

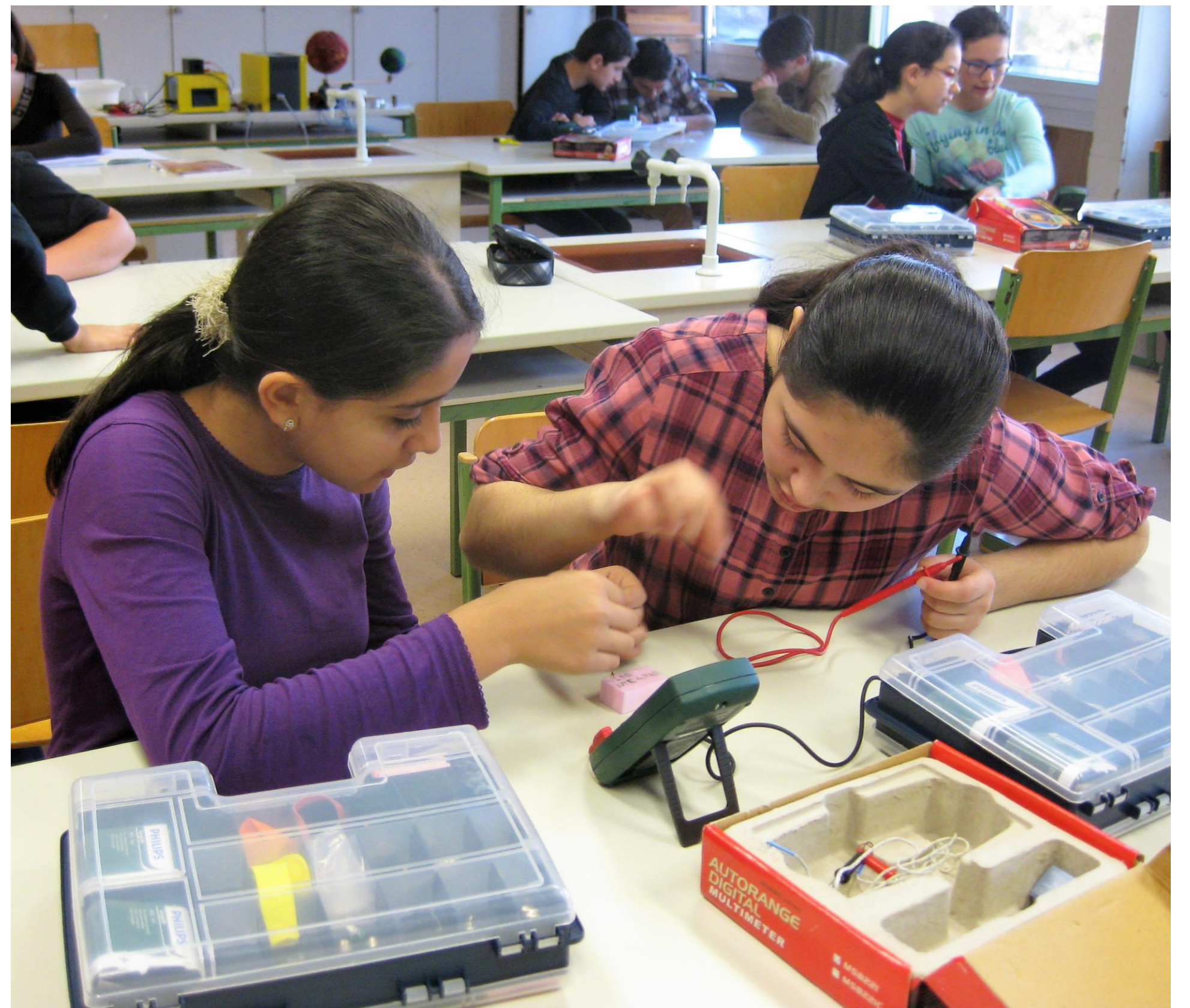
Dipl-Päd. Angelika Fussi | MS Feldbach – Secondary School | Feldbach | Austria

## An Experimental Box for Kids

The attribute electricity should pass from "danger" directly into "fascination with deep knowledge". A first possible and actually successful approach to electricity is to equip each kid with material for experimentation.

Assembling an "Experimental Box" with basic experiments on electricity, electrostatic, electromagnetism and electrochemistry is the top project of the Middle School Feldbach in the field of our science subjects.

This experimental box includes more than 40 experiments, for example lemon-based battery, conductivity tests and galvanic element or electrolysis of water in a very small scale.



350 Students benefited from their self-made experimental box for their own use. This experimental box is used in class and can be taken home by the students to repeat the experiments and re-test and consolidate the results.

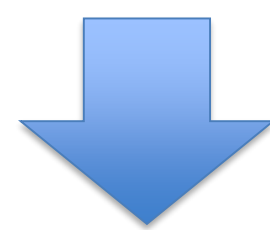


Prof. Dieter KADAN | Austrian St. George's College | Istanbul | Turkey

## MatheMagic

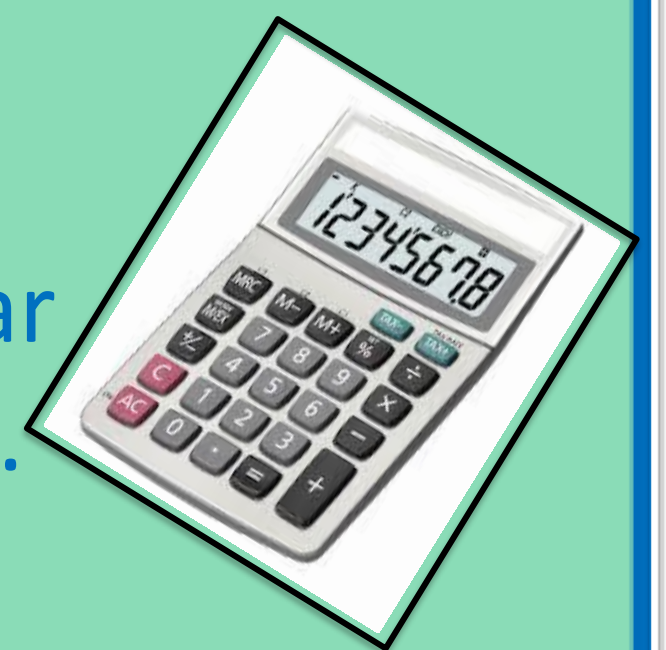
Raising curiosity about mathematics by magic tricks

Start now and try it out by yourself:



### THE MINDREADING CALCULATOR

This worksheet works best with a calculator showing numbers in this old angular style: 123, e.g. download the „CLASSIC CALC“ App from your Google Play Store.

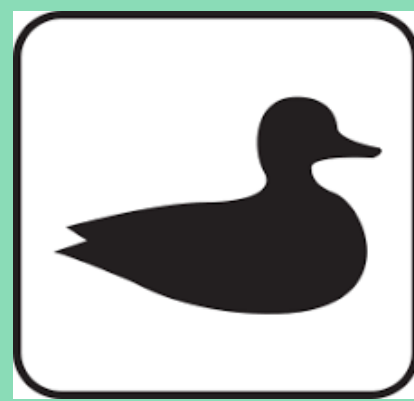


- 1# Mentally dice a number from 1 to 6.
- 2# Put your secretly chosen number three times in a row in your calculator, e.g. 222.
- 3# Divide this three digit number by the sum of all three digits, e.g. by 6 because  $2+2+2=6$ .
- 4# Memorize the animal which is shown at your result below.

19  
Bear/Bär



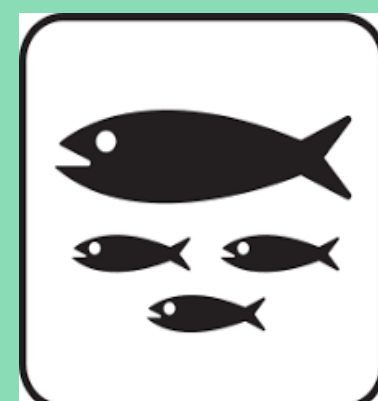
28  
Duck/Ente



37  
Donkey/Esel



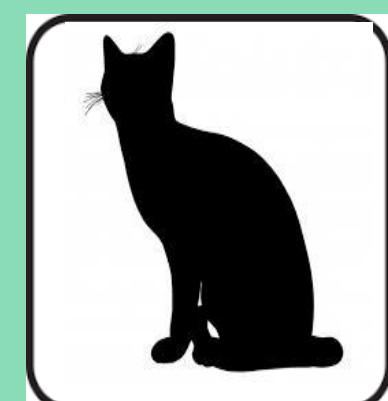
46  
Fish/Fisch



55  
Seal/Robbe



64  
Cat/Katze



- 5# Now multiply your result by the magic number 199.
- 6# Then subtract number 10.

**ABRACADABRA!**

Although you could have chosen any number -  
1, the mindreading calculator, know the animal you are thinking of!

- 7# You only need to read the result upside down.

\*

Could you explain the MatheMagic behind this trick?

MatheMagic is an easy way to attract our pupils' attention because mathematics is the key to some magic secrets. Even if you have never performed a magic trick before -  
**Welcome to my workshop with more MatheMagic.**



Nikola Karavasilev | First Private Mathematical High School | Sofia | Bulgaria

## Liquid world

### Interesting experiments with liquids

In this project, we demonstrate interesting phenomena, related to liquids. In some of the experiment, You can see on our stand we will show You how to:

- Build a tower of colourful liquids
- Make the water to shine
- Make a liquid volcano
- Create a “solid” liquid

We have prepared brochures for all the experiments.

