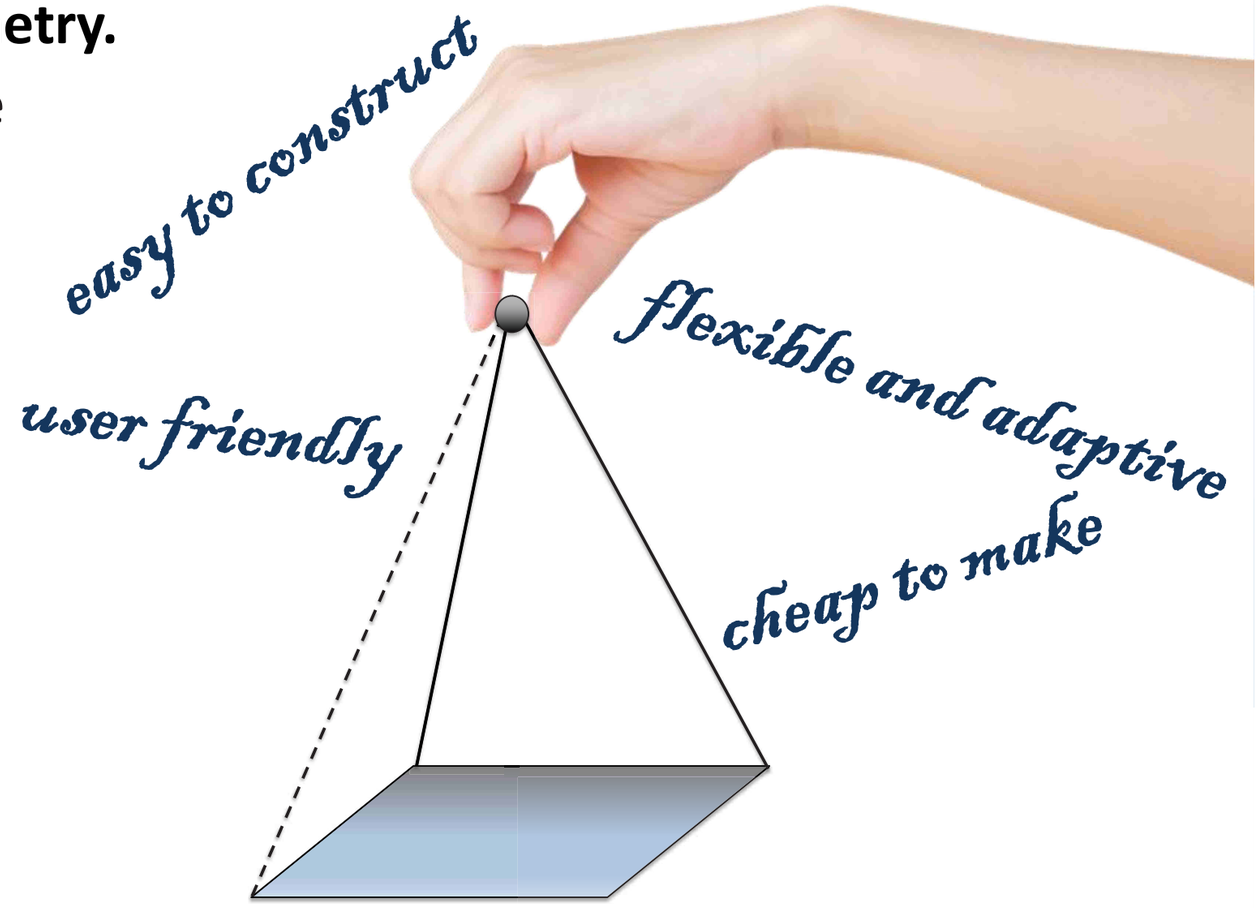
Reconstructing Stereometry

Construction & Computer Based Implementation

An innovative construction for teaching Stereometry.

The instructional tool is made out of a small piece of whiteboard, some elastic strings with magnets attached to their ends and a metallic bar.



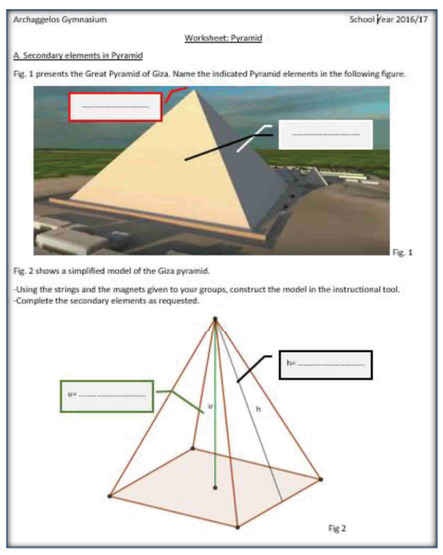


Bridging the gap between book representations and 3-D reality is a hard task for teachers to cope with. This flexible instructional tool allows building almost all 3-D figures presented in students' workbooks. Users interact directly with the figures, as physical objects and this increases their understanding. The whiteboard at the base enables users to take notes and even solve a given exercise.

