Low-cost Science

SCIENCE ON STAGE 2017 DEBRECEN
THE EUROPEAN NETWORK FOR SCIENCE TEACHERS

Enda Carr| St. Mary's Secondary School| Dublin| Ireland

Zippie Chemistry

This work is directed towards enhancing student understanding of what it means to be a chemist in the laboratory in terms of, working safely with materials, displaying the dexterous capacity to carry out a laboratory investigation , working in a group, recording results, presenting results and interpreting the same results to develop a hypothesis. A 'hands-on', 'minds-on' inquiry based learning approach with second level students (aged 15-16 years).

Liquid	Powder 1	Powder 2	Observations
1	C	B	liquid went white.
3	D	A	Bubbly, gasie + foamy + Co
5	E	A	Milky colour cold
2	D	B	Green Super Cold
6	E	B	Purple' Liquid

Liquid	Powder 1	Powder 2	Observations
2	E	A	light green milky liquid
3	C	D	liquid was not + milky looking.
5	B	A	liquid was cold + very watery
1	C	E	liquid was warm - no colour change
4	B	D	liquid was cold no colour change
3	B	D	Colour went green + cold
1	B	D	Pink to blue + cold

Students were free to select from available combinations of household chemicals, mix and match them in zip-loc bags and observe the results. The materials used included six powders labeled A→ F and six liquids labeled I → VI. An instruction sheet was provided to each individual student to facilitate data recording. Eight different tests with randomly chosen sets of chemicals were undertaken. Finally, students were required to make inferences as to what powders or liquids are most likely to cause a certain type of chemical change.

Students enjoyed the opportunity to be a real chemist and take ownership of their work – as evidenced by students recalling accurate details of the investigation some weeks later.

Science on Stage Ireland has been made possible by the coordination and support of:

CASTeL Centre for the Advancement of STEM Teaching and Learning
DCU
IOP Institute of Physics In Ireland
Science Foundation Ireland sfi For what's next

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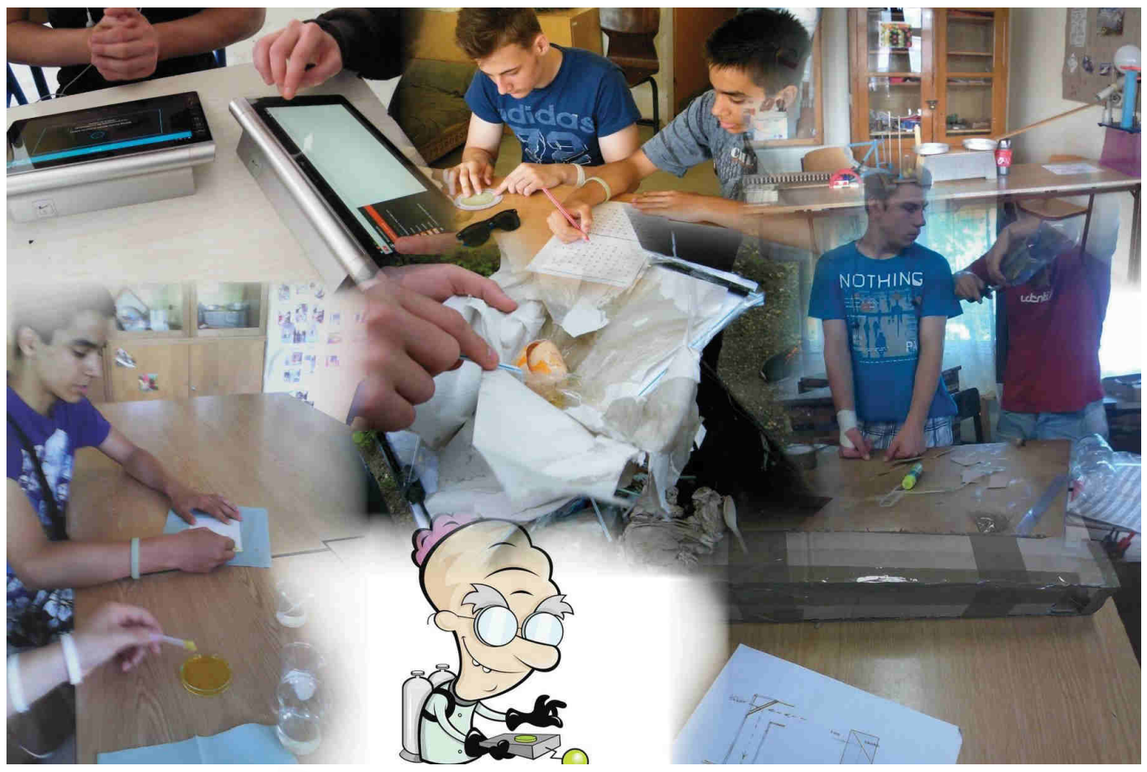
Erika Nemes-Nagy| Vocational Centre of Szeged Attila József Primary and Vocational School| Szeged| Hungary

The missing scientist

During the project, the students were looking for a missing scientist Professor Brain and they had to cope with many challenges and scientific tasks. Our main hero did science experiments and the students had to repeat his attemps. When they solve challenge, they given a code or a clue. These all helped the students to find the missing scientist. 12 classes and 42 teachers and supporting teaching staff participated in this theme week.



The project playfully involved students in the learning process with elements such as experimentation, problem solving. With the help of the integrated teaching, students with special needs (autism, ADHD) have successfully completed the project tasks, too.

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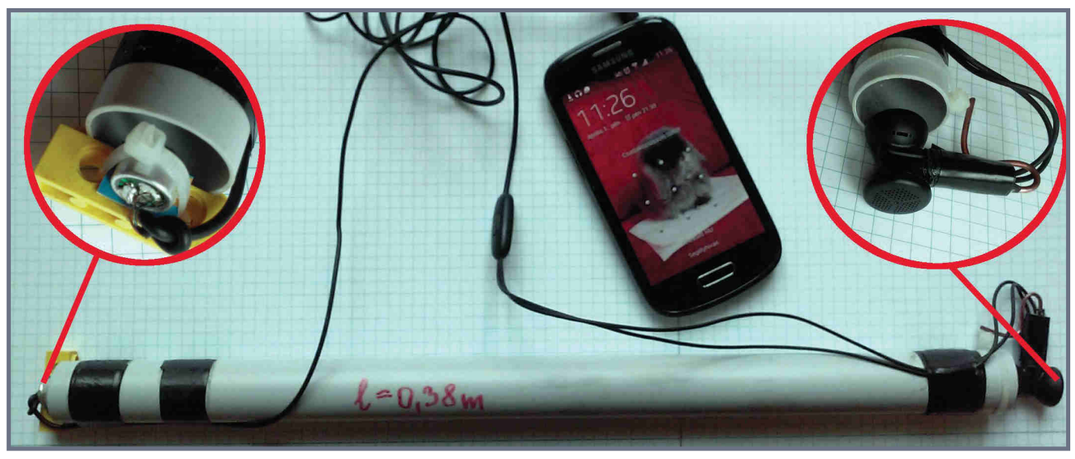
Fanni Vitkóczi | ELTE Trefort Ágoston Practice Grammar| Budapest| Hungary