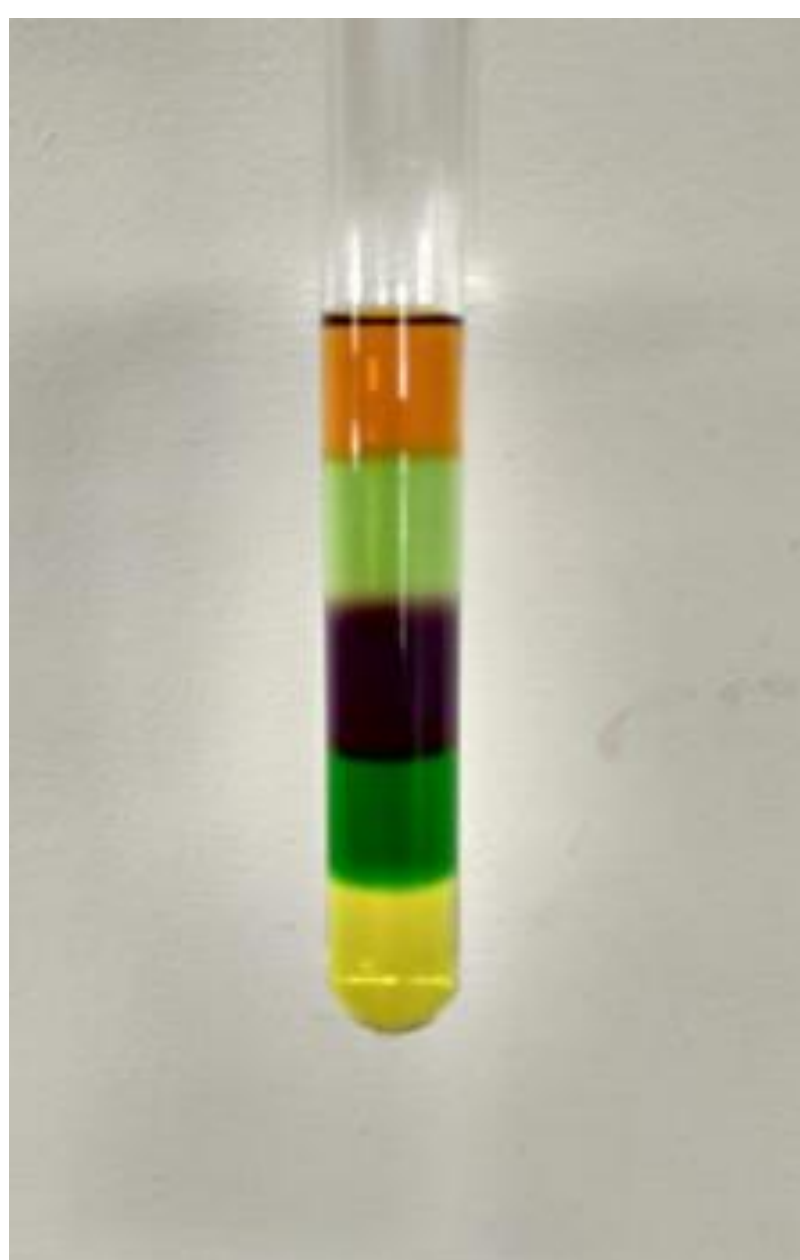
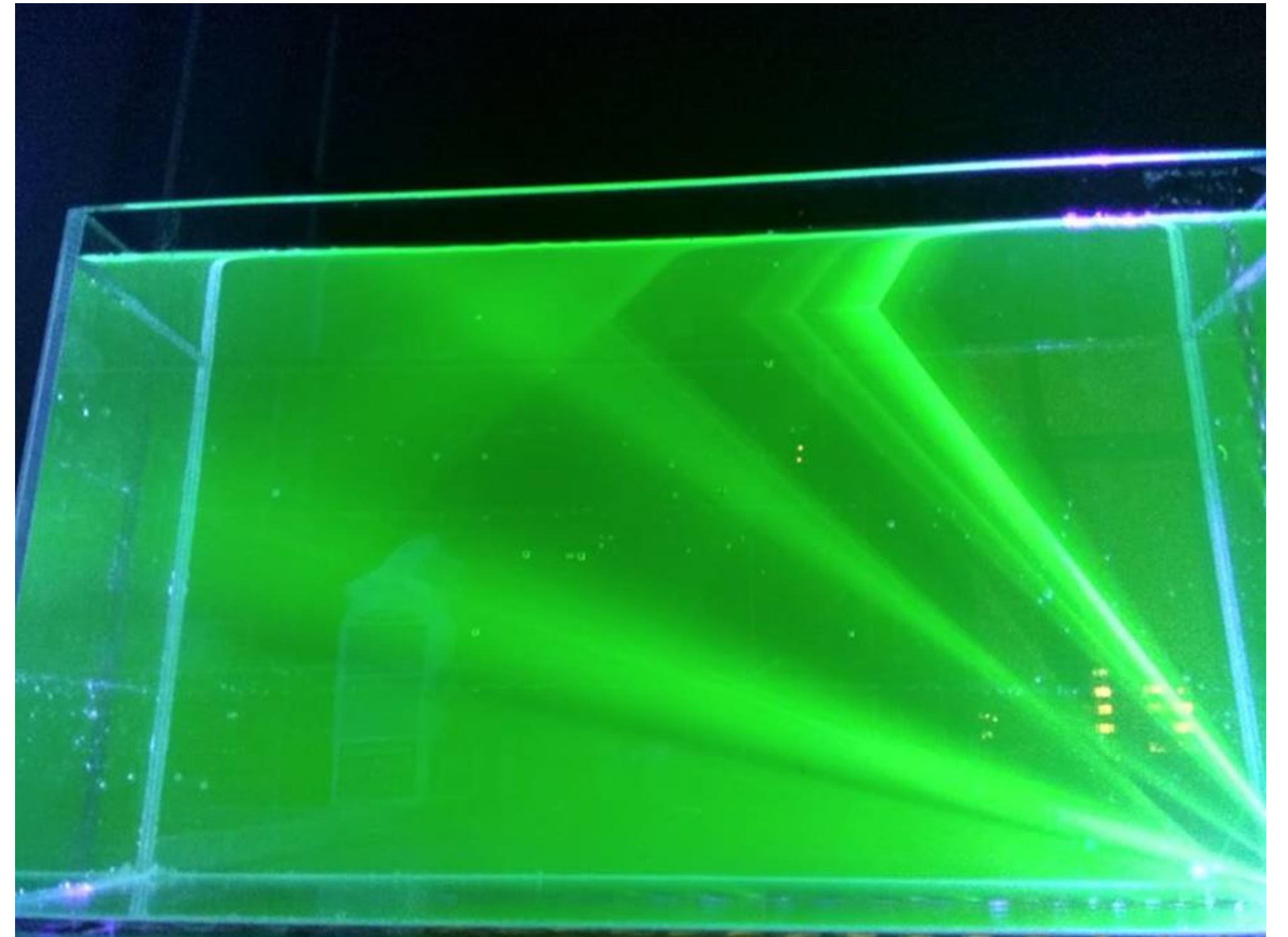


Fig.1: Shinning water; Fig. 2: Tower of colourful liquids; Fig. 3.: Our team

**Conclusion:** With our experiments, we will demonstrate how beautiful physics can be!

We hope, You will repeat our experiments at school or at home!



Vasilka Krasteva | Fifth Primary School "Hristo Botev" School | Kyustendil | Bulgaria

## Butterfly Festival

### The Children's Feast at the Polskoskakavishki Waterfall

**Goal:** This project uses an attractive, an innovative and an inexpensive way to familiarize the children of Kyustendil with the species of butterflies distributed in protected areas.

**Method:** Learning by playing; teamwork.



**Materials:** old paper/plastic/packing – an inspiration for rewilders and recycling designers.

**Conclusion:** The children create butterfly costumes and puzzles to learn about the lifecycle and the significance of the butterflies from the Polskoskakavishki Waterfall area, while understanding the usefulness of reusing old plastic and paper.



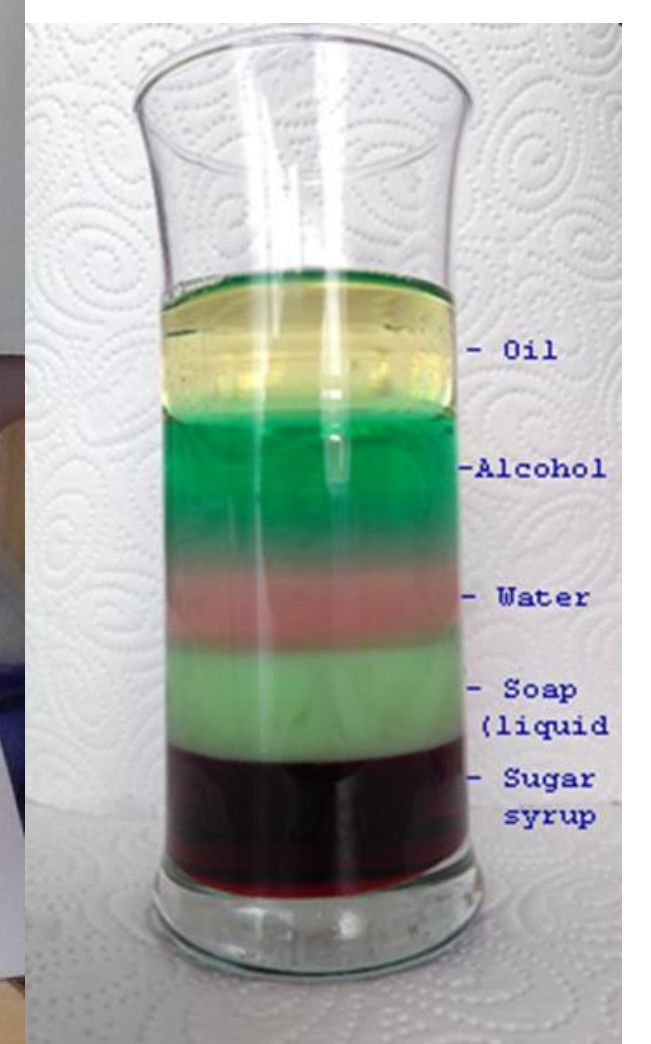
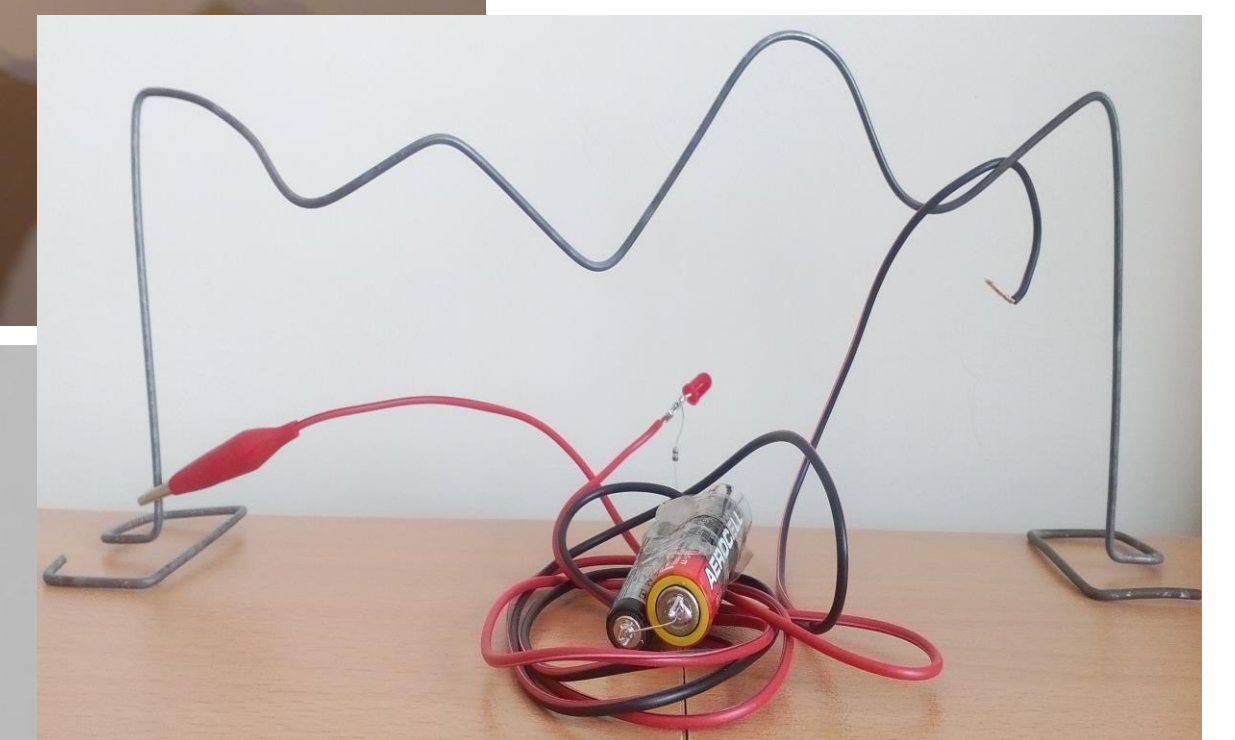
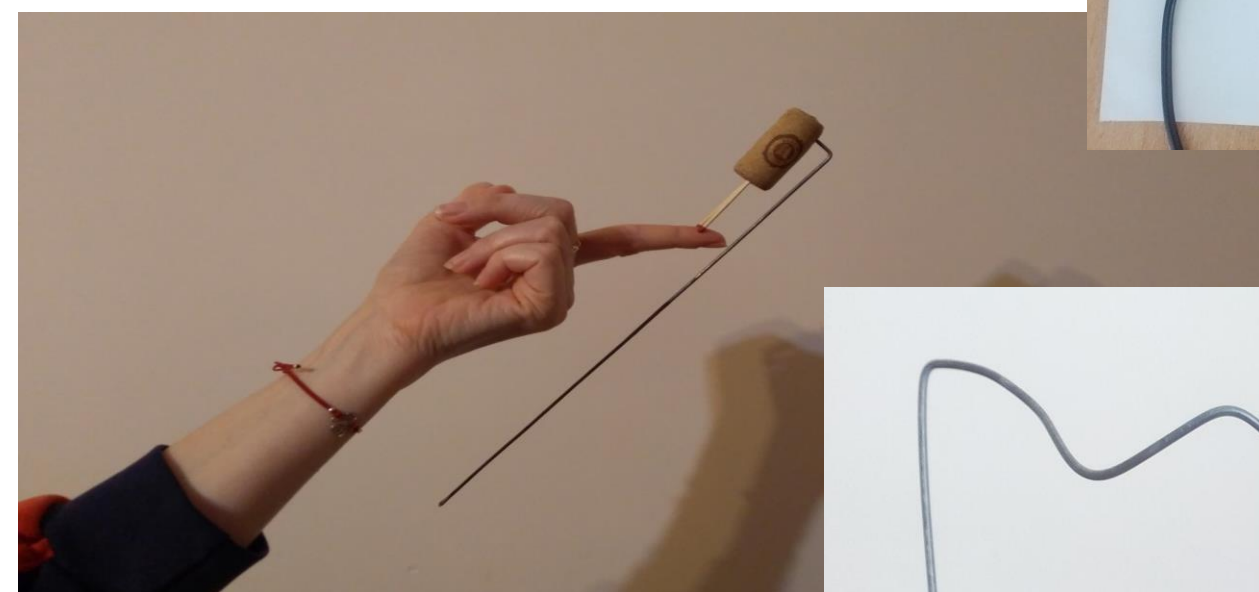
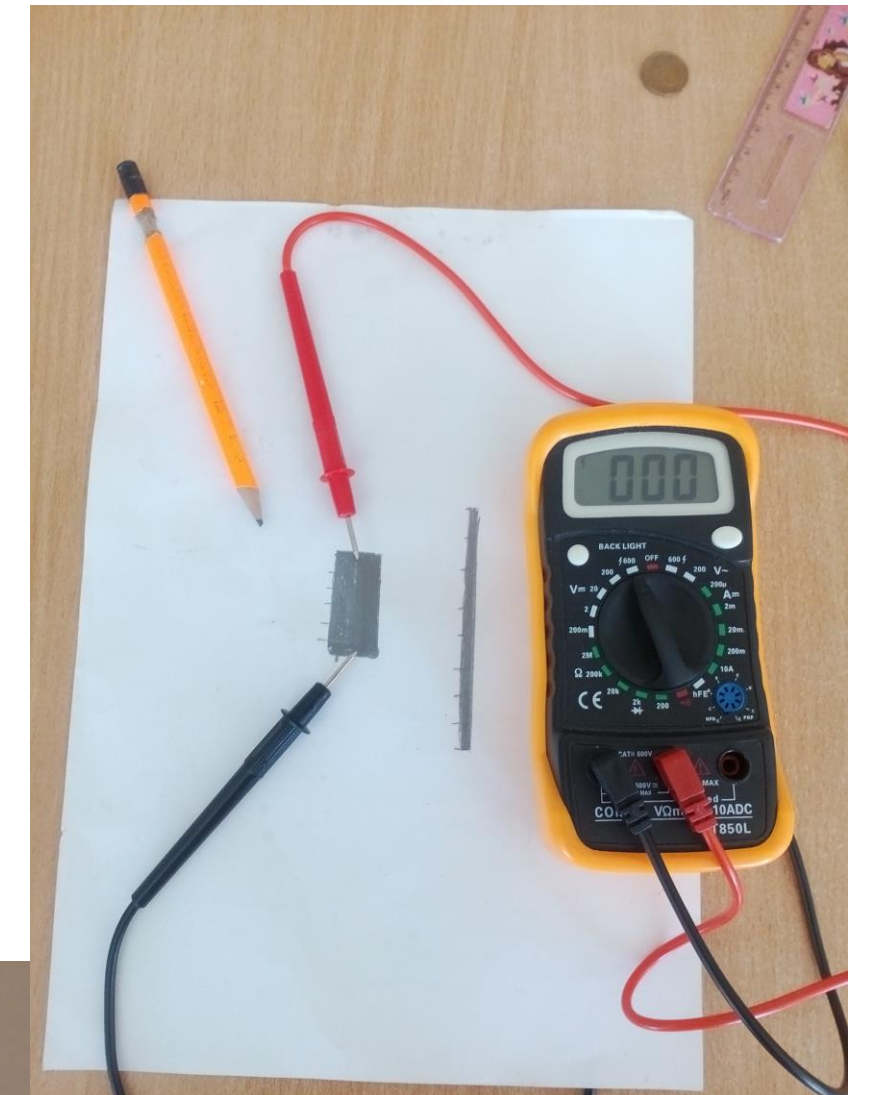
Antoniya Petrova | Profiled Nature-Mathematical High School | Stara Zagora | Bulgaria