Teaching Implementation Using Architectural Design Software, "Sketchup"

The instructional tool combined with "Sketchup" was used in the implementation with a group of twenty five 9th grade students.

Students completed their task surprisingly easy whereas a similar group of students didn't manage to do so in the traditional teaching way.


Archaggelos Gymnasium — School Year 2016/17

Worksheet: Pyramid

A. Secondary elements in Pyramid

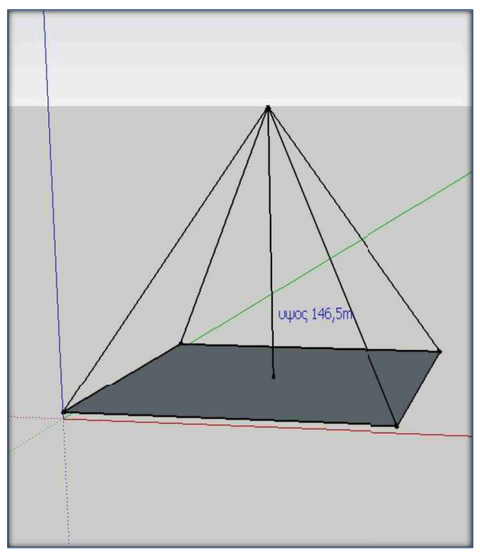
Fig. 1 presents the Great Pyramid of Giza. Name the indicated Pyramid elements in the following figure.

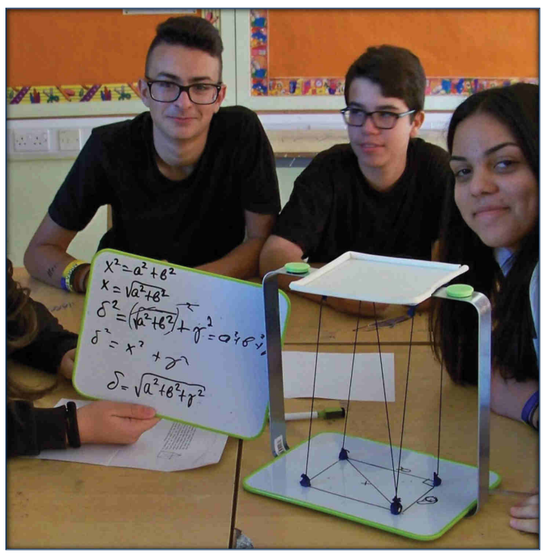
Fig. 1

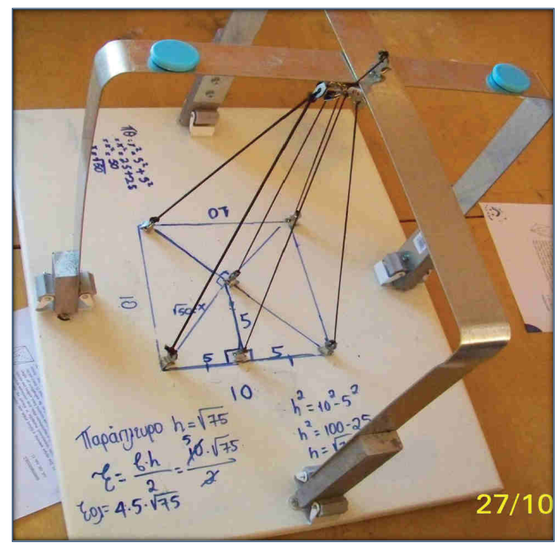
Fig. 2 shows a simplified model of the Giza pyramid.

-Using the strings and the magnets given to your groups, construct the model in the instructional tool.
-Complete the secondary elements as requested.

Fig 2







They were asked to estimate the total surface area of a pyramid and to calculate the diagonal of a rectangular prism ($d^2=a^2+b^2+c^2$), having no knowledge of Stereometry up to that point.

Students said:

"Watching the workbook figures "come to life", enhanced our perception of 3-D space".

"We could easily spot the hidden right-angle triangles in the Pyramid".

Teachers said:

"It can easily adjust to demonstrate a broad range of 3-D figures and topics within Stereometry and Geometry. This is of great help for us teachers."

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László Csatári, István Kozsup | St. Joseph's Secondary School | Debrecen | Hungary

Physi-chemistry

Experiments & show

How to complement the dry, school-bookish curriculum with the help of experiments?

