

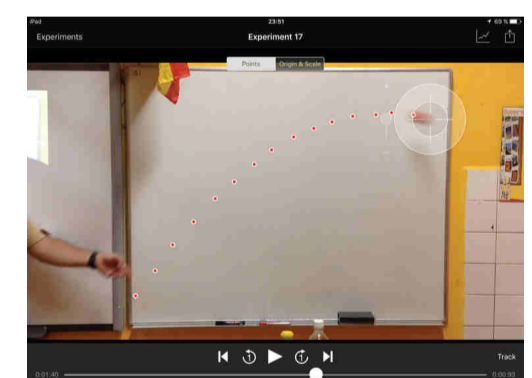
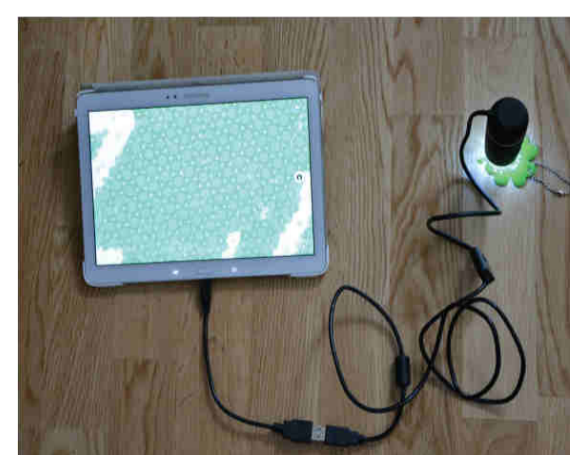
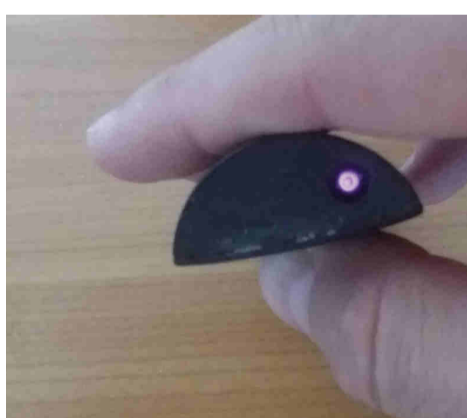
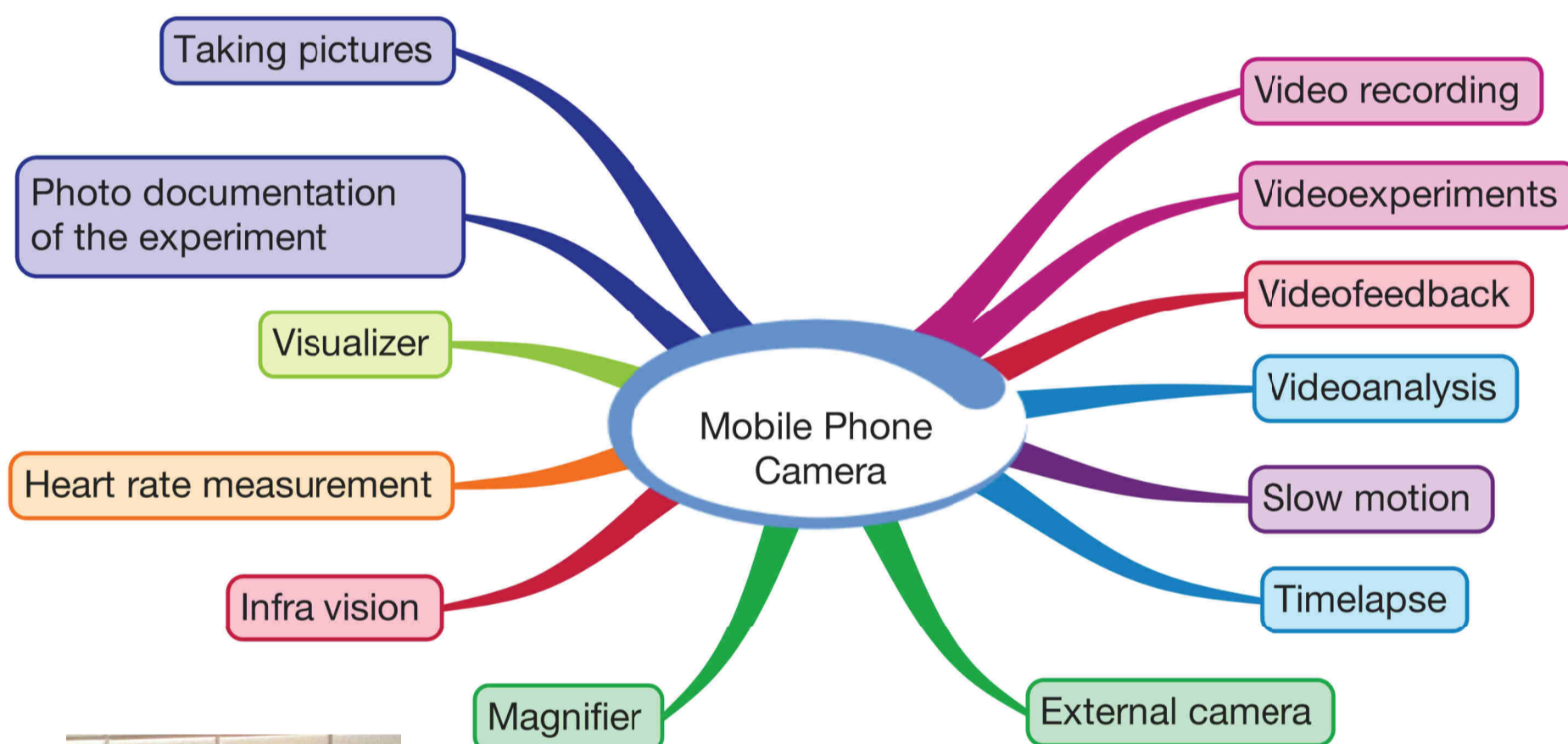
Radim Kusak | MFF UK | Prague | Czech Republic

## Physics with Camera of the mobile phone and tablet

Students usually think of mobile phone as tool for Facebook, games and calls.