## Cheap Science – Real Physics

### Simple physical experiments at school

In our school we decided to show that physics is everywhere even in the simplest things that surround us. In this project we demonstrate 12 experiments from the study material of high-school level physics which can be done by every student using what is available in every home..

The basis of the illustrated experiments are physical phenomena – electricity, magnetism, heat, weight.. In a fun way the students now know that these phenomena are everywhere.



The first project aim is the students independent work. They are tasked to prepare the necessary materials and theoretical explanations. The second aim is to present the working models with practical skills.

When we show the practical nature of things using accessible materials, the students understand and remember much more and become a part of an effective learning process using experiments that provoke their interest to learn more.



Nasko Y. Stamenov | National High School of Science and Mathematics | Sofia | Bulgaria

## Affordable Experiment For Every Pupil

### Bringing practical work back in class

This project aims to lower the cost of a science experiment and as well to optimise the work so even less prepared students can partake actively.

The goals are achieved by omitting unnecessary glassware, using smaller quantities of reagents and devising an intuitive work environment which helps students in their work.

The result is a small set which is enough for two students for the whole year that can be used again and again.



Figure 1. The set, shown on the National Sons

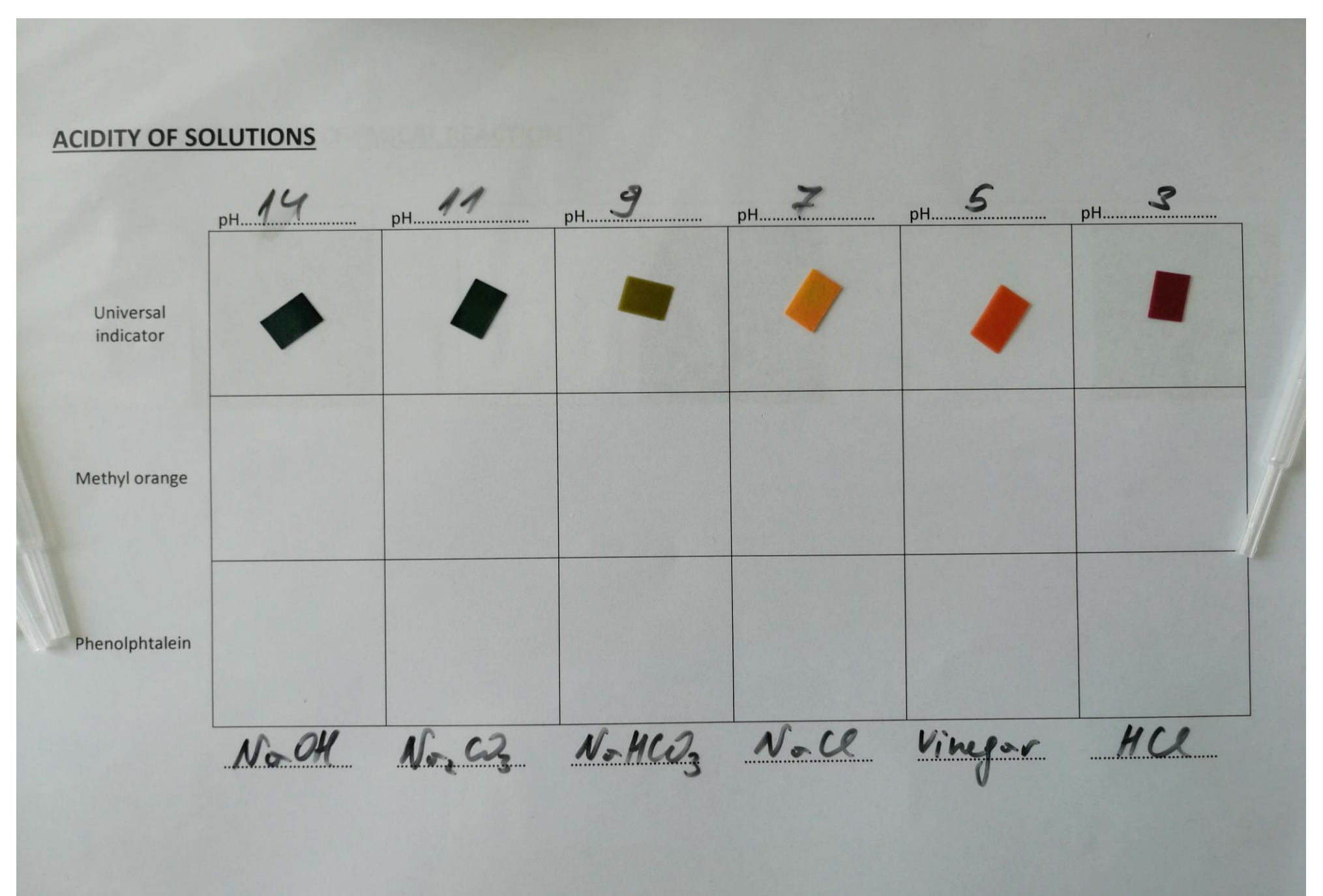


Figure 2. The whole set; Figure 3. The 'Acidity of solutions' experiment in working process

**Conclusion:** An easy to use, cost effective experimental set solves most issues in chemistry education. The one that remains is the teacher's motivation.



Paul Stinson | Sun West Distance Learning Centre | Kenaston | Canada

## Magnifying Curiosity – Foldscopes

### Origami Paper Microscopes

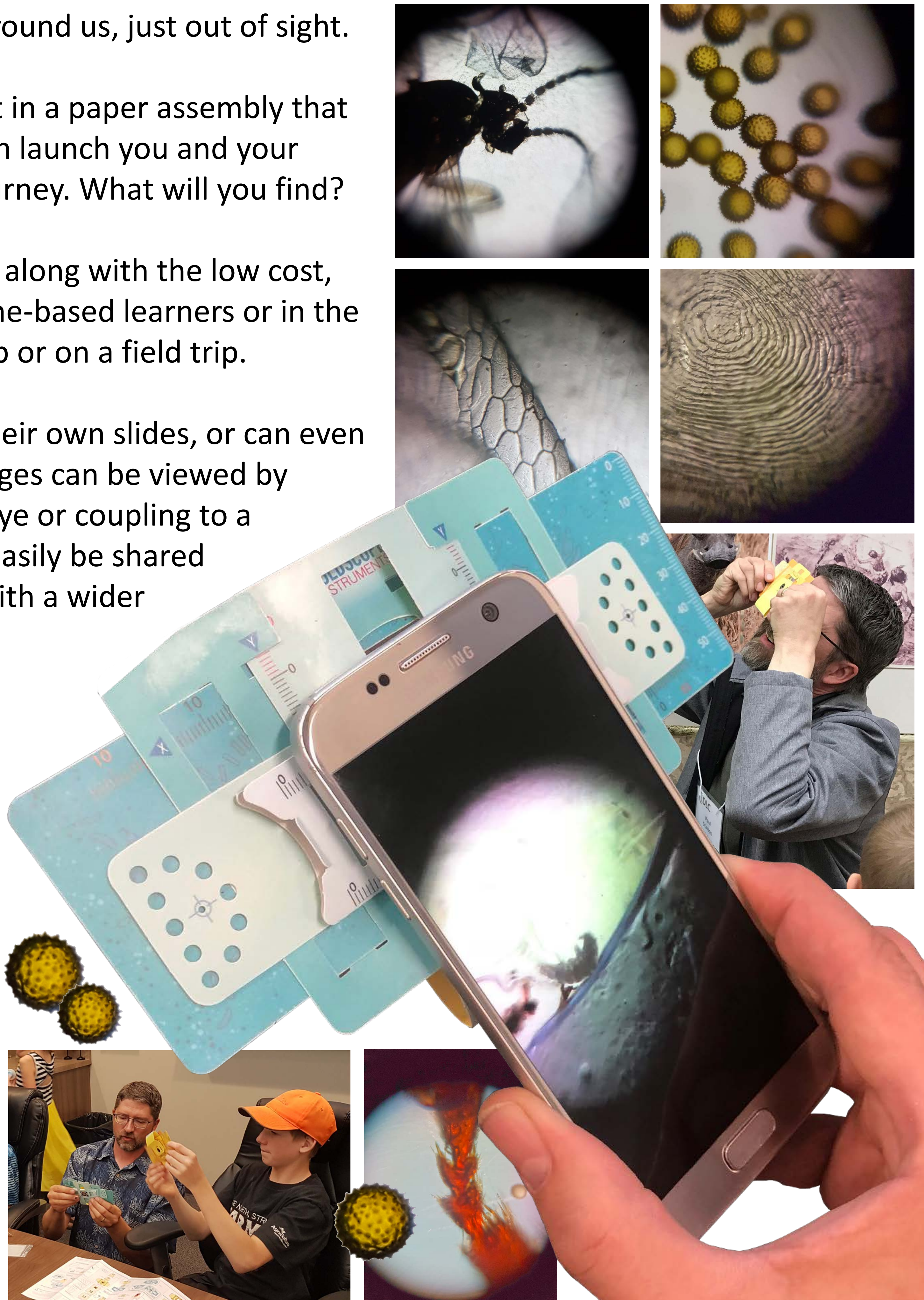
There is a hidden world all around us, just out of sight.