On the one hand we present physical and chemical experiments that anyone can perform easily with simple instruments.

On the other hand we perform really spectacular physical and chemical experiments which are expected show elements by the students but hard and perhaps unnecessary to provide at school.

Many times they need just a little help to be able to connect their classroom studies to their perception of the environment. If there is an emotional bond as well, they will remember the lesson longer.

100% Great!

It's wonder?
No, it's only physics and chemistry.
Only science, science on stage!

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THE EUROPEAN NETWORK FOR SCIENCE TEACHERS

Csabáné Magyar and Beatrix Frankel| Eötvös József Gimnázium | Tata | Hungary

Easter Experiments

Scientific playground for kids and grown-ups

In our playground, the youngsters do experiments and craft presents along with their parents. They gain useful experience and develop concentration skills while also enjoying themselves!

The main elements of the Easter project:

1. A holder from plaster, soil and seeds - an Easter present *(chemistry, biology)*
2. Raw or boiled egg? *(physics)*

3. Making a boiled egg crawl into and out of a bottle with hot water *(physics)*
4. Cracking the raw egg
   - separating yolk with a pressed plastic bottle, painting with yolk (physics)
   - dropping blue vitriol and HCl on the egg white (chemistry, biology)
5. Putting the eggshell
   - into the flame + indicator *(chemistry)*
   - in HCl and pouring the generated carbon-dioxide on the flame of a candle *(chemistry, biology)*

Excellent learning opportunity for everyone!
Depth of explanation can vary.
The experiments are for kids aged 6-16.
Everybody will enjoy, guaranteed!

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Antonis G. Margaritis and George K. Marakis
Experimental General Lyceum of Heraklion , Heraklion Crete, Greece

Underwater Human Vision and the visual system of fish

The eye is perhaps the most important sensory organ with which most organisms interact with the environment. The anatomy of the eye has evolved in such a way that both organisms which live on land and those which live in aquatic environment, have a clear view, in order to survive. In this work, transverse slices of two eyes, a human and a fish's eye, with simple materials were constructed and presented. With these exhibits we can see how the optical system of each eye works when it is located in the environment which it has evolved, i.e. the man on land and the fish in water, and also the malfunctions that occur when a human dives in an aquatic environment, and how we could deal with them.

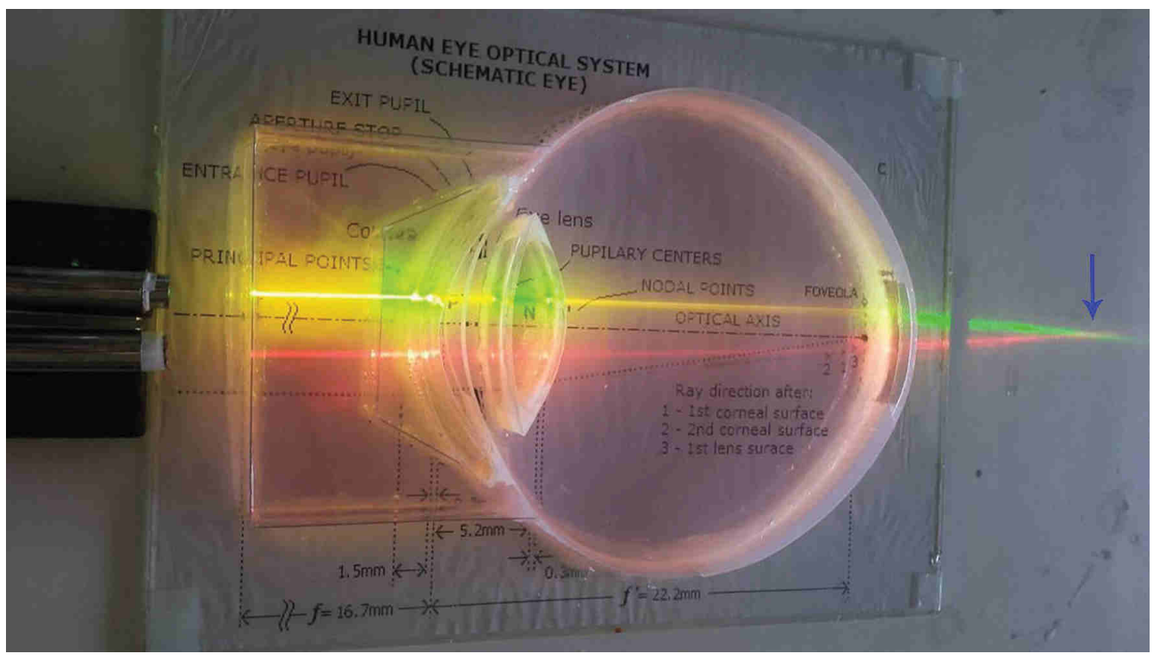

Figure 1. Two parallel light rays coming from a distant underwater object are focused behind the retina. In this case the eye has a high hyperopia.