But it has many usages in physics and other science field. This stand is innovative in point of view how to look to your own mobile phone and tablet.

You measure heart beat, watch water drop in slow-motion or see your own crystals growing in the time-lapse.



Conclusion: Mobile phones and tablets can be gateway to many fields in a science. It's up to you to open it!

Lucia Mišianiková<sup>1</sup>, Brigita Balogová<sup>2</sup> | <sup>1</sup>Gymnázium Poštová 9, <sup>2</sup>Faculty of Science, Pavol Jozef Šafárik University | Košice | Slovakia

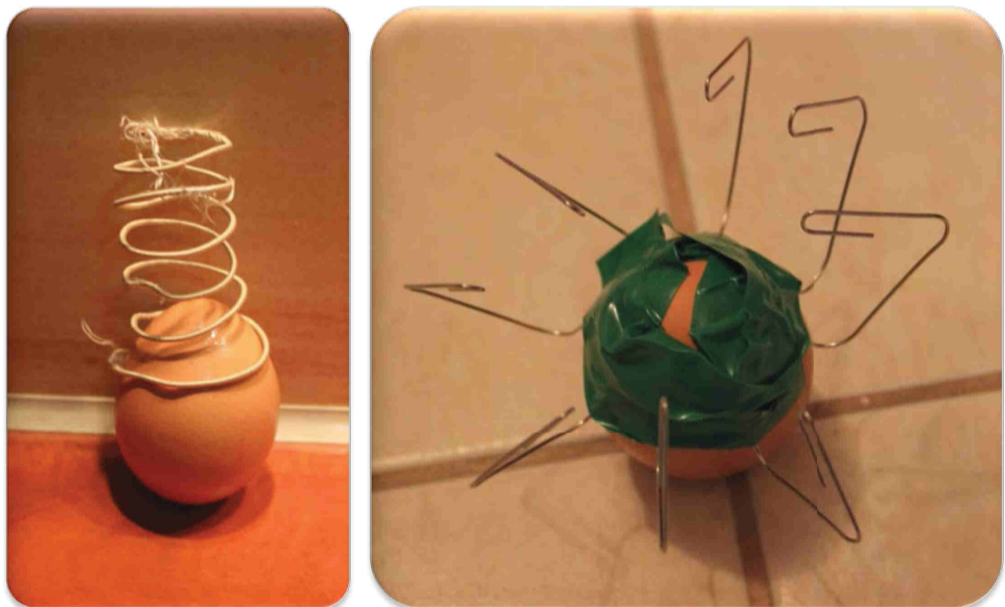
## Young scientists' research ideas

Open problems in physics education can motivate students to find their own way how to approach them. Solving problems of the Young Physicists Tournament competition (YPT) is a typical example of doing inquiry when students formulate a problem to be solved, design experiment and experimental procedure, collect, analyse and interpret data and draw reasonable conclusions. The project presents examples of strategies that students developed when solving selected YPT problems. The designed experimental procedures involve the use of digital technologies, e.g. measurements with the help of sensors, videoanalysis and tools to process and analyse data.

### Examples of problems

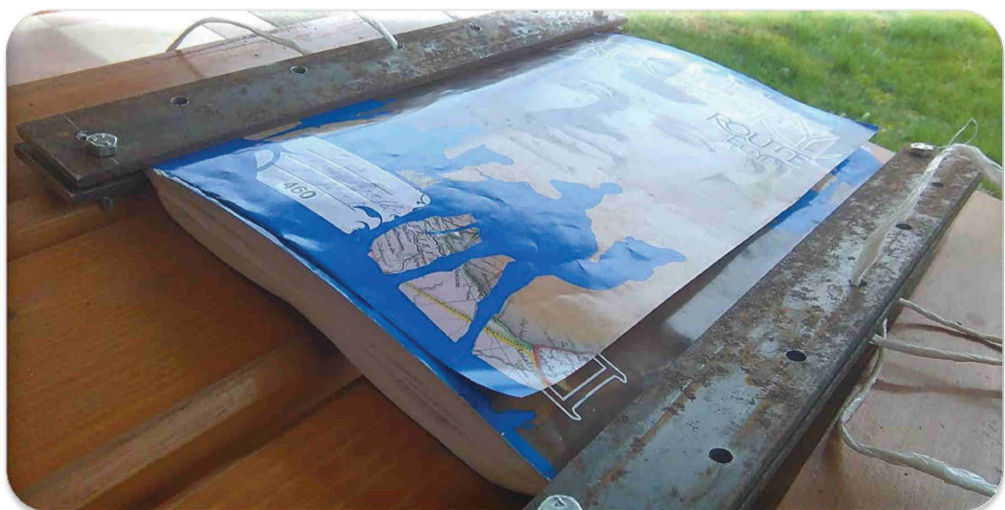
#### SAFE EGG'S FALL

How to construct a passive device that will provide safe landing for an uncooked hen's egg dropped onto a hard surface?



#### PAPER VICE

Two similar paper books interleave a few pages at a time. They are stick together.