A very small glass sphere, set in a paper assembly that students fold themselves, can launch you and your students on an incredible journey. What will you find?

The small size and durability, along with the low cost, makes it ideal for use by home-based learners or in the traditional classroom; in a lab or on a field trip.

Students collect and make their own slides, or can even view a specimen *in situ*. Images can be viewed by holding the device to one's eye or coupling to a camera. Digital images can easily be shared with others in the class, or with a wider online community.

[paul.stinson@sunwestsd.ca](mailto:paul.stinson@sunwestsd.ca)



A tool for learning about cells, micro-organisms, optics, and more!

**Ingenuity + Paper + Lens + Specimen + Creativity =**





Dana Mandíková | Mensa gymnázium; KDF MFF UK | Prague | Czech Republic

## Playing with Sound

The project presents a comprehensive series of experiments with sound that can be used and adapted to a wide range of age categories. Simple experiments show how sound is created and how propagates, how to measure the speed of sound in the air, the principle of recording and reproducing sound, some unconventional sources of sound and simple musical instruments..



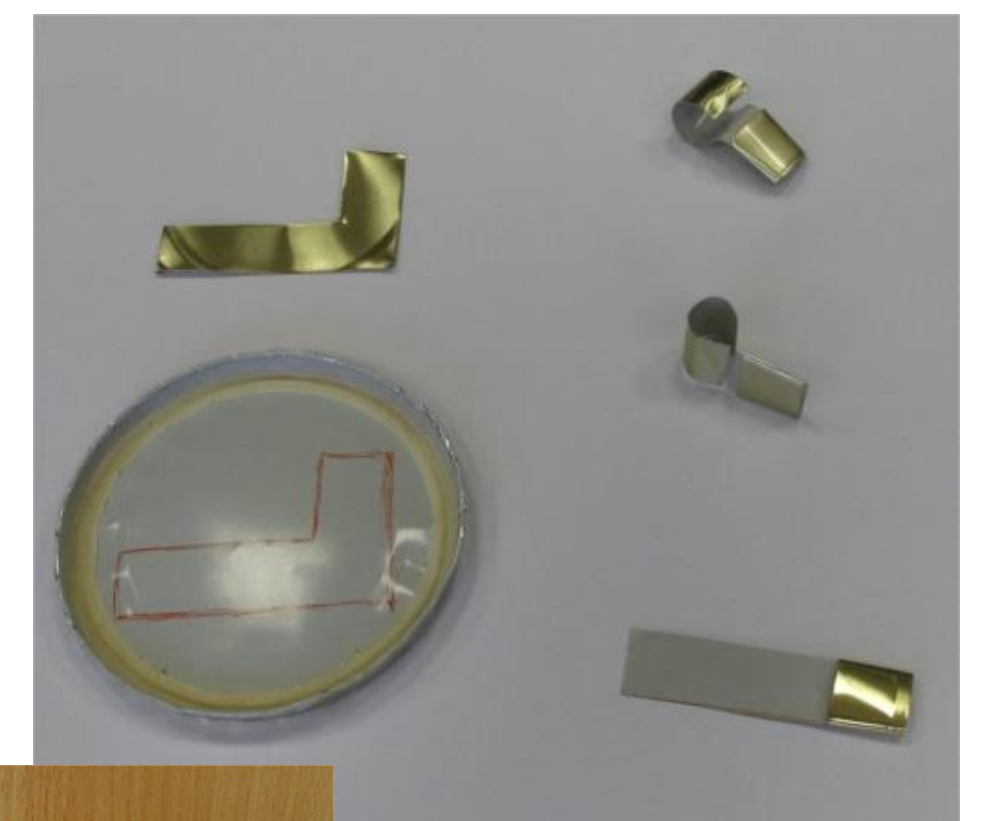
How is sound created and resonance



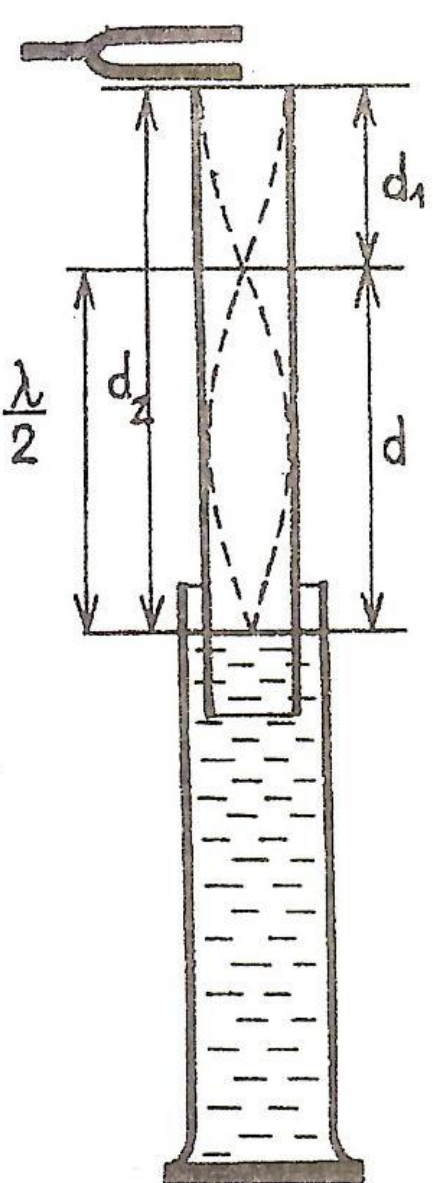
Why do we have two ears



Bell from the fork



Whistle



Crowing cup, mooing bucket



Growling tube

Measuring the speed of sound in the air:  $v = \lambda f = 2df$



Cosmic sounds



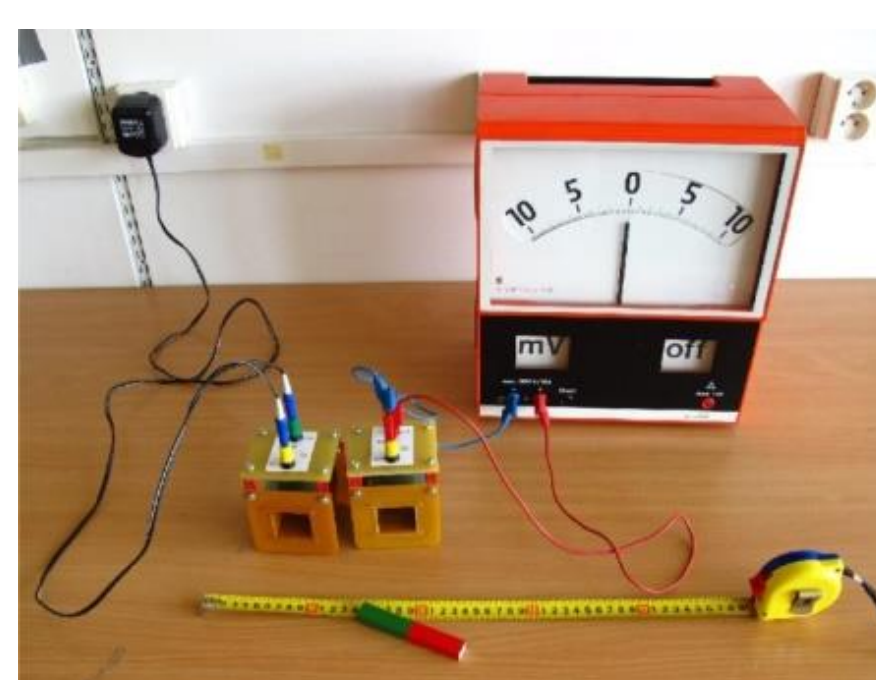
„Bagpipes“



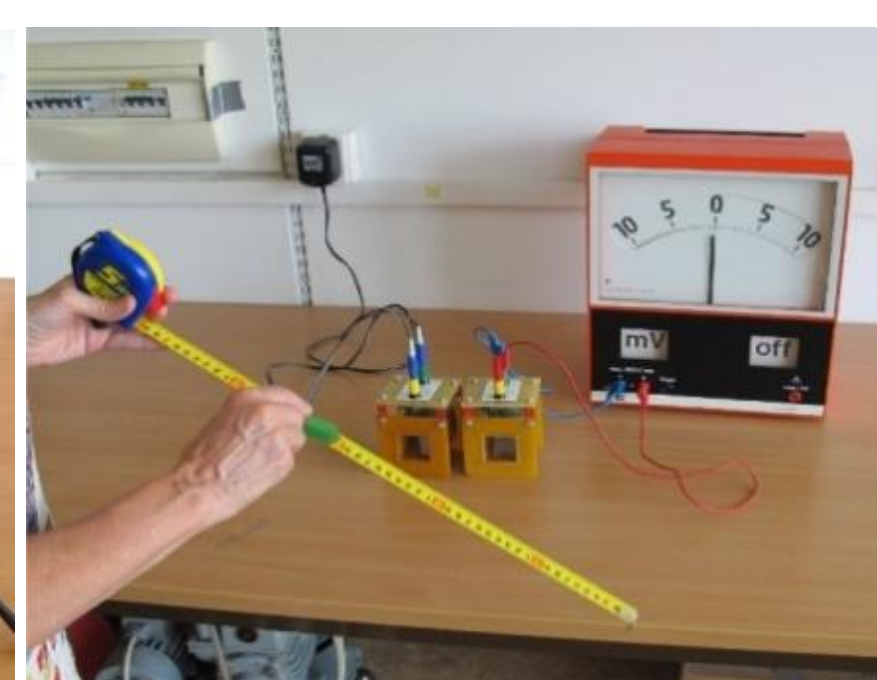
Straw trumpet



Sound reproduction



The principle of the tape recorder



[dana.mandikova@mff.cuni.cz](mailto:dana.mandikova@mff.cuni.cz)

<http://kdf.mff.cuni.cz/~mandikova/kurz/materialy/zvuk.pdf> (czech)

<http://kdf.mff.cuni.cz/~mandikova/kurz/materialy/sound.pdf> (english)