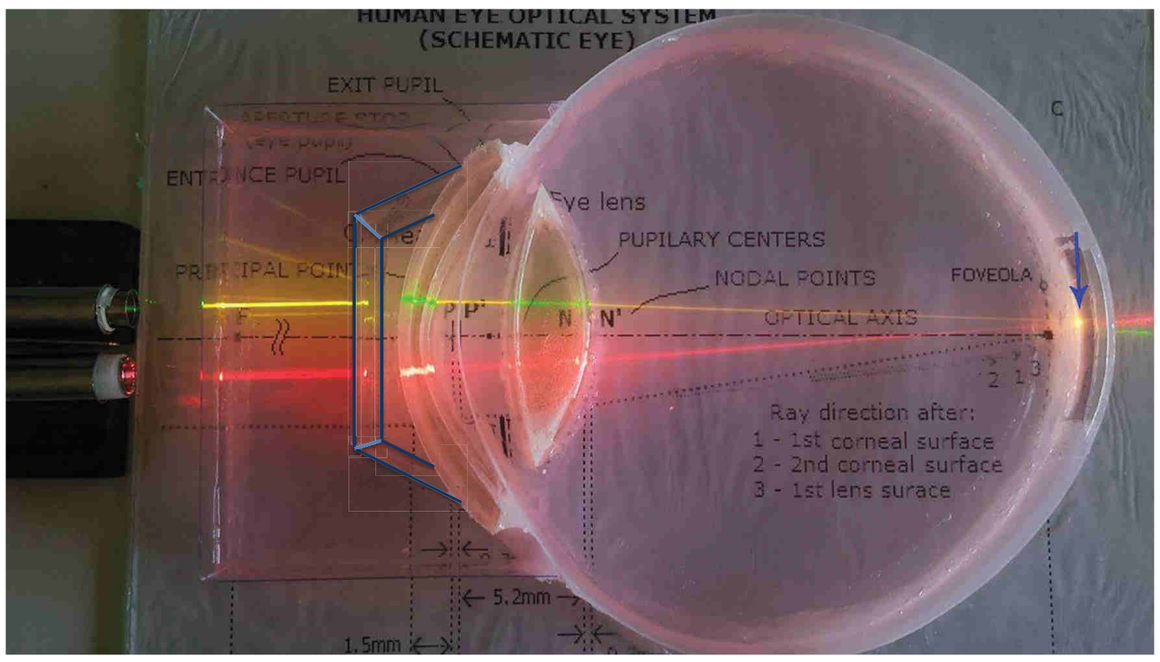

Figure 2. By using a diving mask, the parallel light rays are normally focused on the retina. By doing this the eye becomes emetropic.

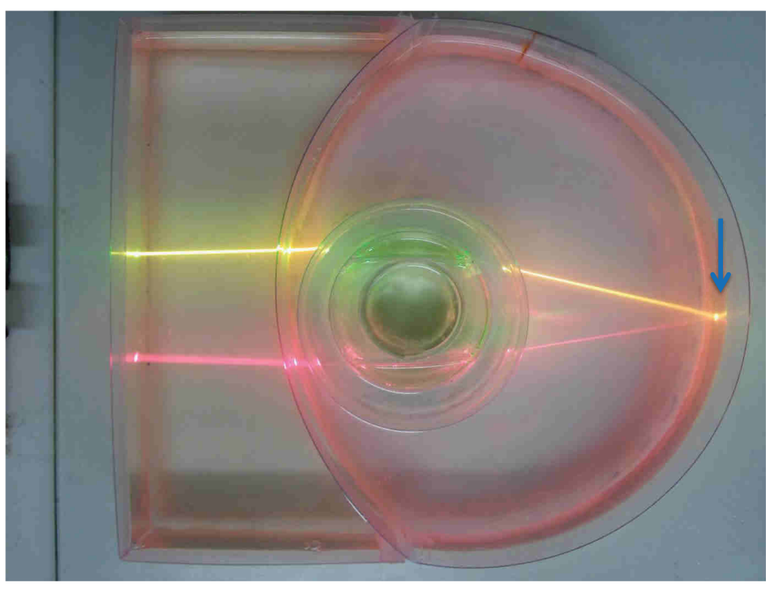

Figure 3. As the spherical lens of the fish's eye approach the cornea the light emanating from a nearby under-water object is focused on the retina.