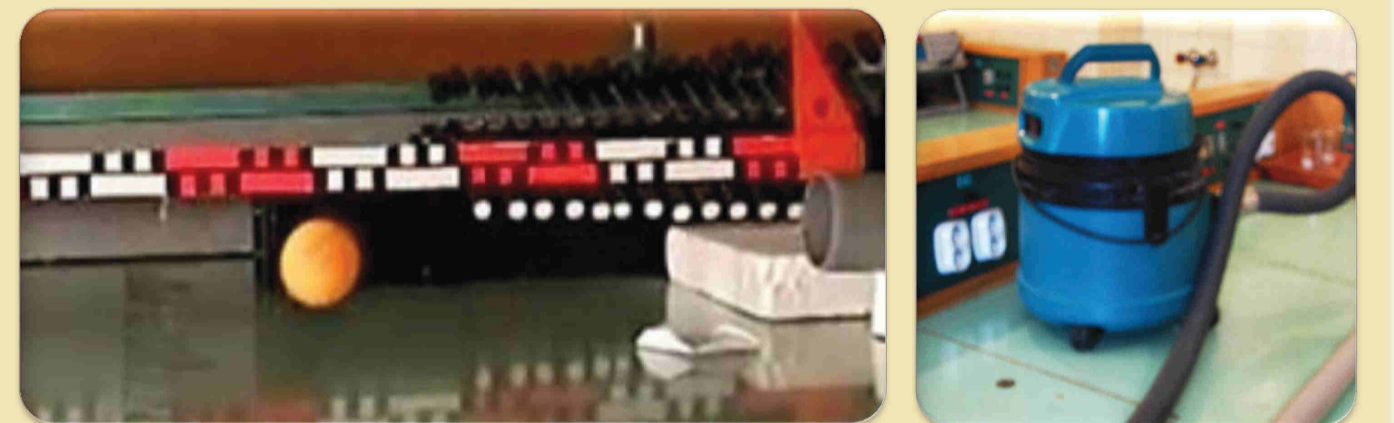
#### MAGNETIC TRAIN

Button magnets are attached to both ends of a small cylindrical battery. When placed in a copper coil such that the magnets contact the coil, this "train" starts to move.



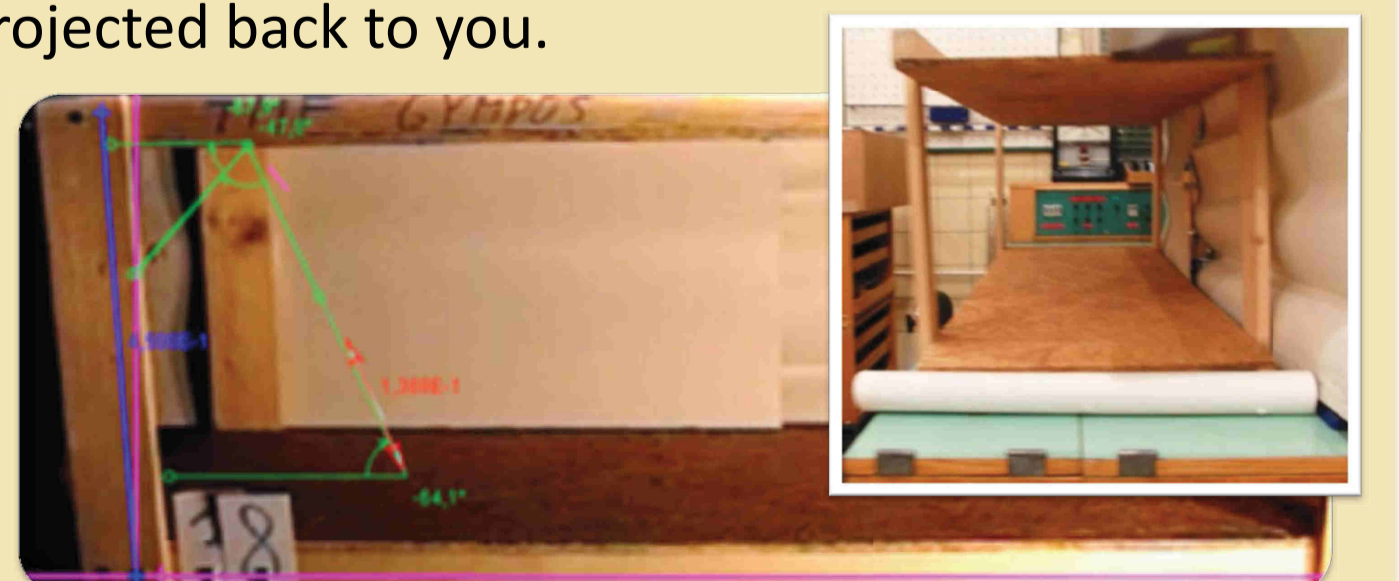
#### VACUUM BAZOOKA

A 'vacuum bazooka' can be built with a simple plastic pipe, a light projectile, and a vacuum cleaner. How to maximise the muzzle velocity?



#### SUPER BALL

Once a highly elastic ball is thrown into the space between two plates, the ball starts bouncing and under some circumstances can even be projected back to you.



#### RUBBER MOTOR

A twisted rubber band stores energy and can be used to power a model aircraft. How such an energy source power output changes with time?