Maxime BIET | Collège Hippolyte Rémy | Coulommiers | France

## Flying in the Flow

### Is it easier to fly in the water ?

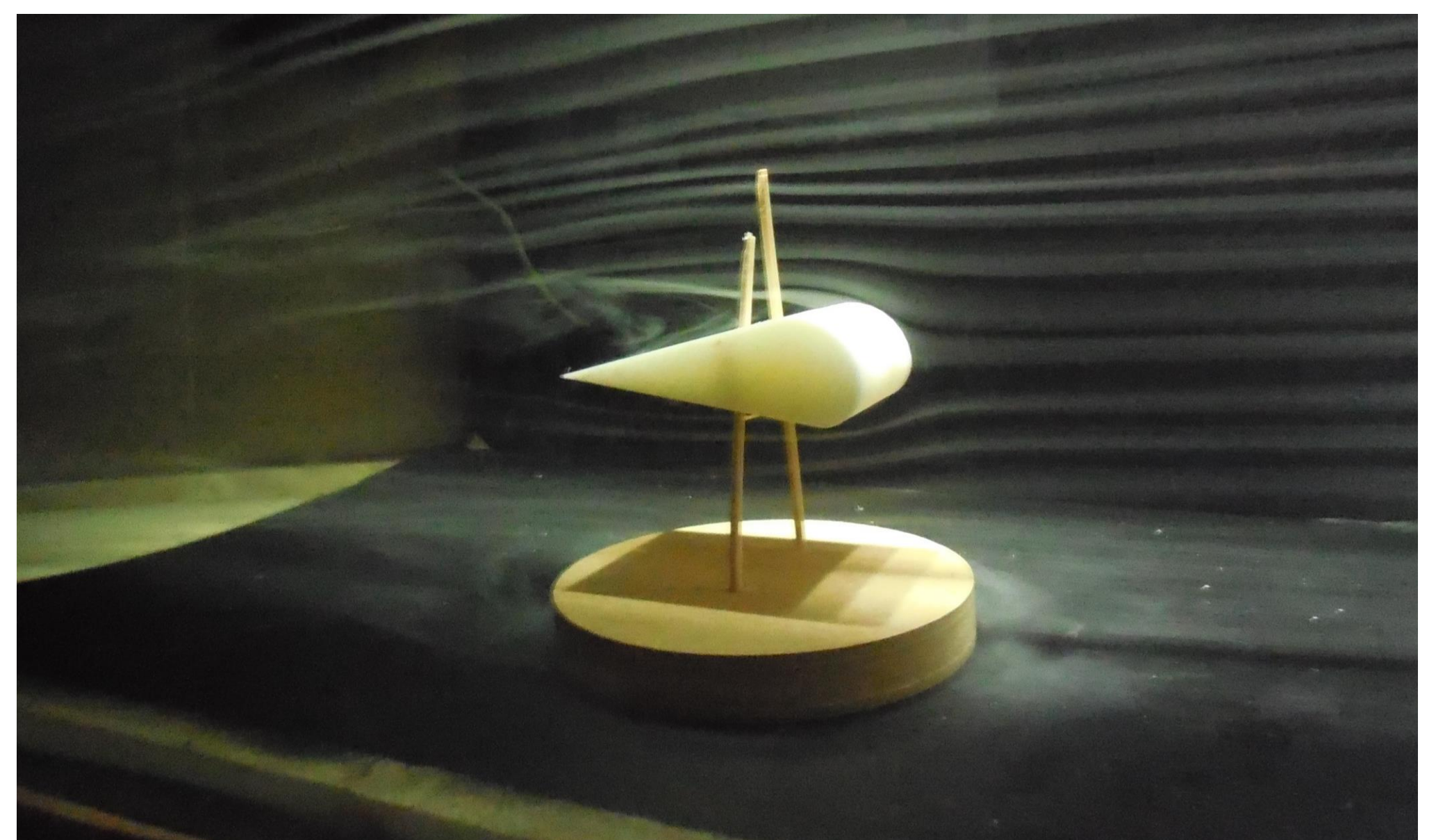


Atelier scientifique  
Collège Hippolyte Rémy  
Coulommiers

encadré par  
Maxime BIET

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@Dscientifique Les scientifiques d'Hippolyte

We wondered if it would be easier to fly in the air or over the water. Therefore, we decided to use our further wind tunnel to study the flight of a wing. Nevertheless, while the flow around a wing is quite laminar, the airflow in our wind tunnel was very turbulent. We had to improve it. Moreover, we had to imagine an experiment to test the flight of a hydrofoil in the water. After hours of research, and several partnerships, we succeeded in clearing up the mystery...



	FLYING IN THE AIR	FLYING IN THE WATER
LIFT STRENGTH	0,01 N	0,01 N
FLUID SPEED	1,5 m.s <sup>-1</sup>	0,02 m.s <sup>-1</sup>
DENSITY	1,3.10 <sup>-3</sup>	1
FRONT SURFACE	We used the same wing with the same angle.	

**Conclusion:** So, Flying over the water seems easier than flying in the air! In fact, if you don't need to go very fast, it's better to fly over the water but if you need to go fast, you cannot fly over the water because of resistance strength.



Philippe Mancini, Collège Louis Clément | Saint-Mandrier sur mer | France

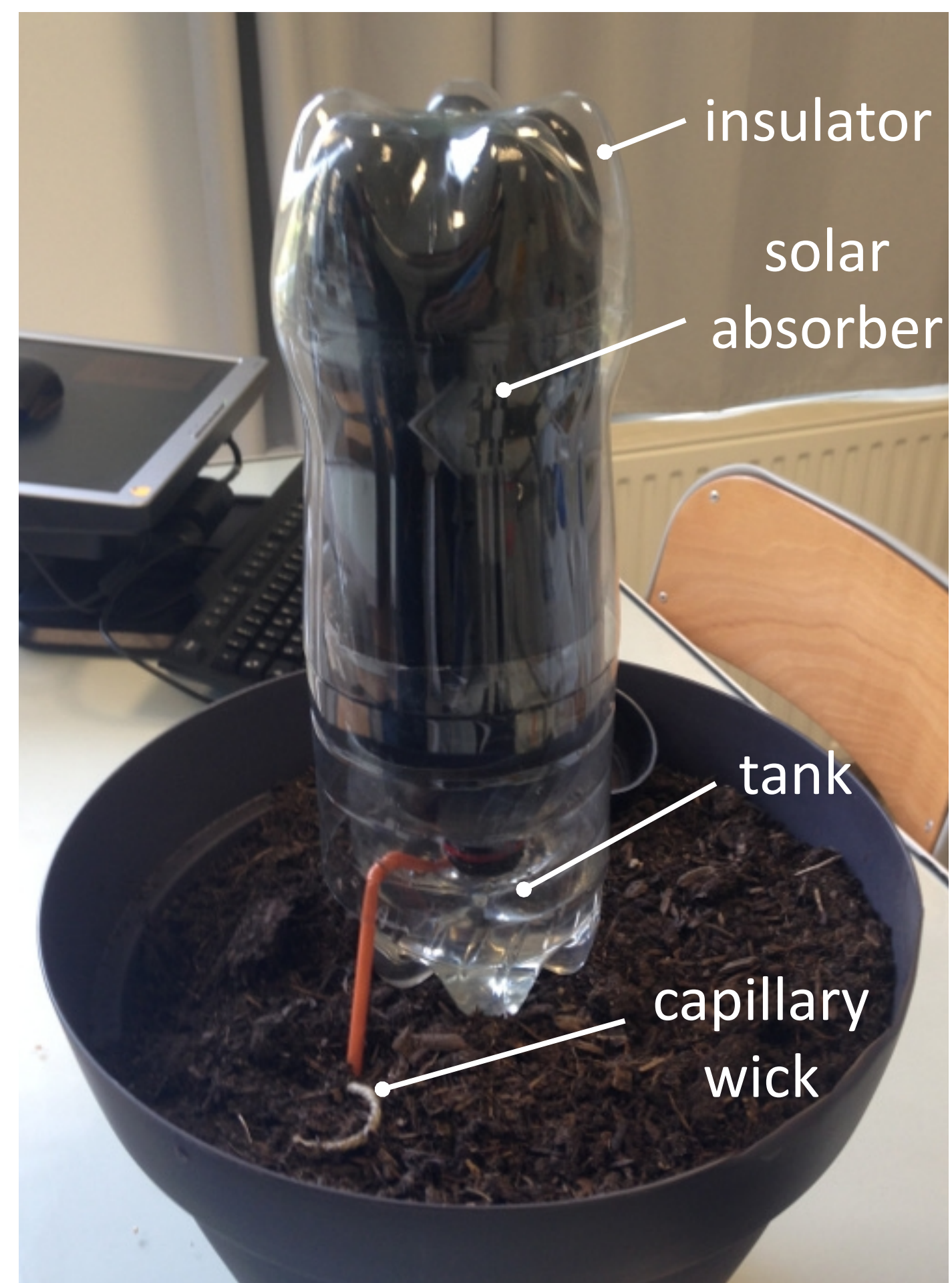
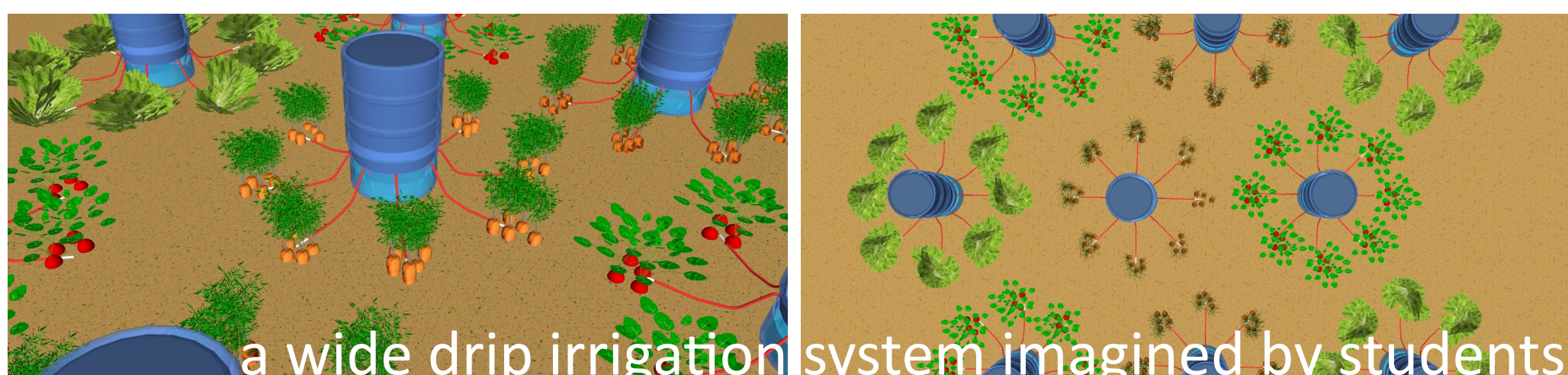
## Aquasun

### A low cost sunny drop-by-drop watering system



Aquasun is an innovative, economical drop-by-drop watering system, costing less than 1€. It is made from recycled materials. It allows automatic autonomous watering (without electricity) whose flow rate varies with sunshine responding the water needs of plants.

Students adopt an engineering approach. First, they study existing commercial systems. Then they design an equivalent device that meets the specifications by providing technological innovation.



Students cooperate, experiment, model, use mathematics, physics, biology and their creativity. This project was carried out in collaboration with an engineer from the CEA.

A multidisciplinary low cost science and technology project. It can be implemented from elementary to secondary.

STEM approaches through a concrete and successful project.