Interference in the world of sounds

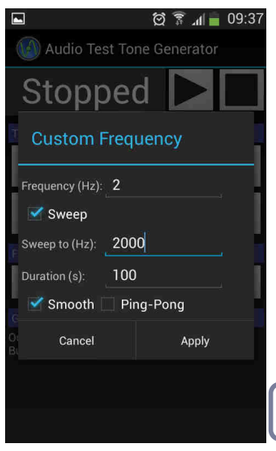
Measuring the speed of sound in a tube with smartphone

Measurement tools: *A plastic tube, a headset and a smartphone*

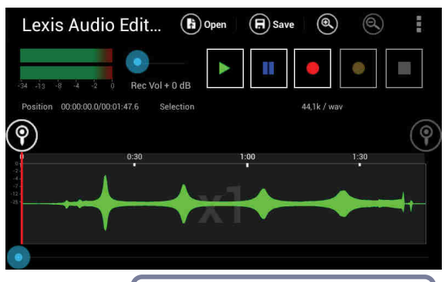


Sound generated by the smartphone with a rising frequency passes through the tube. The signal of the microphone is also recorded using the phone.
Studying the recorded file, the change in the amplitude can be observed both visually and is also audibly (see below).

Generating and recording sounds using a smartphone



Audio Test Tone Generator

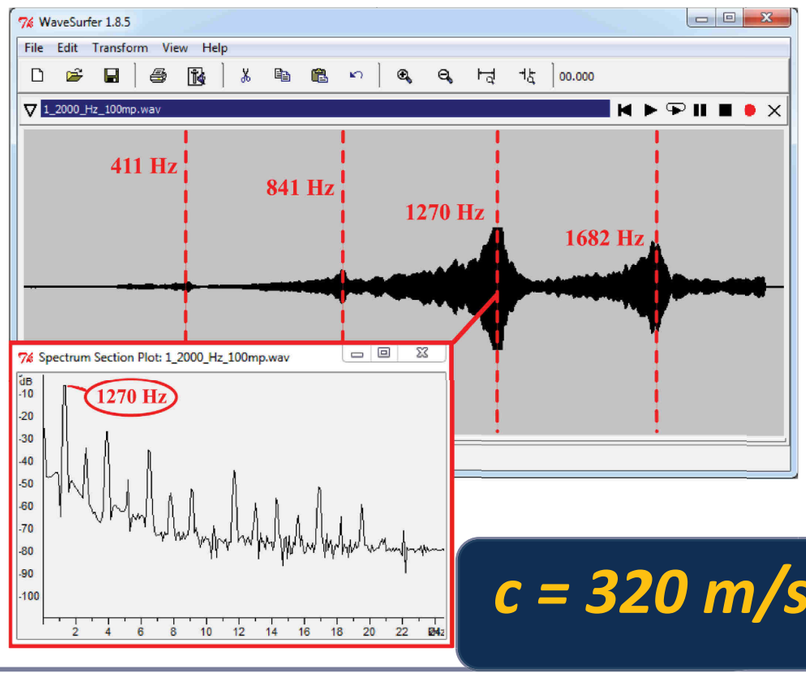


Lexis Audio Editor

Evaluation

An FFT analysis can provide more accurate results. The free program *WaveSurfer* can be used for such a purpose.

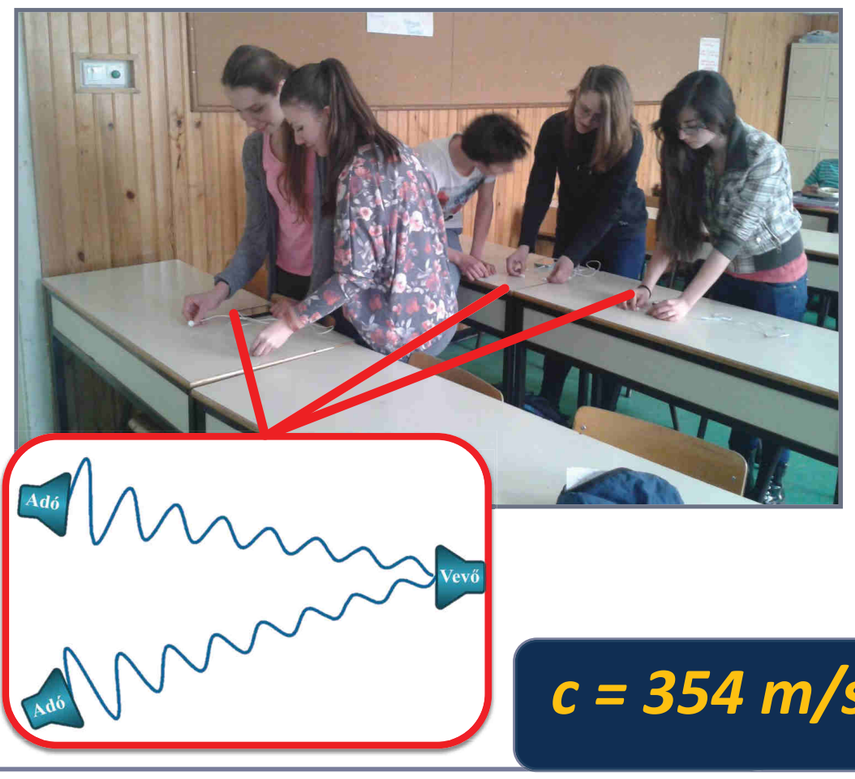
WaveSurfer



c = 320 m/s

Measuring the speed of sound using interference

A headset was connected to the smartphone, with one of the earphones and the microphone fixed at the same place. A sound signal of constant frequency was generated using the app *Audio Test Tone Generator*. Then, the other earphone was moved slowly towards the fixed one and the microphone. The half-wavelength of the sound could be determined using the distance of the adjacent positions of the maximal amplifications and attenuations. Knowing the frequency and the wavelength, the speed of sound could be calculated.



c = 354 m/s

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Dr. Zsuzsanna Farkas PhD and Eszter Kiss
University of Szeged, Juhász Gyula Faculty of Education,
Department of General and Environmental Physics
Szeged, Hungary

Pocket experiments

You don’t have a well-equipped science laboratory?