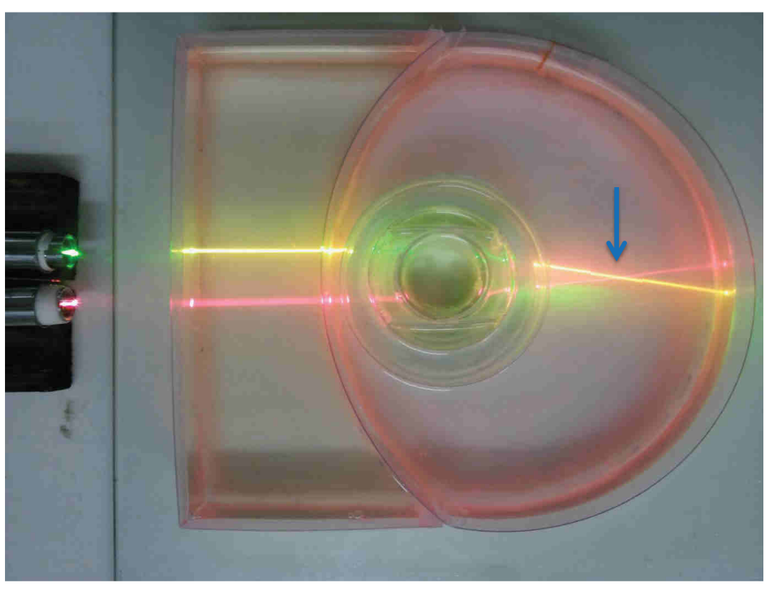

Figure 4. While the lens remain near the cornea, the parallel light rays emanating from a distant underwater object are not focused on the retina.

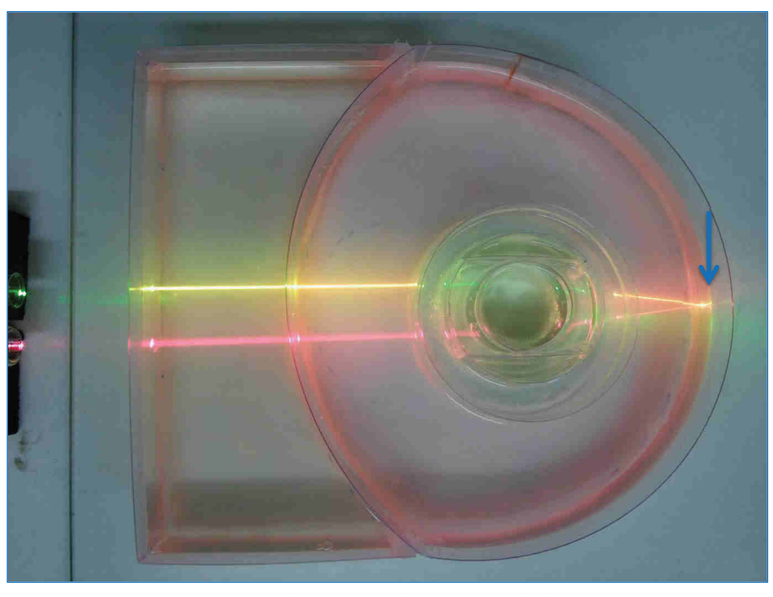

Figure 5. As the spherical lens moves from the cornea to the retina, the parallel light rays focused on the retina.

Conclusion: The underwater human vision and the visual system of the fish can be presented through a very simple and low-cost model.

Antonis Margaritis: amargariti@sch.gr
George Marakis:marakisgk@gmail.com

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Marie-Louise Raväng, Pauliskolan, Malmö, Sweden

Forensic science in school

A simple way to get the puplis excited and eager to study

”Forensic science“ can easily be adjusted to the youngest. For a very small budget you can make every pupil from the age of 5 and above very excited to use science in solving a problem, a **detective mystery**. The pupils have the chance to work together and learn how maths, physics, biology and chemistry is involved in solving a crime.

Age group: 5-19 years

CRIME SCENE DO NOT CROSS

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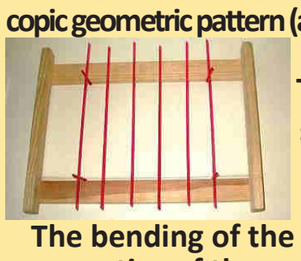
MORE THAN MATHEMATICS

Entertaining and modern methods to teach mathematics

The physical forces and other interactions (physical, chemical, biological) create geometric patterns. The physical and other characteristics of materials depend on the macroscopic and microscopic geometric pattern (and inner structure) of that material.