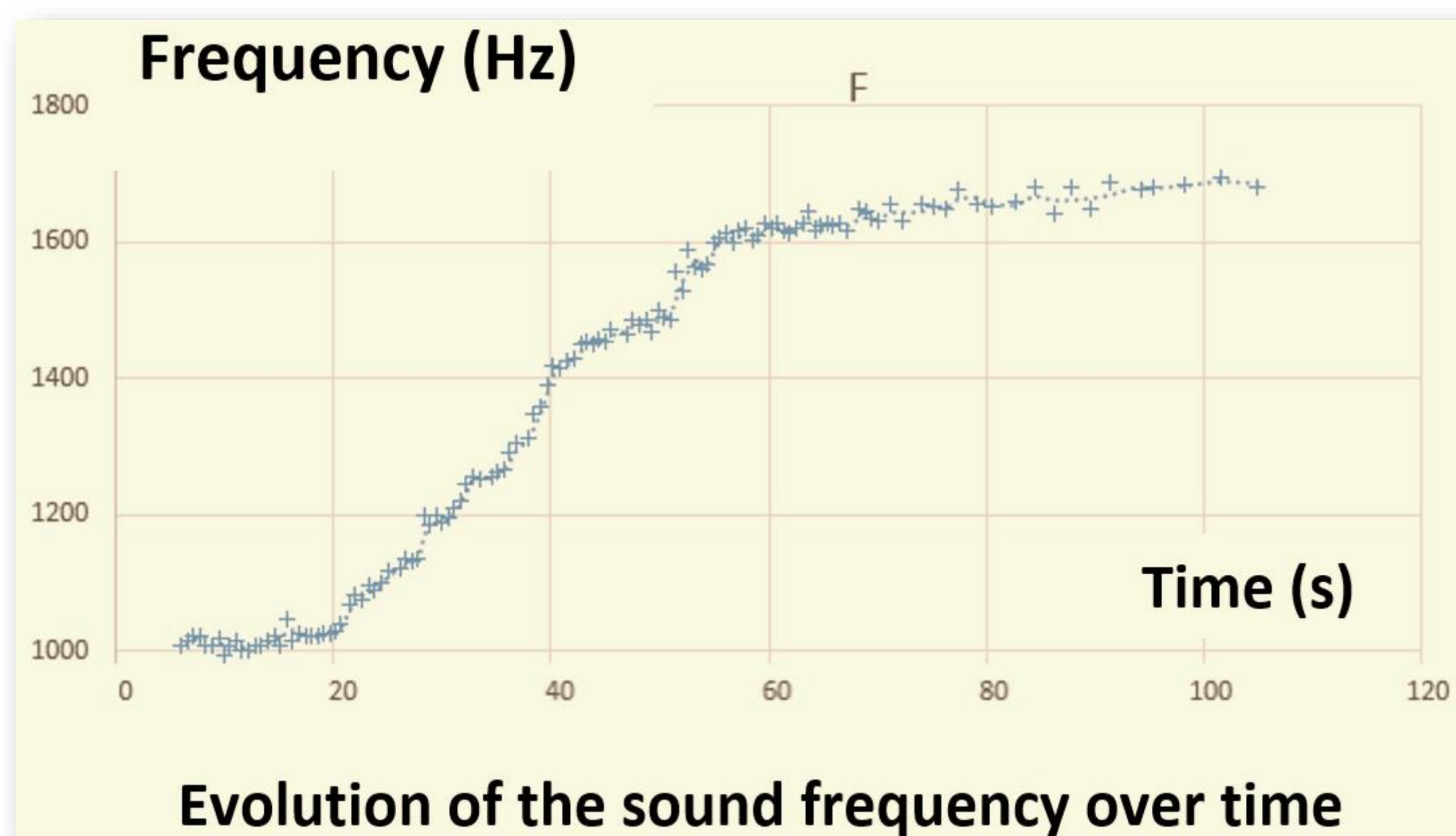


Jean-Brice MEYER | LP2I | Jaunay-Marigny | FRANCE

## A Mysterious cup

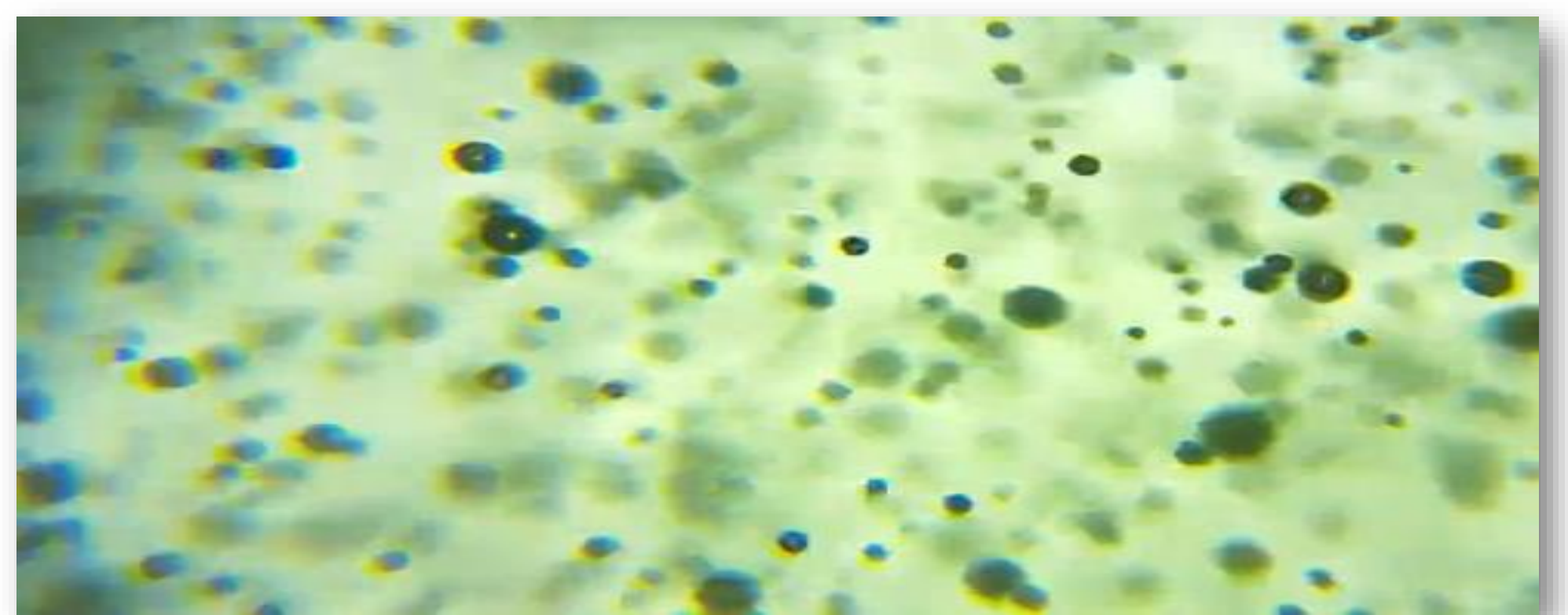
Add some milk in a cup and put it in a microwave so that the milk is warm. Add some chocolate powder and stir the mixture during a few seconds. Then, if you shot the cup with a spoon, you hear a sound whose the frequency increases with every shot. We wanted to understand this phenomenon.

With this project, students can learn what a scientific approach is, using accessible material: cup, chocolate, spoon. They also use the sensors of daily technology (computer, mobile) to make experiments.



To understand the phenomenon, we first measured precisely the evolution of the sound frequency. Then, we looked for a physical parameter whose the evolution can explain the frequency increase. Is it the temperature? Or is there something that appears is the cup? And how prove all our hypothesis? It's only after a rigorously scientific approach we solved the riddle.

This is a project full of surprises, an exciting stories full of suspense! For example, students seen that bubbles appears in this experiment. But how can the bubbles modify the sound frequency?



**Conclusion:** The solve of the riddle is very fun, but the investigation to discover it is even more interesting and shows students why sciences are amazing!



# Low-Cost and Recycled Science

Buckwood International School – Tbilisi  
156 Rustaveli street, Tskneti, Tbilisi, Georgia 0181  
Keti Tatishvili – Teacher of Physics

# COW DUNG VS WOOD

## THE RELEVANCE OF THE PROJECT

Every year our country loses trees and forest of 446 ml. GEL (Georgian Currency – 1\$ = 2.6GEL) amount for the fuel; The legal delivery of firewood can not provide the need of population and it is made illegally; The forest ecosystem is destroyed and number, scale and volume of natural disasters increases. Biomass (organic wastes) is an important source of energy, which is an alternative firewood for food preparation and heating. The fossil (manure) is a fuel, which can be used instead of wood due to its high heat calorific value. The technology of fuel production



from fossil is very simple and it can be produced easily by women and children as well.

## SCHOOL EXPERIMENT

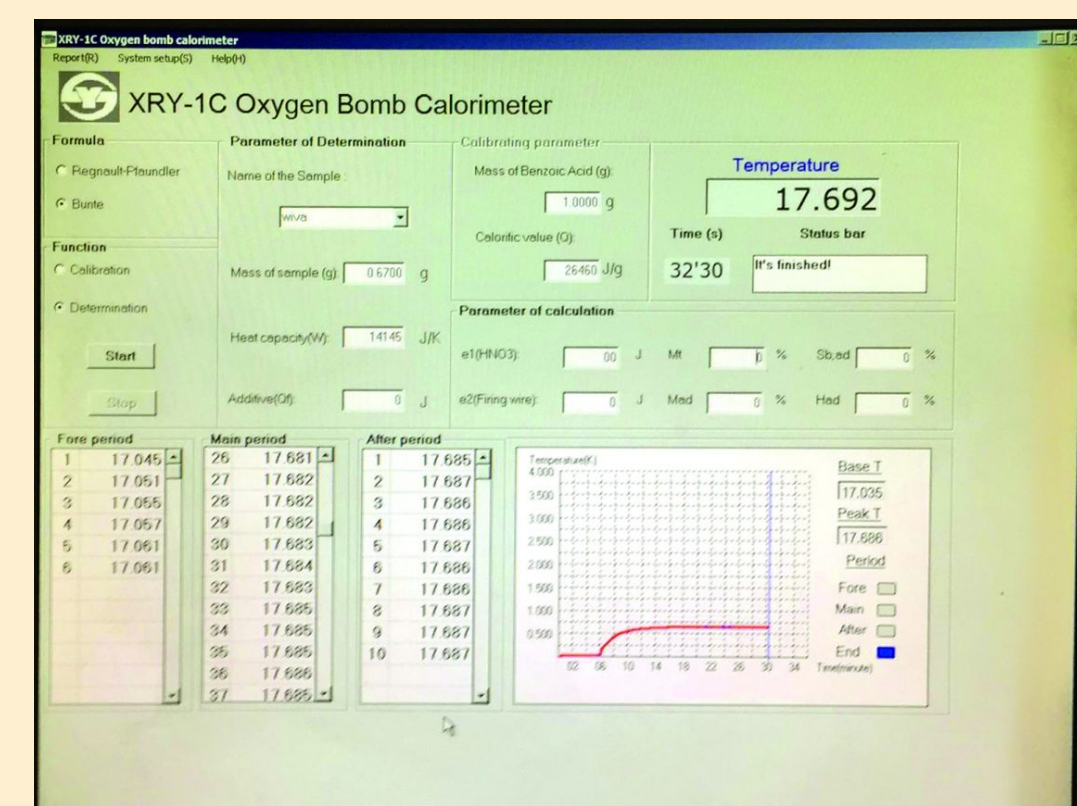


We prepared a double wall fireplace out of cans to maximally avoid the loss of energy; At the expense of the energy discharged as a result of burning the cow dung the water is heated. We get the necessary indications and with the help of heat balance equation we calculated the boiling heat of cow dung.