You don’t even have a science laboratory?

No time to prepare for physics experiments?

As a beginner teacher you feel uncomfortable carrying out complex experiments?

In our project, we collected *simple*, *low-cost* and *moveable* experiments, that you can even put into teachers working dress’s pocket, so you can show these experiments quickly, without any extra preparation.

Roll the dices!
Try our experiments!

100% Great!

Let’s change students’ attitude towards physics through this innovative way!

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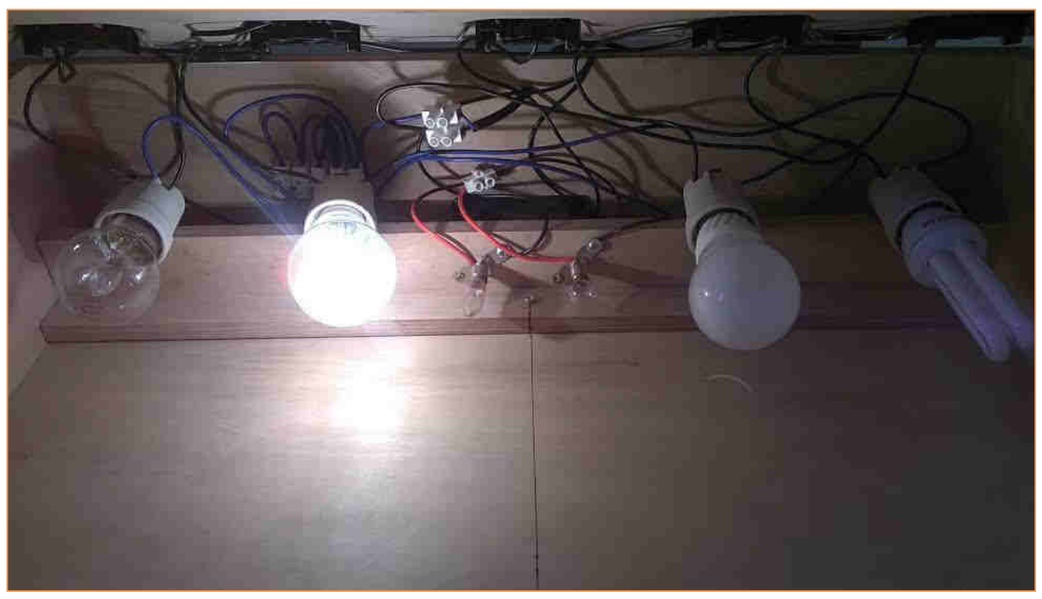
Zsanett Finta| Szombathelyi Nagy Lajos Gimnázium | Szombathely | Hungary

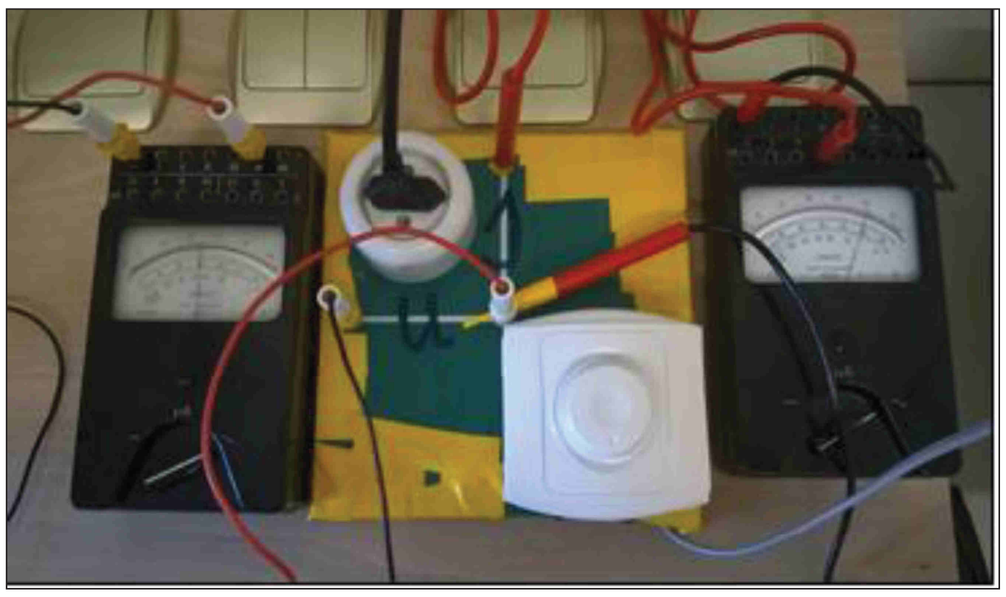
Exploring light with smartphone

Smart phones include a number of well-known sensors. During the studies of the different type of waves we were started dealing with the light. The experimental device was a home-made wooden box, which was made by one of the students. In the large size box four different light sources were located with their own switch.



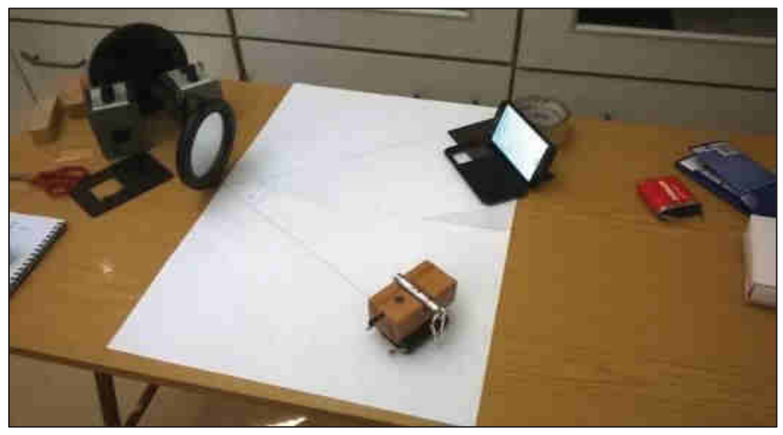
The first step we were watching the value of illumination in the case of these different light sources. These results were compared with the once that we got with a classic method, the Bunsen photometer, and we got nearly similar data.

We wondered how the value of the illumination depended on the power of the light source. For this purpose, we had put together a simple circuit with a potentiometer, an voltmeter and ammeter.



In addition we were able to examine the light-transmission by the glass. After performing the measurements we were able to determine the transmittance of the glass. We calculated with the formula of *Fresnel reflection* the reflectivity and the result was compared with our measured data.