Henning Vinjusveen Myhrehaugen & Magdalena Kersting  
Asker Upper Secondary School | University of Oslo | Norway

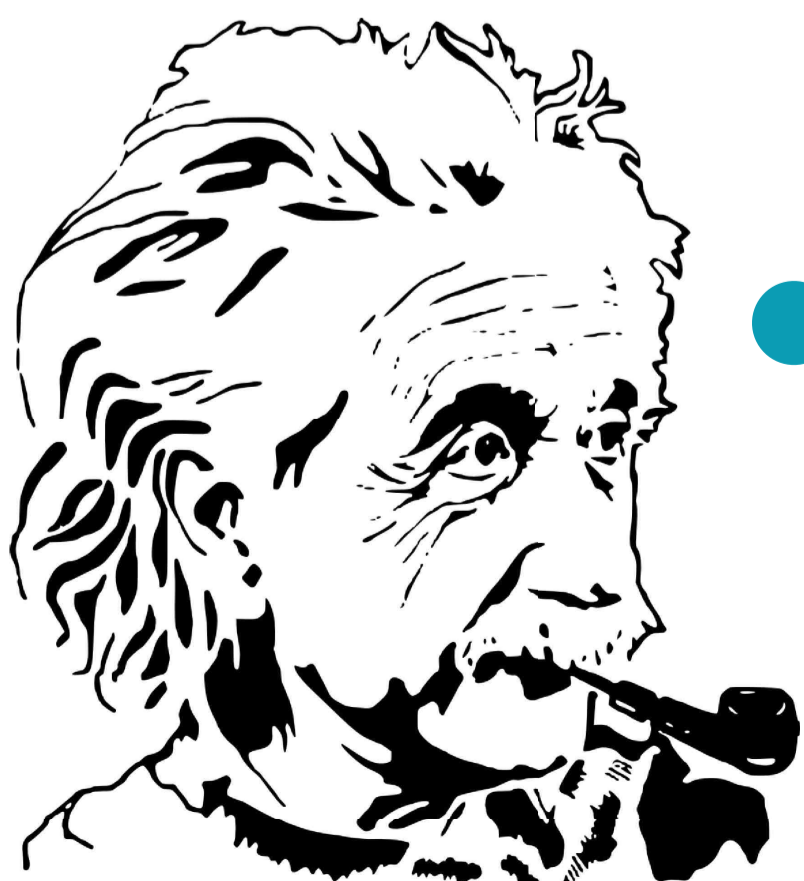
## A Relatively Modern Physics Lesson

In collaboration between science educators and teachers, we have developed a collaborative online learning environment that promotes teaching and learning of Einstein's general theory of relativity. A simple video demonstration with a falling bottle of water illustrates the "happiest thought" in Einstein's life. This thought experiment explains the principle of equivalence which is a key concept in general relativity. By working with the video demonstration that we supplement with interactive animations and illustrations, students discuss the physics of gravity from Einstein's point of view.



100%  
Great!

«I was sitting in a chair in the patent office at Bern when all of a sudden a thought occurred to me: If a person falls freely he will not feel his own weight! I was startled, as this simple thought made a deep impression on me, that impelled me to a theory of gravitation.» - A. Einstein -



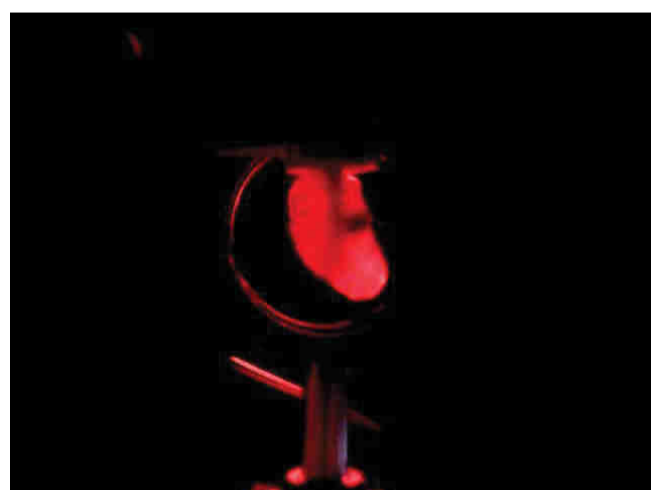
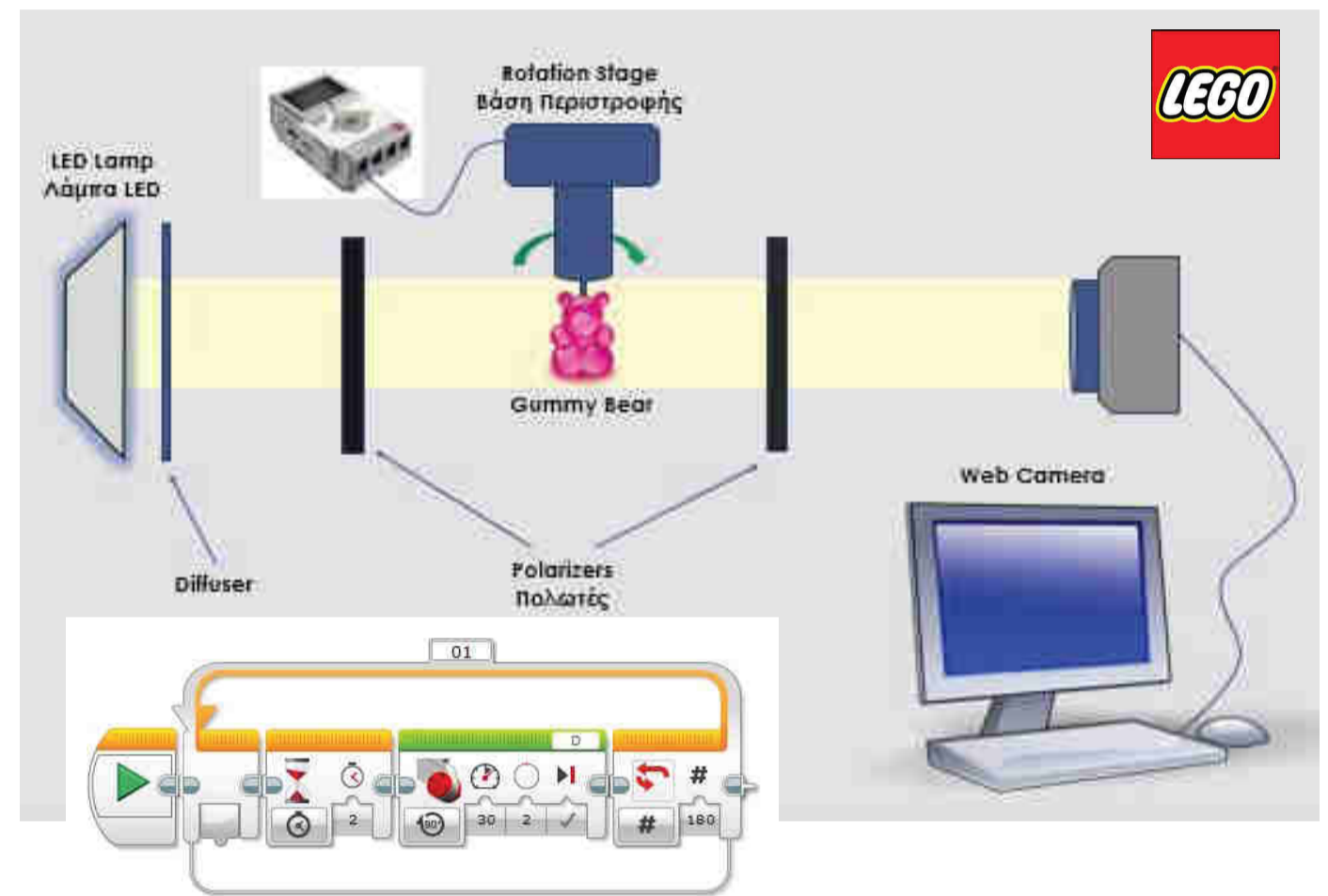
Students can understand Einstein's theory of general relativity on a qualitative level with the help of modern learning environments.