Test No	Fuel mass, m, kg	Container mass m <sub>1</sub> , kg	Water mass m <sub>2</sub> , kg	Container c <sub>1</sub> , j/kg°C	Water c <sub>2</sub> , j/kg°C	Initial temp., t <sub>1</sub> °C	Final temp., t <sub>2</sub> °C	Δt	$q = \frac{c_1 m_1 + c_2 m_2}{m} \Delta t$
1									
2									

**In the scientific laboratory:** A specific weight of our sample (sheep manure) combustion is equaled to 12 812 J /g. Also, we have measured the heat capability of various alternative fuel samples combustion:

Plum-stone – 21700      Nut shell – 19724  
Beech – 17932         Hornbeam – 17631

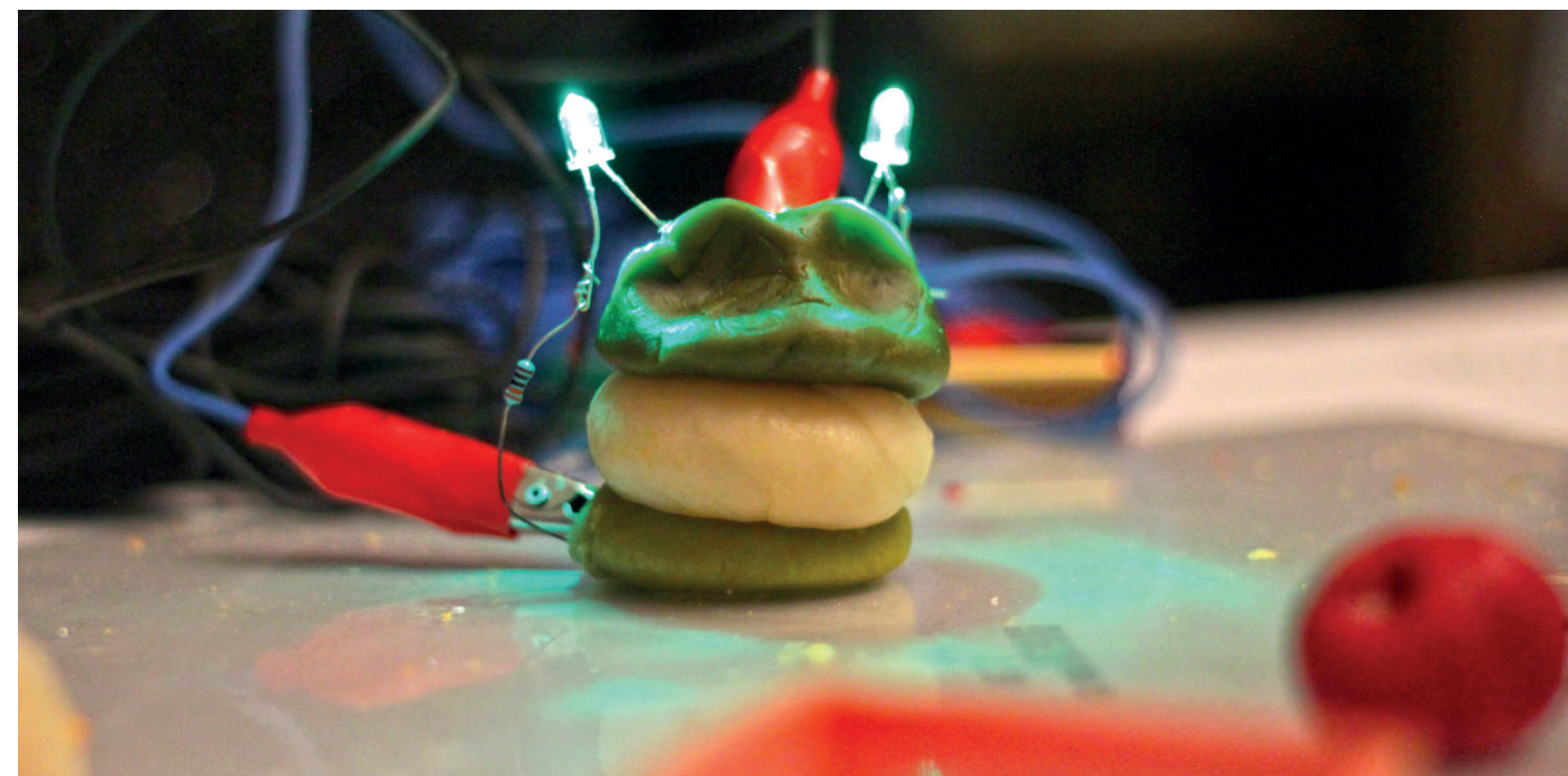




# Low-Cost and Recycled Science

Buckwood International School – Tbilisi  
156 Rustaveli street, Tskneti, Tbilisi, Georgia 0181  
Keti Tatishvili – Teacher of Physics

## DOUGH for electrical circuits



### Conductive dough

**Required ingredients:** 1½ cup of flour; 1 glass of water; ¼ cup of salt; 9 tablespoon of lemon juice; tablespoon vegetable oil; the dye of the desired color for food.

### Nonconductive dough

**Required ingredients:** 1½ cup flour; 1/2 cup of sugar; 3 tablespoon vegetable oil; ½ cups distilled water; **Advice:** Do not mix the dye with nonconductive dough to easily distinguish the nonconductive dough from the conductive (colored) one.

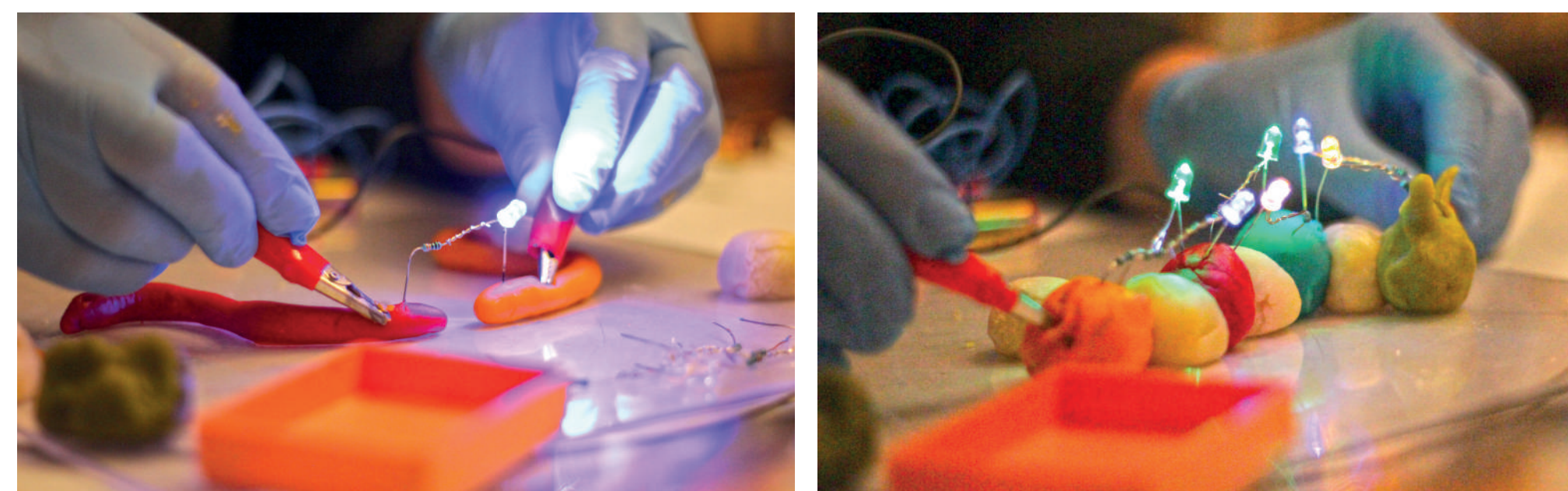
**Inquiry 1.** In which case does the lamp light up?

**Inquiry 2.** What will happen if we do not separate the conductive doughs with air-gap or with nonconductive dough?



**Inquiry 3.** How does the lamp light depend on the conductor's length?

**Inquiry 4.** How does lamp light depend on the conductor's thickness?



**Inquiry 5.** How does lamp lighting change if you switch it on with the other lamps in sequence in the circuit? What will happen if one lamp "burns"?

**Inquiry 6.** How does lighting lamp change if you switch it on with other lamps in parallel? What will happen if one lamp "burns"?



The activity is very useful in cognitive terms, promotes inquiry based learning: Physical content of electric phenomena and qualitative attitudes of electrical power on different parameters are demonstrative for early age students. The "dough" used in the activity is made of edible ingredients and is safe for children's health.



## Bore-hole Making Machine "Woodpecker-1"

The main idea of the project is arranging borehole in the school yard based on cheap technologies by using the golden rule of mechanics and after that creating the mechanism-borehole making machine "Woodpecker-1" which will work by using electricity.

### Project aims

- ✓ Encourage raising motivation for learning physics
- ✓ Facilitate development of students inquiry skills
- ✓ Encourage students to focus on solving practical task using different type of leverage

### Project tasks

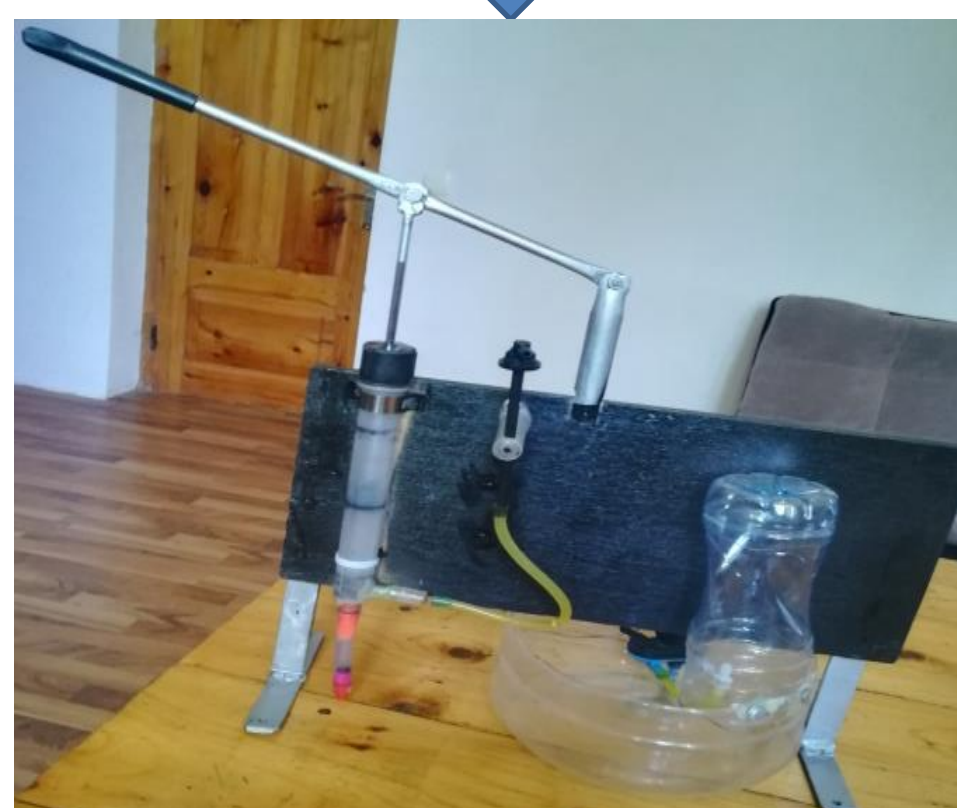
To illustrate the golden rule of mechanics students prepare a simple mechanism - leverage, conduct classroom experiments, write equilibrium equations, calculate the ratio between physical quantities:  $M_1 = M_2$   $F_1 / F_2 = L_2 / L_1$ , and on the base of it they create the technical instructions of a well-arranged borehole. After that, they follow these instructions and make leverage as well as the loading burden for the water pipe.



Finding appropriate resources for making the bore-hole and fixing a water pipe into the depth of the ground by operating leverage based heavy burden.

Creating water pumping mechanical vacuum pump (tap) and a model of electro engine based fan-tan with according to which the bore-hole will be equipped with a water intake mechanism and also, the installation work will be done.

Development of the project that aims to use electric energy instead of human physical energy for drilling wells: creation of a model of electric motor based "bore-hole drilling machine Kodala-1".



### Expected Results

Within the framework of the project, students will develop new knowledge and get a better and more efficient experience that will reflect in the ability of making analysis of problematic situation, will develop problems solving skills and decision making.

Vaja Tetunashvili  
Gori, Georgia.