ADDITIONAIL EXPERIMENTS FROM OPTIC THEME



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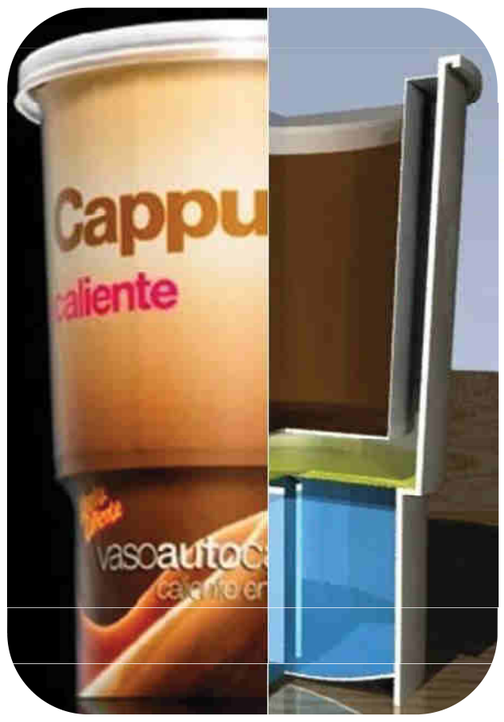
Gabriel Pinto | Group of Didactics of Physics and Chemistry (RSEF / RSEQ) | Madrid| Spain

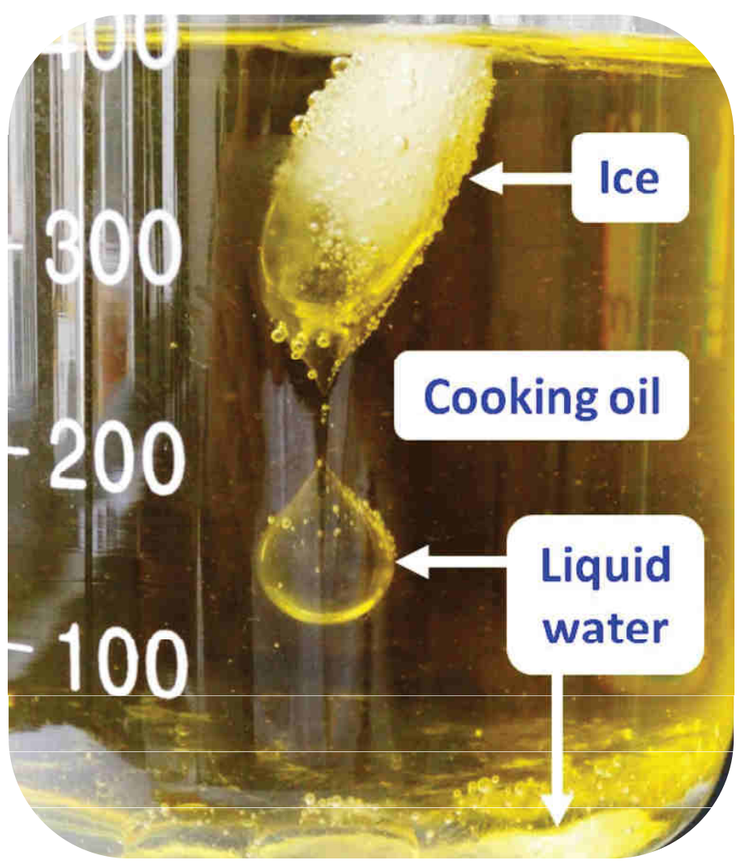
Engaging students with STEM learning through a magical substance: the water!

Contextualized experiments and inquiries to investigate STEM topics are proposed.

Questions to be solved:

- Where would an ice cube melt faster, in pure water or in saline water?
- The *botijo* (Spanish water cooling pitcher), the African *pot-in-pot* refrigerator, and the *drinking bird* toy, have something in common?
- What happens when ethanol, oil or other liquid is added onto an ice cube?
- Can be the osmotic hydration rate of beans easily measured? Does it change with temperature?
- What happens when a drop of water is poured into hot oil? Why?
- How does artificial snow work?
- And self-heating drinks?





- All experiments are very easy to carry out but they show very clearly how STEM are involved in daily life.
- Topics include physicochemical properties (density, miscibility, heat capacity, boiling point, refractive index...), chemical reactions, evaporative cooling, etc.

Water is present in all cases, and through these experiences, we learn about other interesting facts as **ocean thermohaline currents**, or applications as the use of **condensing boilers**.

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Anne de Groot & Joris Koot | Segbroek College | Den Haag | Netherlands

Escape the Classroom

How to lock up your students

What would it be like to be locked up by your crazy teacher? The only way to escape is by using all your knowledge and skills. You've got one hour and the clock is ticking…

During an Escape the Classroom lesson students have to solve a series of challenging puzzles in order to break out of the room or open a box.

As a teacher you can develop a complete room or use a single puzzle to motivate your students.

You are not only testing the knowledge of your students, you are also teaching them to think outside the box, communicate and to persist! Cheap to set up; use the materials you have available in school, add a few locks and boxes an play!

ESCAPE THE CLASSROOM

Have fun trying some of our puzzles! Can you beat the crazy teacher?

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János Kapitány | BMSZC Wesselényi Miklós Vocational School | Budapest | Hungary