Michalis Orfanakis | General Lyceum of Makry Gialos – Gymnasium Koutsouras | Ierapetra, Crete | Greece

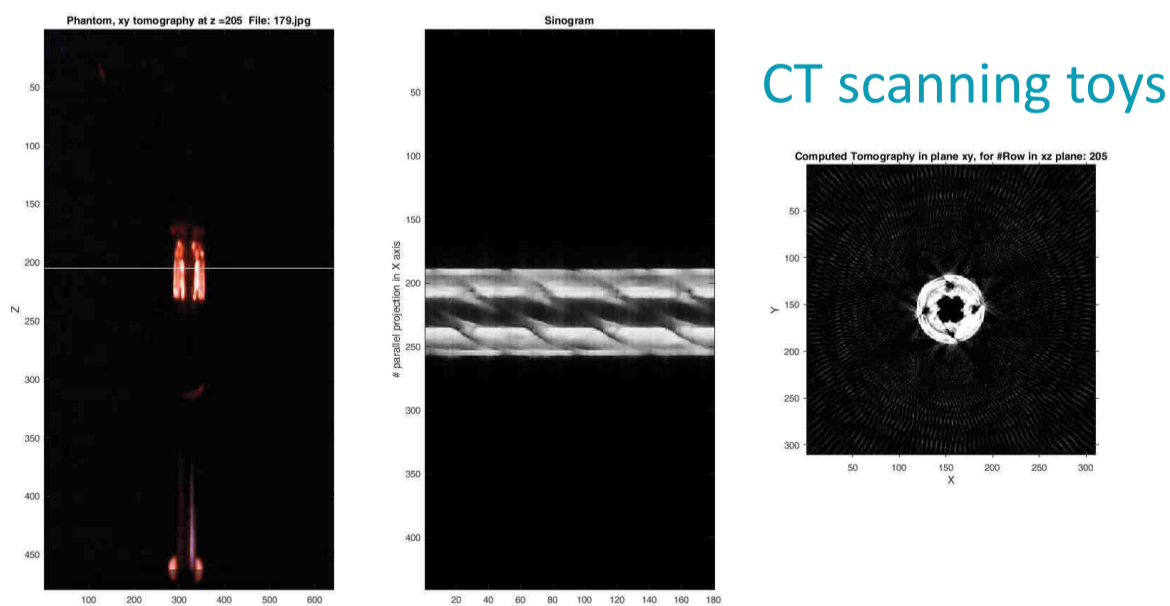
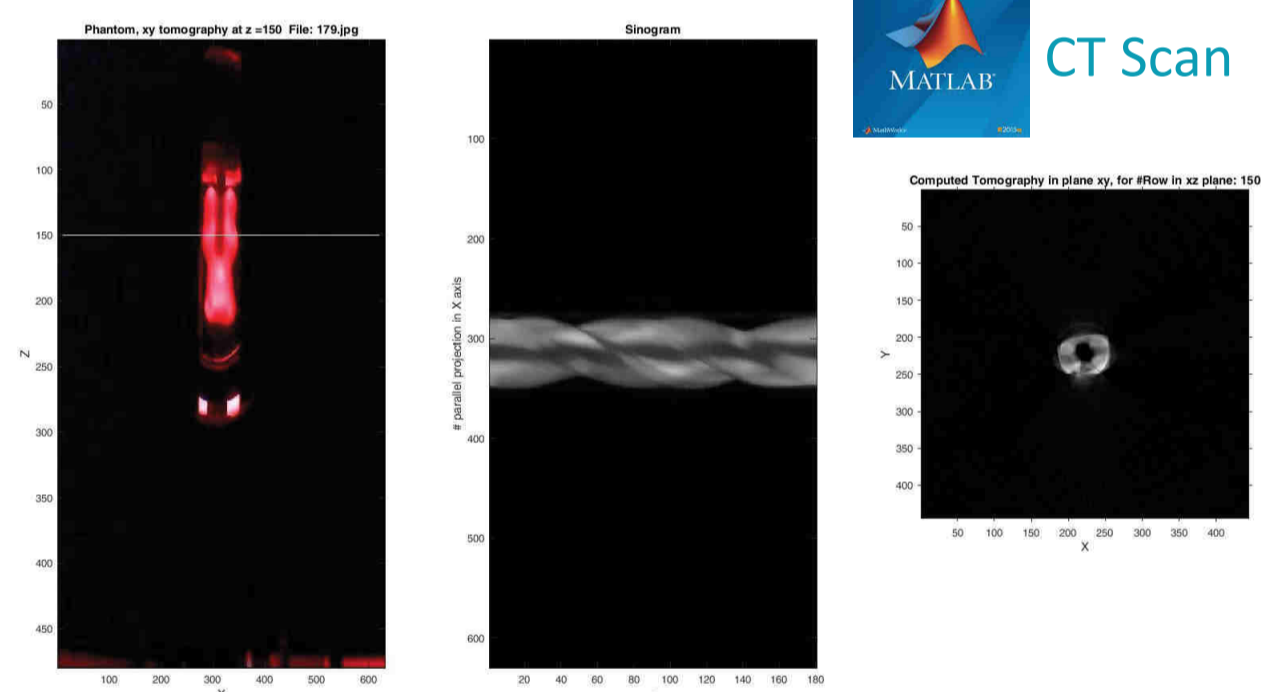
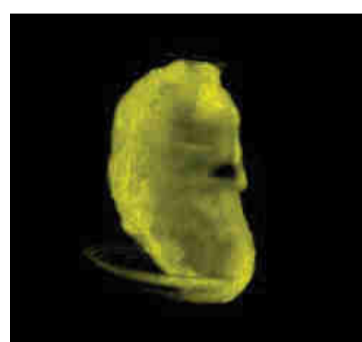
## CT Scanner with LEGO & Arduino