Matthias Franke | Bettina-von-Arnim-School | Berlin | Germany

## Development, manufacturing and testing of musical instruments

### An interdisciplinary project

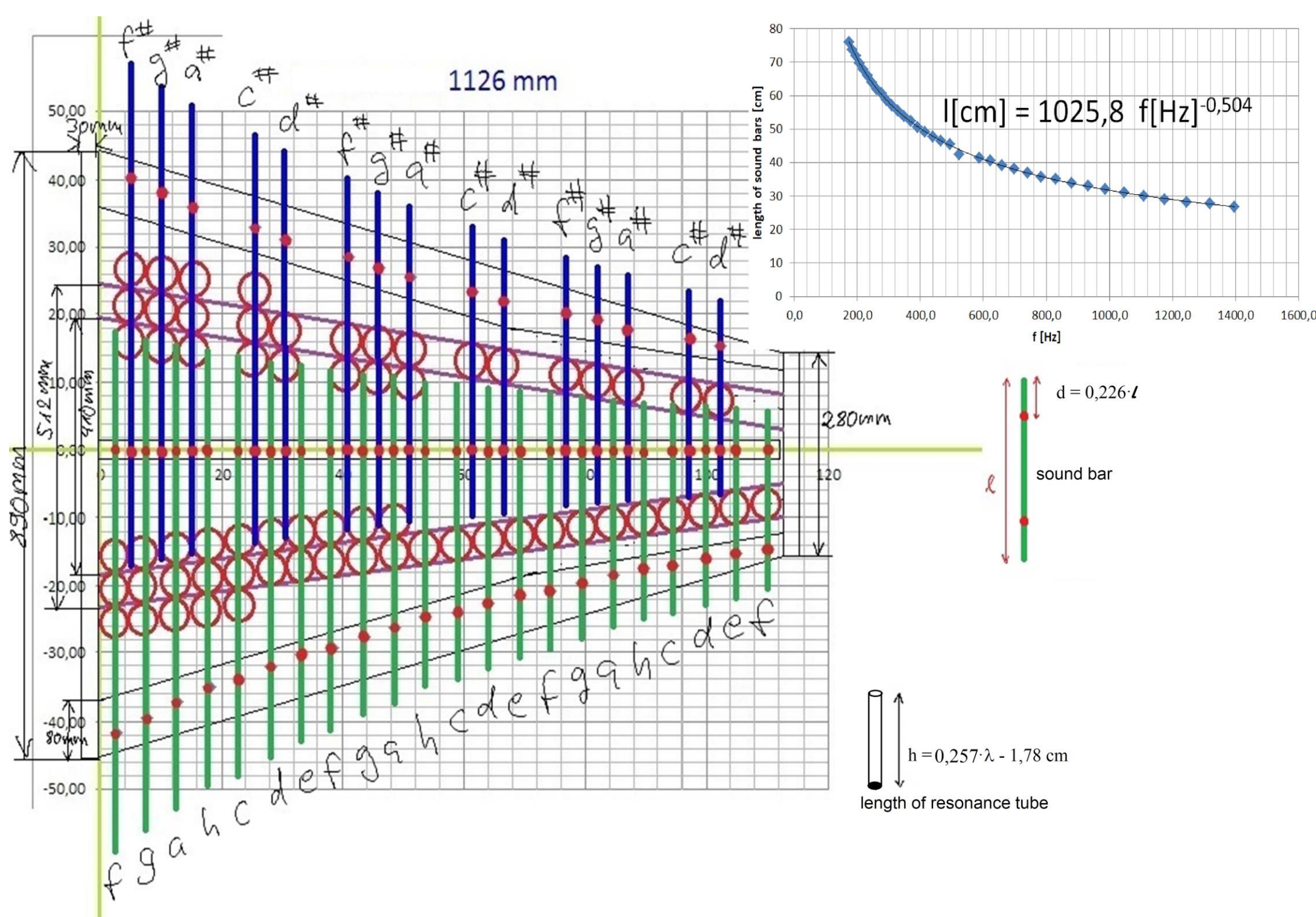
In the 2018/19 school year, 10<sup>th</sup> graders built a metallophone in physics lessons. The materials that were available in the DIY store were the starting point.

The project was carried out on an interdisciplinary basis; in addition to the craftsmanship, the physical process of generating the sounds was also analyzed.

Finally, the instruments were used in the school orchestra at the school festival at the end of the school year in June 2019.



Illus.: Work process and the physics class

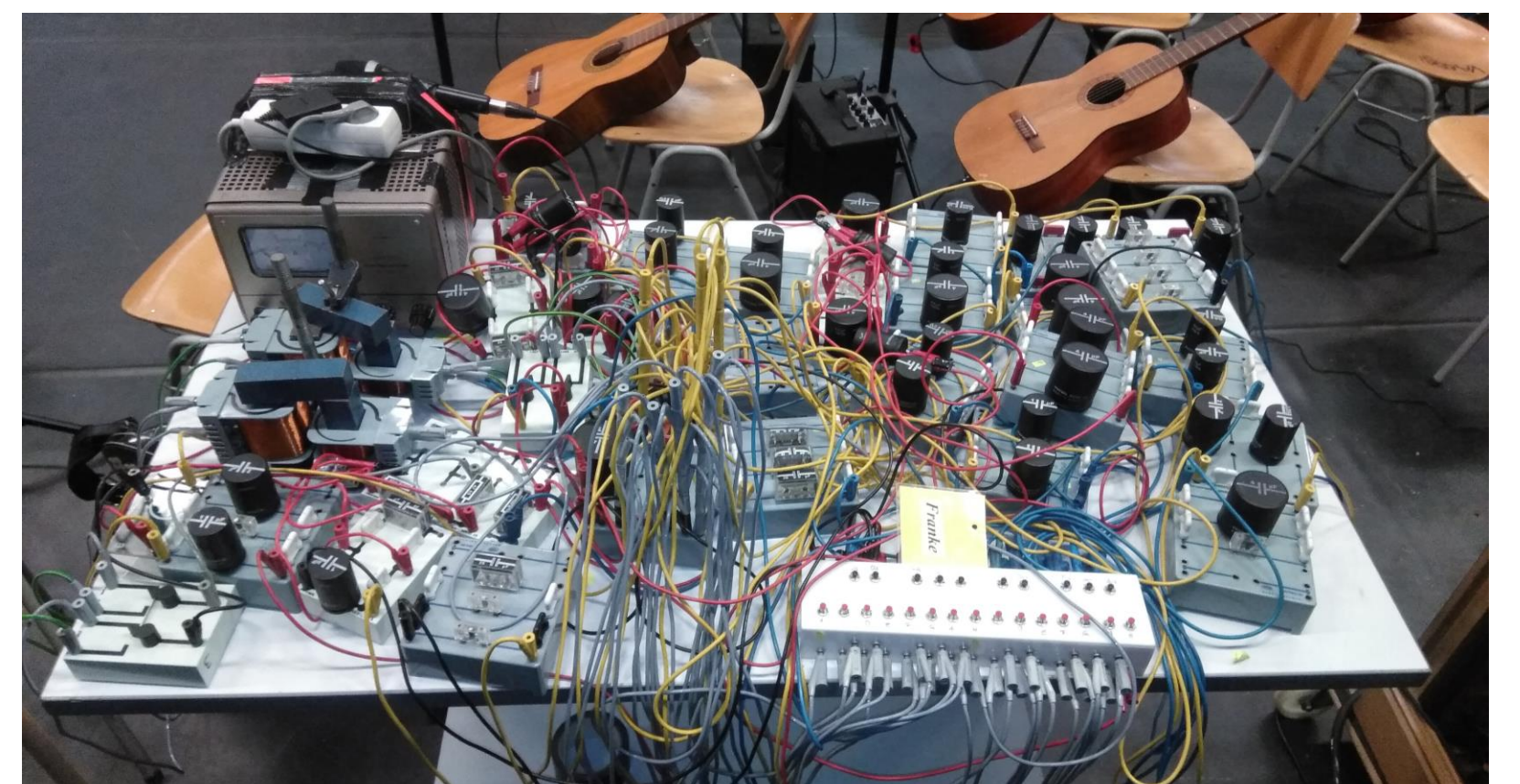


Illus.: Planning sketch and mathematical-physical calculations



Illus.: Use of the metallophone in the school orchestra

In a second and a third project students made guitars and a synthesizer.





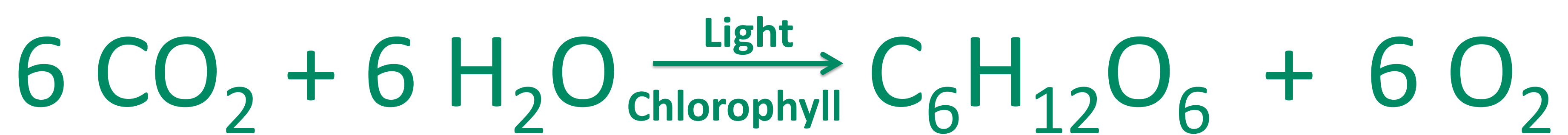
Ulrike Hölting - Gymnasium Mariengarden - Borken-Burlo - Germany

## It's a green world!

The air that I breathe



The ivy lift



Teatime



On the foot-steps of Joseph Priestley

Four fantastic photosynthesis experiments

Four low-cost experiments, suitable for all ages, which demonstrate the main aspects of “the dream formula of life”.



Franziska Langer and Laura Schmandt | Burggymnasium Friedberg, Germany

## How Tomatoes Conquer Biology Lessons

### Biology

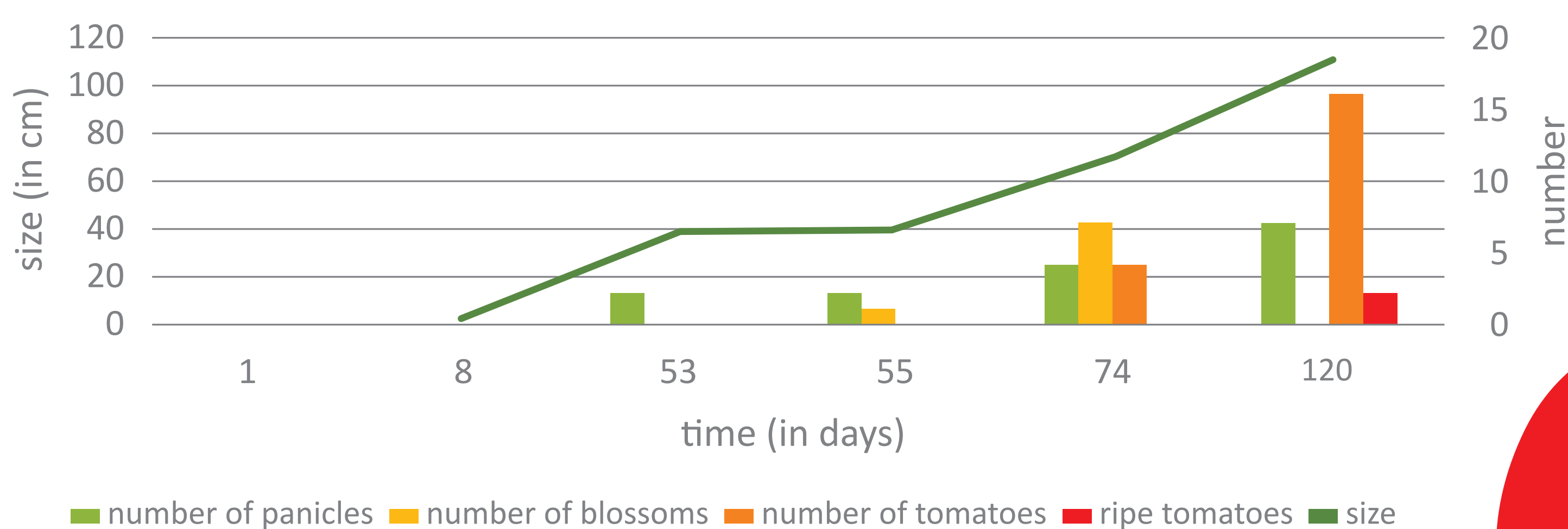
Tomatoes are indispensable groceries for us: we eat Bolognese sauce with noodles, use ketchup for our French fries or add them to salads. When going to the supermarket we can find an assumed large selection of red tomatoes, mainly imported from countries such as Spain. But where does the tomato originally come from? What does a tomato plant need for growing and how many different breeds can be found worldwide? Are all tomatoes red?

#### Process of our tomato-project

- 🍅 Q2: ecological and metabolic-physiological coherence (curriculum)
- 🍅 beginning of February
- 🍅 every student gets his / her own breed
- 🍅 six months of documentation
- 🍅 long-term report
- 🍅 assessment: 50 % of the oral mark



#### Oxheart Pink



**Reasons** 🍅 cheap 🍅 multi-layered  
 🍅 student-orientated 🍅 uncomplicated and easy to care

**Challenges** 🍅 purity of variety 🍅 summer holidays  
 🍅 coherent documentation 🍅 weather conditions

"I will definitely plant herbs and vegetables myself. I have never done it before but it was a lot of fun."

"I had much fun and it was a pleasant alternative in addition to the mostly theoretic and abstract lessons."