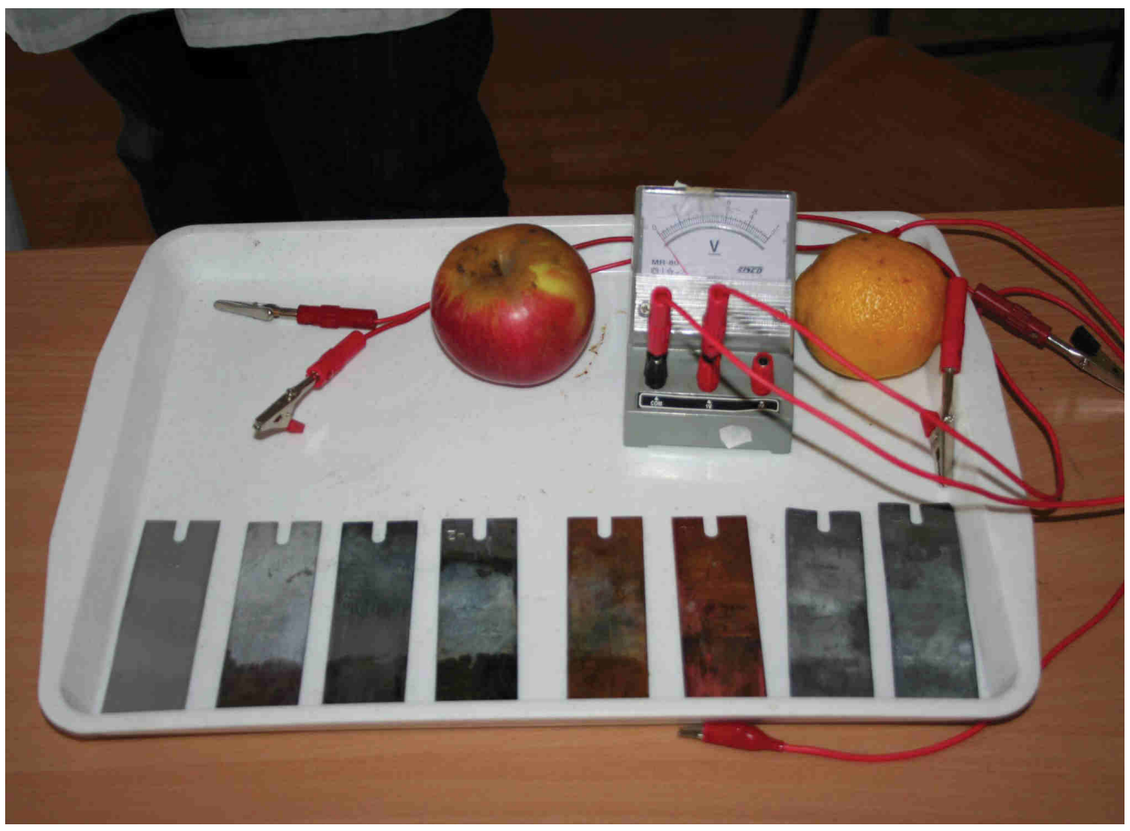
Electrochemistry in practice

What? Why? How?

We deal especially with electrochemistry.
I would like to introduce the practice oriented teaching of this topic .

Questions:

1. What is inside?
2. What's the difference?
3. Why we use that?
4. Why we need that?
5. How does it work?
6. How to make it?
7. How to use it?



I hope you'll like my interactive presentation, I try to show you practical, motivating and interesting excercises, cheap and easy to carry out experiments and tools.

100% Great!

Electrochemistry in practice

Build and measure different galvanic cells, Volta- and fruit batteries; see how batteries work, what's inside; write with electricity, etc.

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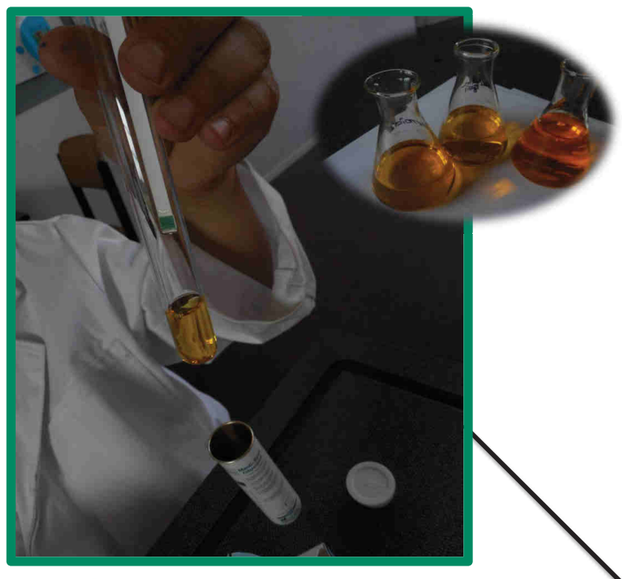
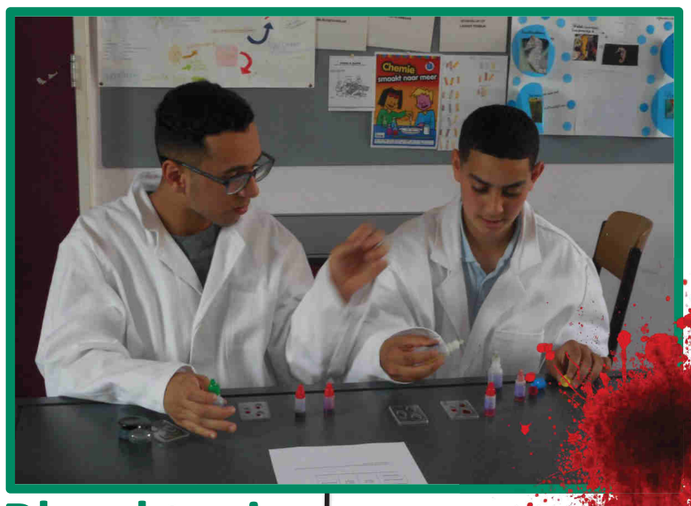
Jarka Buijs| St-Gregorius college| Utrecht| The Netherlands

Crime scene investigation in the class

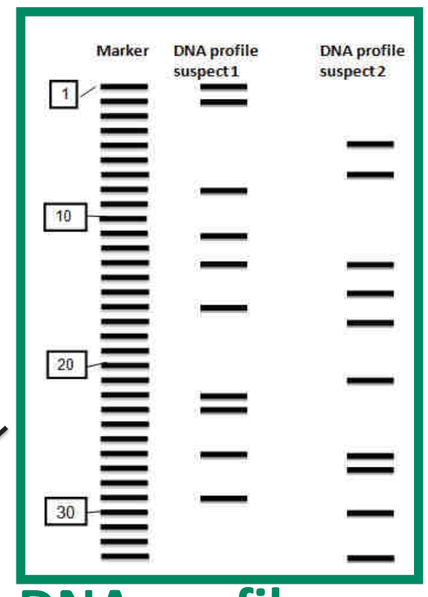
A teacher is killed… Who dit it? When? How? And Why?



Urine



Blood typing



DNA profiles

Entomology

Fingerprints

The CSI project turns students into crime scene investigators. Using their biology knowledge and skills they have to investigate the murder of one of their teachers. They will do this by investigating insects, blood, secret notes, finger prints, urine samples and more. The context and the mainly practical approach are appealing to the student. Their enthusiasm combined with their imagination will make this project successful every time!