### Bringing scientific research in school

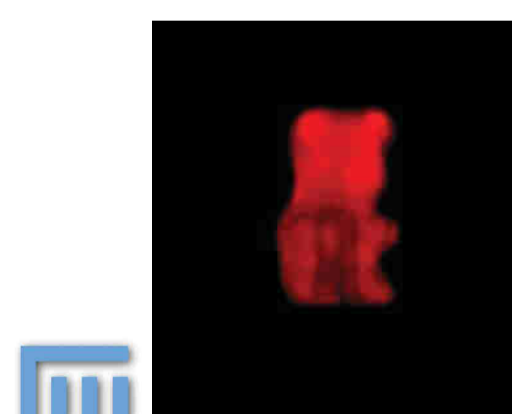
- Developing the first ever Computed Tomography (CT) Scanner for Secondary Education using LEGO and Arduino.
- Transforming a currently ongoing scientific Optical Projection Tomography (OPT) experiment for Secondary Education.
- Utilization of the same techniques, methodology and software that scientists use.
- Presenting the concepts of tomography in school.
- CT Scanning gummy bears, fruits, toys and other light transparent objects
- 3D reconstruction - 3D printing from CT Scans.
- Challenge students to work like scientists.



CT scanning fruits



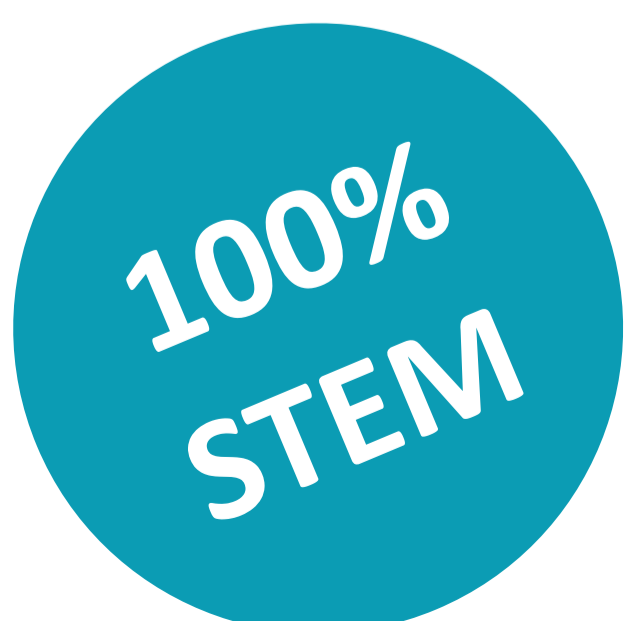
CT scanning toys



3D reconstruction



3D print



Build your own CT Scanner and work the same way like Scientists do!



Petteri Mönkkönen | Kauniainen Upper Secondary School | Kauniainen | Finland

## Space Camp Virtual Tour

### Creating virtual tours with the help of Round.me

#### Introduction

Space Camp was a unique course designed for ca. 17-years-old students on space physics, space explorations space technology and English studies. The highlight of the course was a two day visit to Kennedy Space Center (Orlando, Florida) in April 2017. During the visit students documented their tours with the help of a 360-camera. After the visit 360-tours were finalized and published on Round.me.

#### Pedagogical idea

In this course we used basic ideas of the cognitive apprenticeship model as a learning method. With this model students learned processes which are used by experts e.g. in complex problem solving situations. Students had to learn to use Round.me application with very little guidance from the teacher. If they faced a problem, they had to figure out the solution by themselves. Of course they could make questions but instead of giving direct answers, the teacher never gave direct answers.