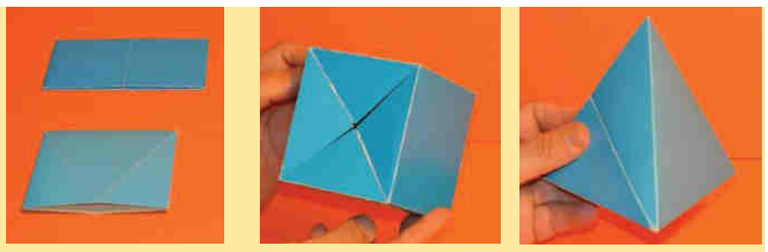


The pattern of the electrically charged straws (suction strains) is determined by the force effects acting on them.

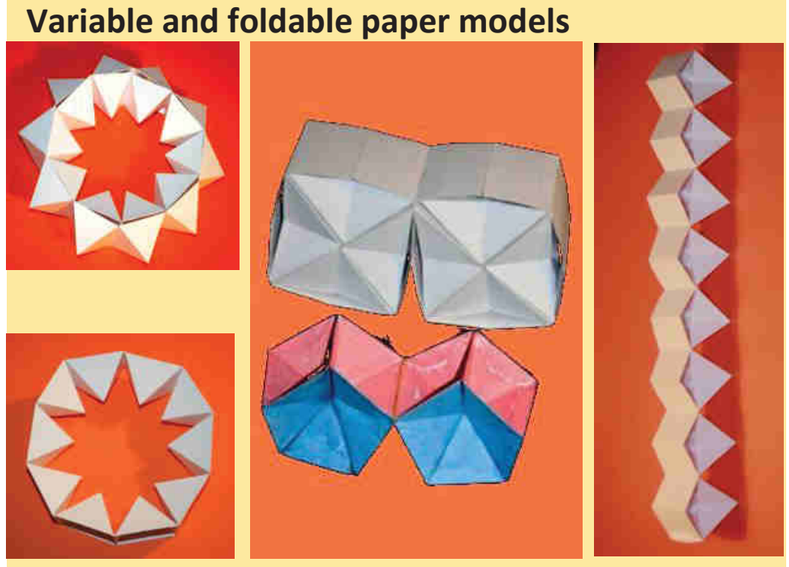
The bending of the paper strips and the pattern and properties of the paper spring (made from paper roll) depend on the geometric structure of the cellulose threads arranged in the fabrics of the paper.

Two compressed paper springs with different compressed patterns

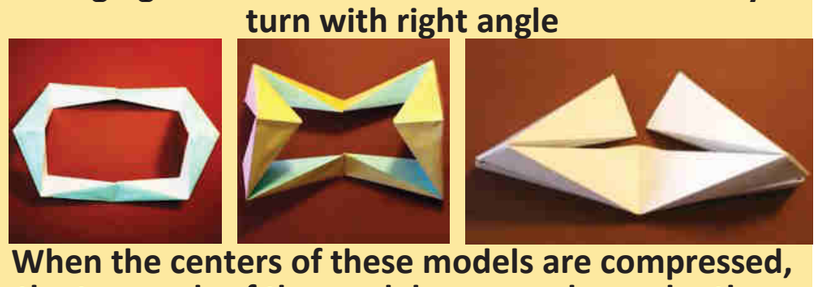
The unparalleled beauties of the world have been produced by the physical, chemical, biological and human interactions.



Variable and foldable paper models



The chain of tetrahedra ...
... solidified in spiral forms ...
One variation
Changing the direction of tractrix of the forces by a turn with right angle



When the centers of these models are compressed, the two ends of the models approache each other: this motion is perpendicular to the direction of the initial compression

Szaniszló Bérczi,
PhD associate professor,
Eötvös Loránd University,
Institute of Physics,
Budapest
Hungary

Dr. János Márki-Zay,
Mathematics and Physics teacher,
Vásárhelyi Cseresnyés Dormitory,
Hódmezővásárhely,
Hungary

Contact information
bercziszani@caesar.elte.hu
janosdrmarkizay@gmail.com

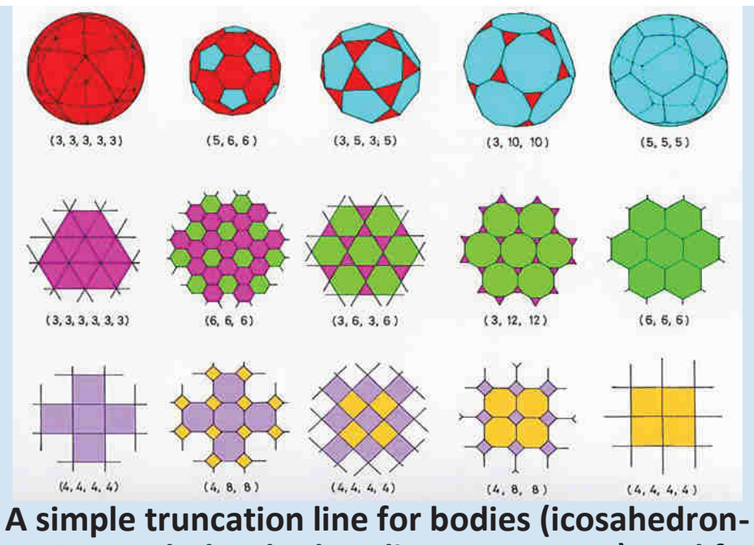
"I hear it and forget; I see it and believe; I do it and understand." (Confucius.)