Key features

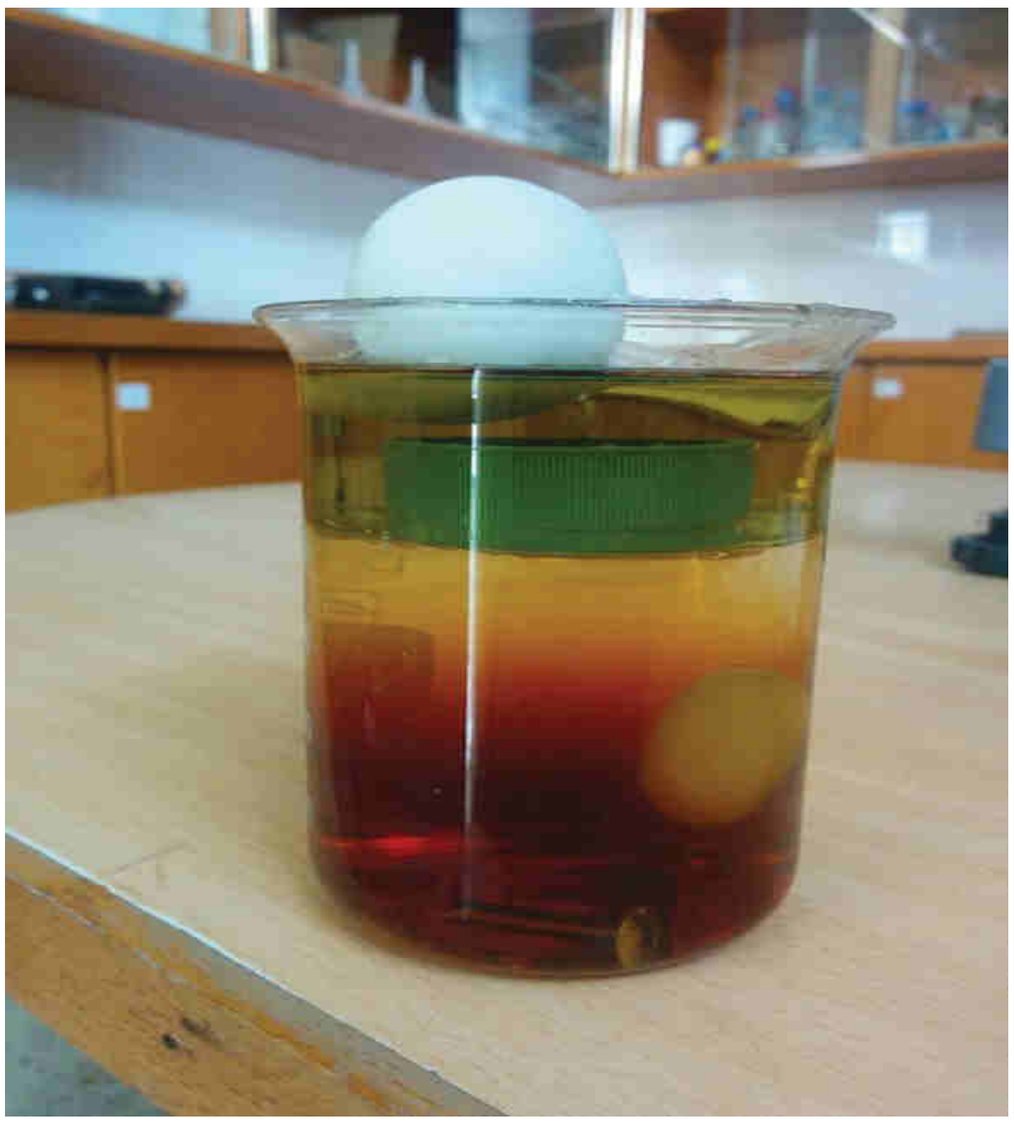
- Secondary school
- Group work
- Low cost
- Easy to adjust
- Recap of the year
- Practical approach
- Fun!

Petros Kalamidas, Makarios C΄Vocational School, Nicosia, Cyprus

Defining density

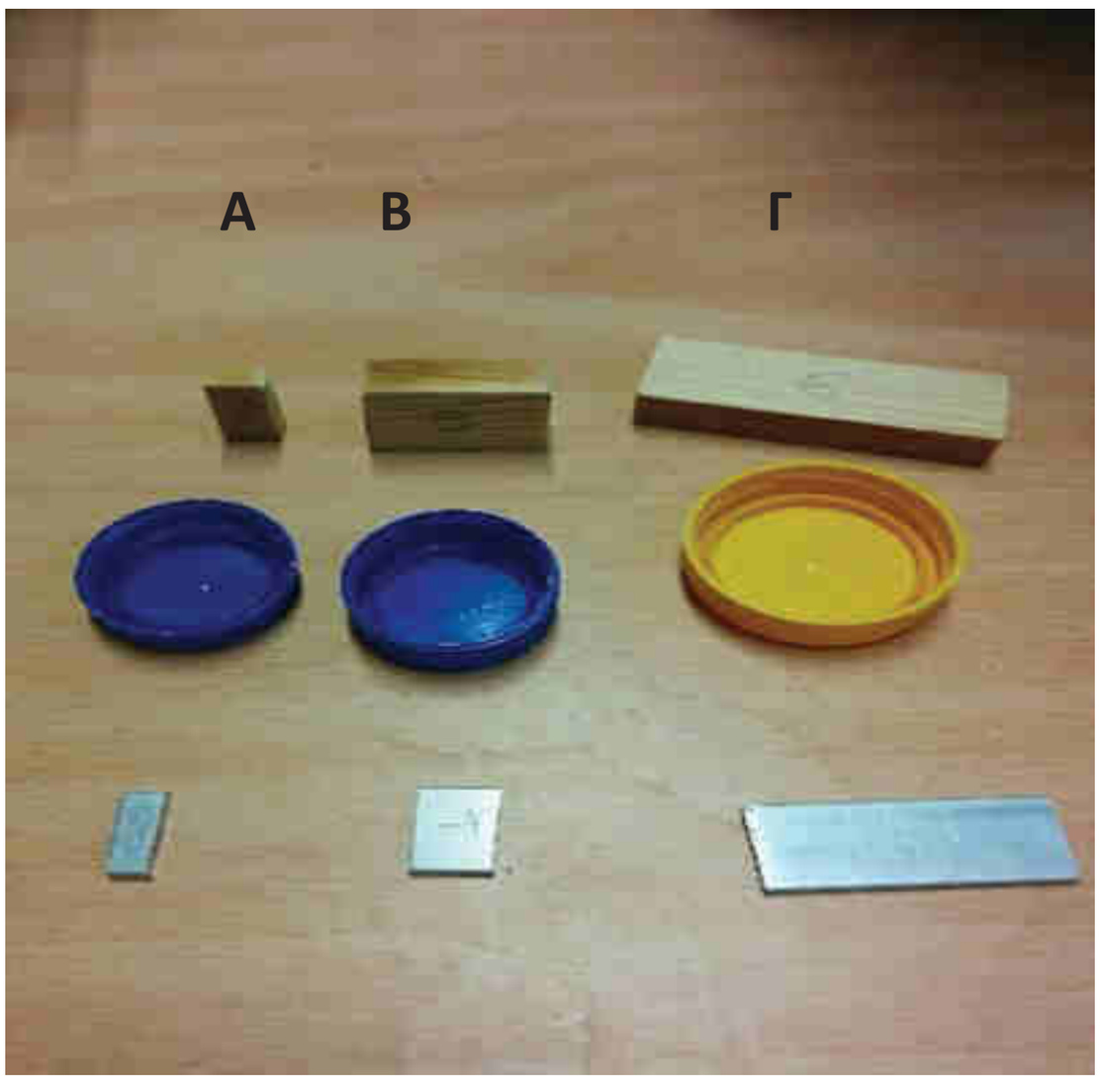
through experimentation

The equilibrium depth between liquids and solids of the following picture will lead us to define the quantity of density.