#### Results

Even though very little guidance was given by the teacher, most of the students thought that it was relatively easy to learn to use Round.me application. Also most of the students felt that the guidance given by the teacher was sufficient. Only few students felt that too little guidance about the application was given. On the other hand, they are now more ready to use the same application again.

#### Conclusions

In this course basic ideas of the cognitive apprenticeship model worked very well. Based on our experiences, this method is a very effective learning tool and should be used more frequently.

#### References

Bieniek, Valri Y. 2011. Implementation of a cognitive apprenticeship model on student programming and perception of problem-solving ability: An exploratory study. Proquest, Umi Dissertation Publishing.



#### How to explore our Space Camp virtual tours?

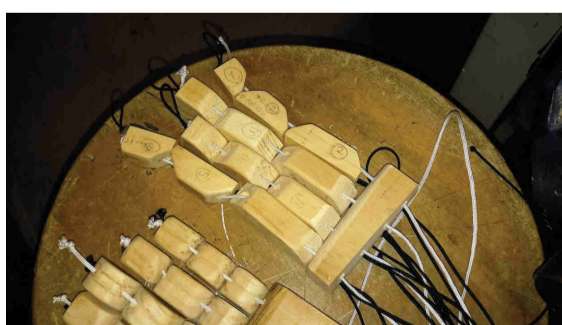
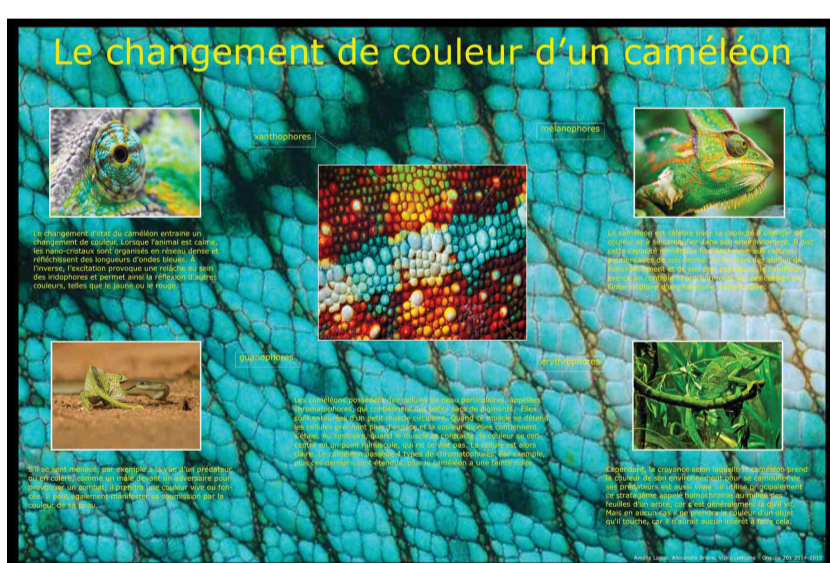
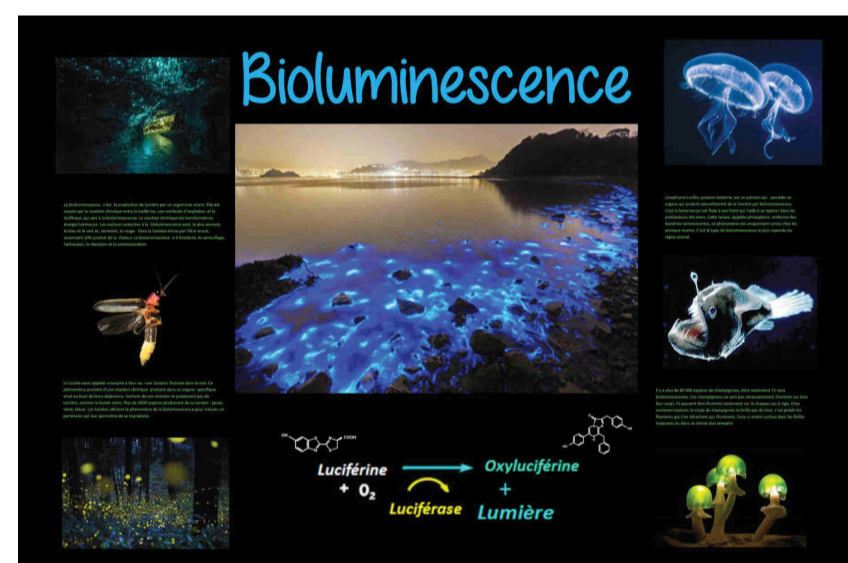
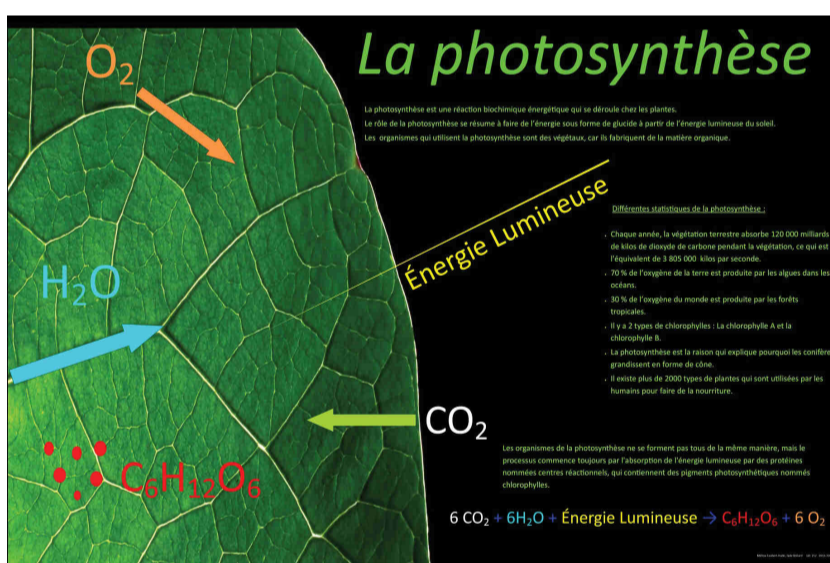
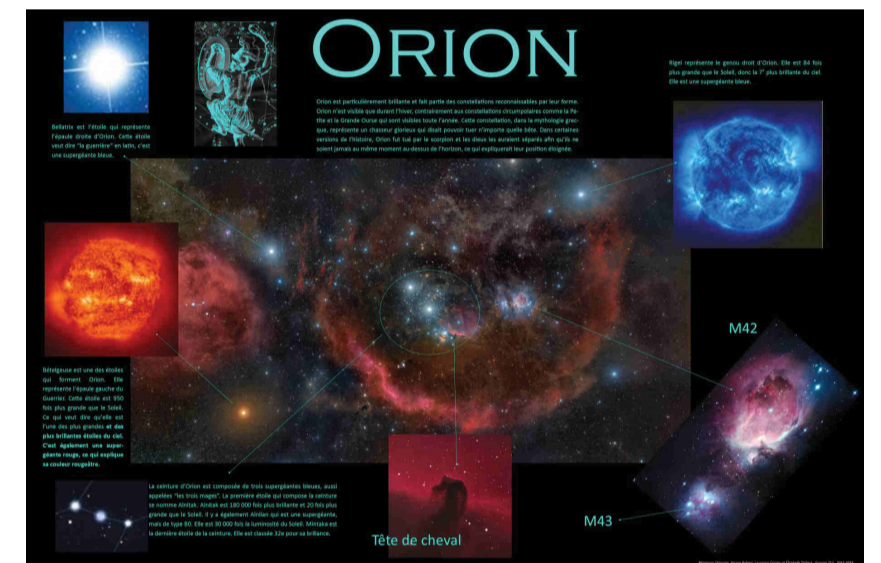
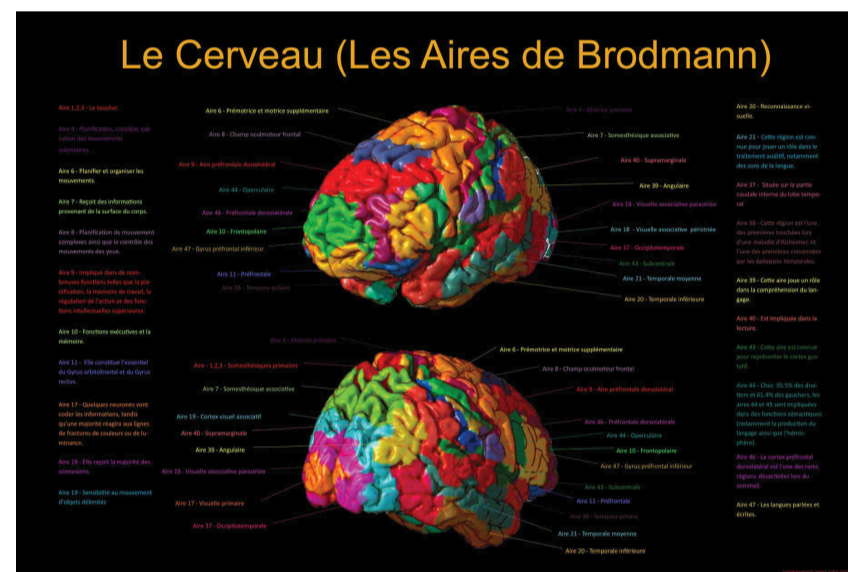
1. Go to Round.me
2. Choose "Explore"
3. Find search tool
4. Type "Space Camp"
5. Space Camp 1 etc. tours are found
6. Press "play" button