For 40 years we have been trying to bring the mathematics to the world of impressions and enthusiasm of students. We did this by making our home-made, varied, variable tools which give playfull learning and experience gaining. We also teach students and young people to make such tools. We stopped the traditional visualization of mathematics which used statical, boring, and rigid illustrations. Our tools and devices are variable, interactive and focus on touch them and concentrate on the coordination of morions. Most of them can be easily folded in small folds and this way they can be transported. The fact that these models can be formed into an almost infinite number of variations arouse the interest of students. Variability also helps discovery of the internal contexts in structures.

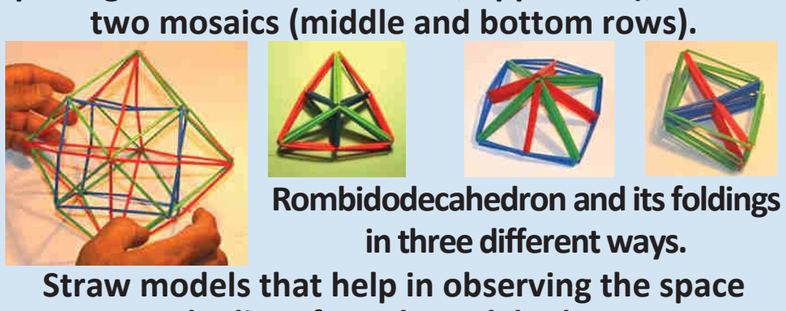
For the sake of effecticity of our work, we do not limit a rigid boundary between mathematics and science education, but we point to mutual relationships. An example is that the structure of the material is shaped by the interactions between its particles and on the other hand, the material properties are strongly dependent on the geometry that is formed.

When producing spectacular color tools we also show the relationship between arts and mathematics and physical interactions, as well.

We pay particular attention to the fact that mathematical and the scientific knowledge is inseparably linked to each other and to the everyday life. This mutual connection requests that the education of mathematics and science should be linked.



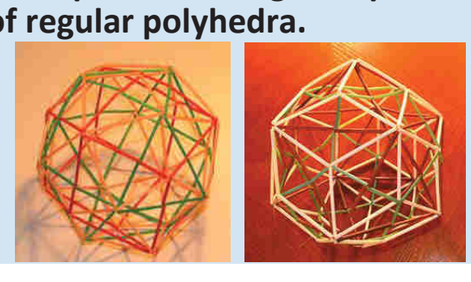
A simple truncation line for bodies (icosahedron-pentagon-dodecahedron line, upper row), and for two mosaics (middle and bottom rows).

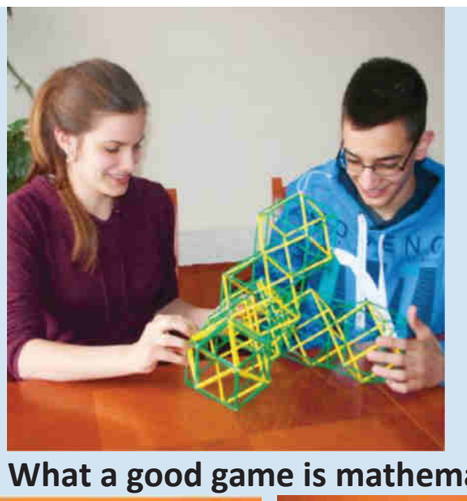


Rombidodecahedron and its foldings in three different ways.

Straw models that help in observing the space duality of regular polyhedra.

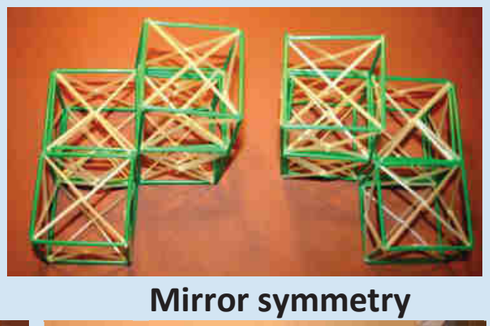
The deltoid 24 and the skeleton of the polyhedron bordered by 48 rhombi faces



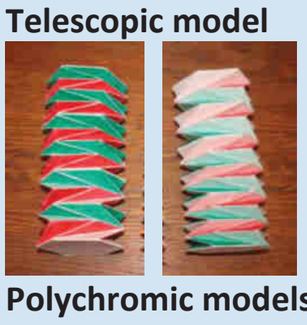


What a good game is mathematics!