Equilibrium depth
of liquids and solids

We choose the specimens B and C so that they are integer multiples of specimen A for three different materials.



We measure the mass and volume of the three specimens A,B and C.

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Defining density

through experimentation

Specimen / Material		A (small)	B (medium)	Γ (big)	m/V
Wood	m (g)	0,6	6x0,6	16x0,6	0,7 g/cm
	V (cm3)	0,9	6x0,9	16x0,9	
Plastic	m (g)	1,2	2x1,2	4,5x1,2	0.9 g/cm
	V (cm3)	1,3	2x1,3	4,5x1,3	
Aluminum	m (g)	0,5	2x0,5	8x0,5	2,5 g/cm
	V (cm3)	0,2	2x0,2	8x0,2	

We observe the ratio = m/V is

α) <u>constant for each material</u>

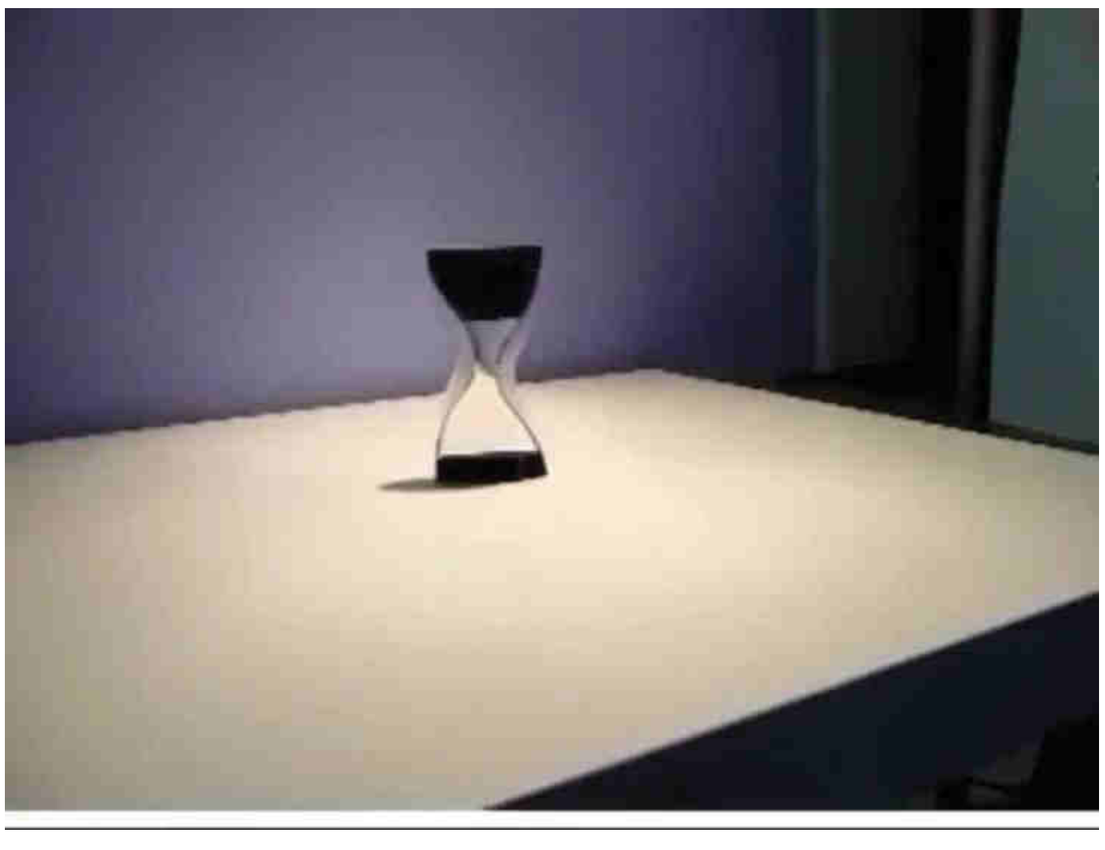
β) <u>independent of the specimen's dimension</u>

We place the specimens A, B and C of each material in oil and water.

We define the ratio m/V as the quantity of density of a material.

We observe that <u>density increases as the depth of equilibrium increases</u>.

Therefore density defines the depth of equilibrium.



Application from everyday life:
<u>Unorthodox hourglass.</u>

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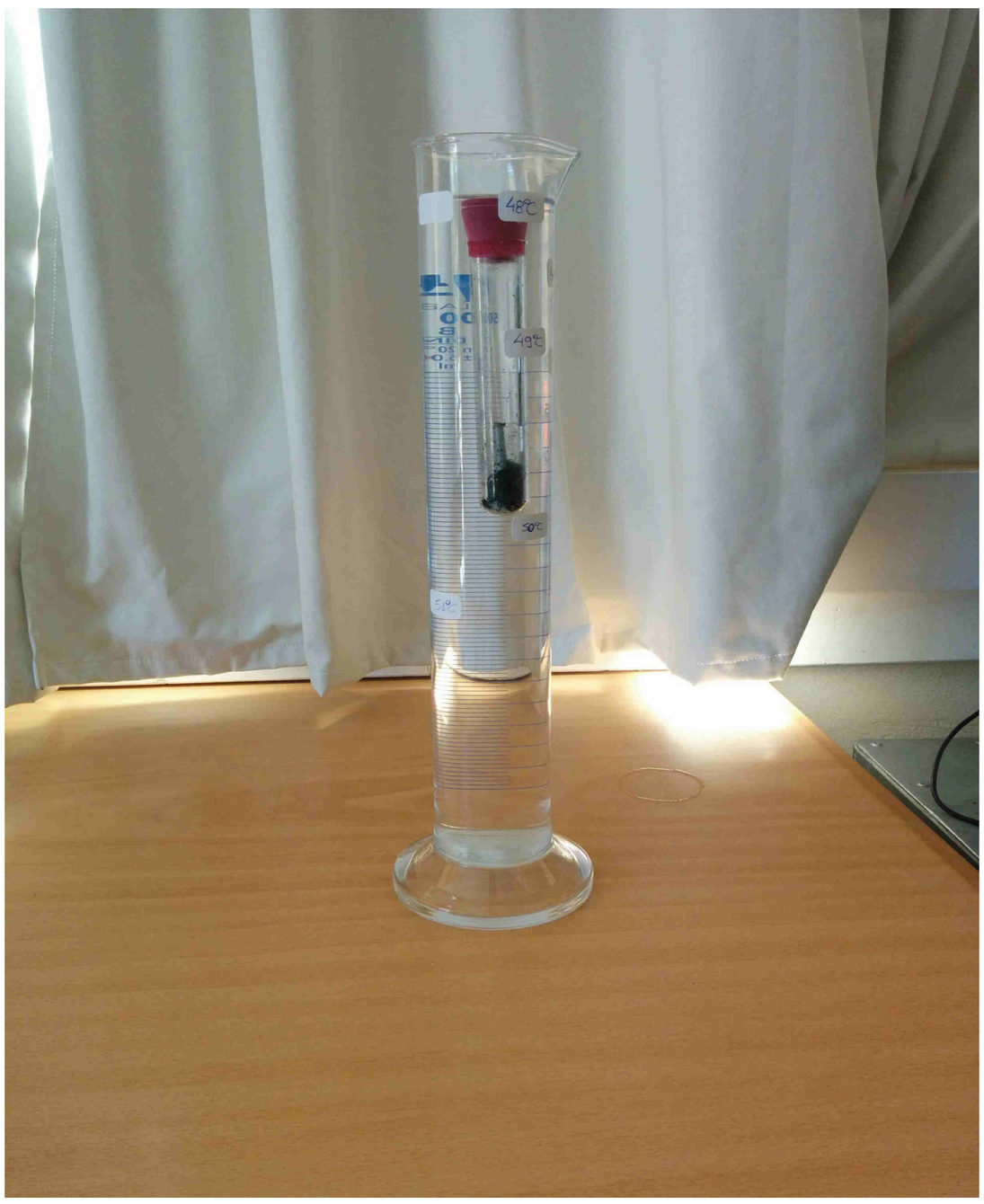
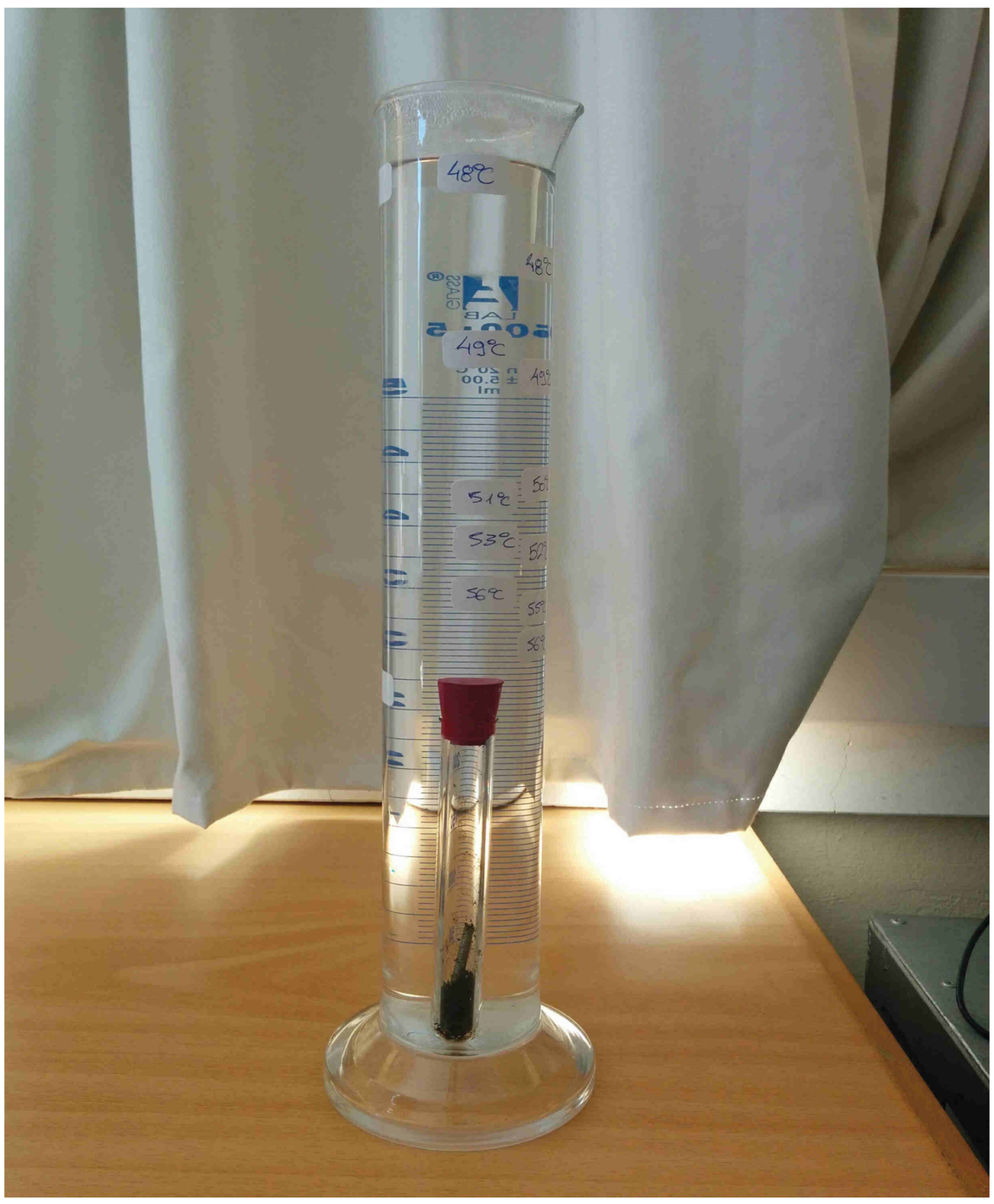
Defining density

through experimentation

A) The density of a material changes with the change of temperature.



In “cold” water
the object barely floats.



The same object in
“warm” water sinks.

Application from everyday life:
<u>Galileo’s Thermometer.</u>

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Petros Kalamidas, Makarios C΄Vocational School, Nicosia, Cyprus

Defining density

through experimentation

B) The density of an object changes
when air is introduced to it.

We use the system of tubes to insert and extract air from the object

Application in everyday life: <u>Submarines</u>

Filled with water the object sinks.

Filled with air the object floats.

100% Great!

CONCLUSION:
We define experimentally the density of a material, we discover its properties and explain everyday phenomena.