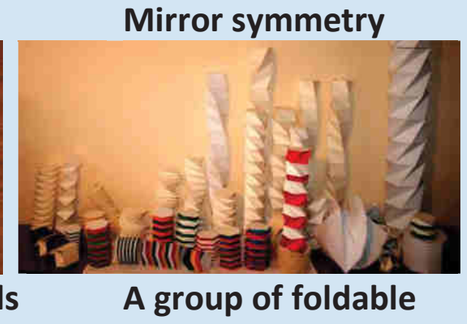
Telescopic model



Mirror symmetry



Polychromic models

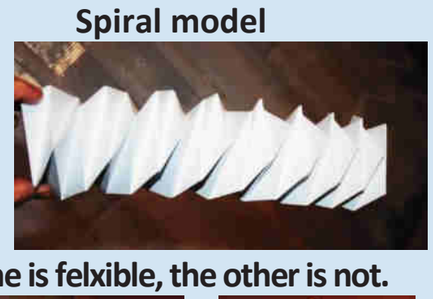


A group of foldable geometric models

Helical shapes topologically homeomorph with the cylinder surface. Thier predefined pattern determines the properties of the helical cylindrical structures. The number of possibilities is, in principle, infinite. We made foldable models for those cases which can be folded into the plane and which have limited space demand, because the design is time-consuming and requests accurate editing.

Foldable model

Spiral model



They are all different: One is felxible, the other is not.

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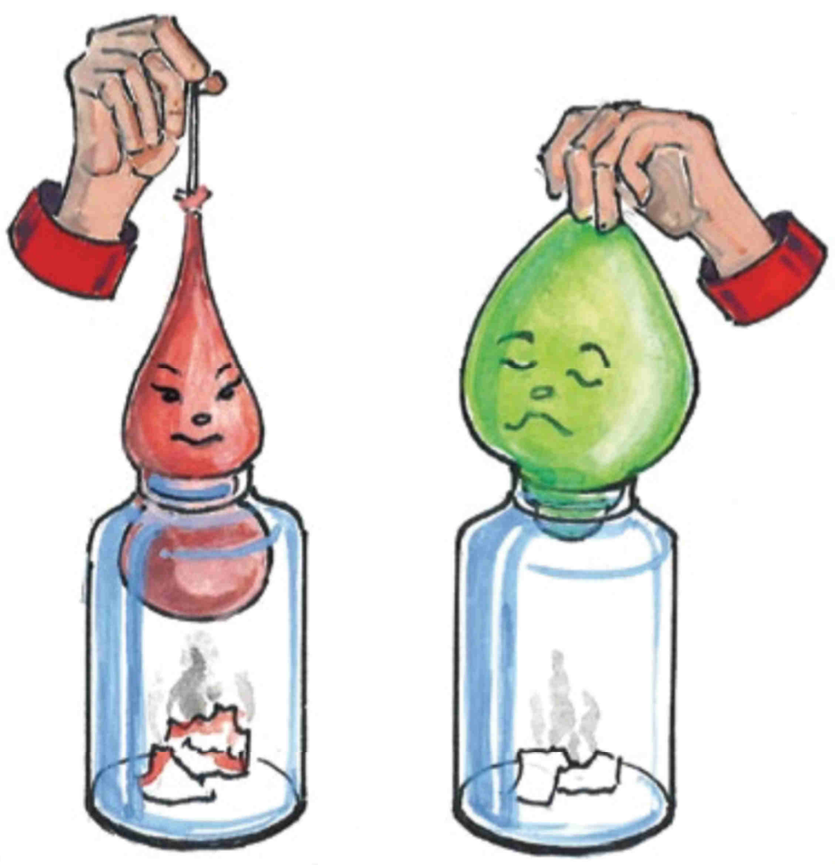
Márta Popa | “János Zsigmond” Unitarian High School | Cluj Napoca | Romania

Playful Learning Science

Wonderland, through physics

The collection of books contains and recommends simple yet interesting experiments from the field of natural sciences to kids and young individuals aged 9-14 as well as their teachers, parents or adults in general.

In many cases, the books create the opportunity to immerse in the secrets of nature, **acquire knowledge** and **learn** through popular as well as less known experiments while deepening basic knowledge and last but not least, **raise interest in experimentation.**



100% Great !

We hope you will have great fun and sense of achievement completing the experiments.