**For mobile phones: Please  
install first Round.me**

Robin St-Pierre École secondaire des Patriotes de Beauharnois, Beauharnois Québec Canada

## The Science Poster Project

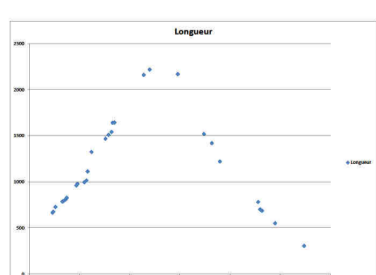
With students of 13-14 years old creation of science posters with Microsoft Publisher. They choose a science or technology and create an A1 size poster. The best posters are hanging on the school's walls.



With strings, elastic strings and wood, students have to design a hand capable of taking various objects.



By using cheap laser point lenses and a smart phone, students are able to build a simple and very efficient microscope.



When you measure the length of the shadow of a pole each day, at the same time you get a graph. Several information can be extracted from it.

When you add graphite powder (solid lubricant) to acrylic paint, you get a conductive paint. This allows you to make simple electrical circuits.





Anna Tóth | Svetits Catholic High School | Debrecen | Hungary

## Manage money well! Financial project in mathematics lessons



### MAIN TOPIC

*financial theory:*  
bank account  
savings  
credit  
pension savings  
*mathematical  
statistic:* average,  
mode, median,  
charts

### TASK

- become experts of a chosen bank
- present an entire bank-offer for fictitious families



### METHOD

project-based  
learning with ICT  
tools

### STEPS

1. All groups choose a bank
2. Member of groups specialize in bank account or savings or credit or pension savings
3. Experts in the same topic collect information in OneNote
4. Presentations + reflections
5. First groups present an entire bank offer fictitious families

### MAIN GOALS

- to pick up basic financial theory
- to improve the students' competence in mathematical statistics
- to develop co-working ability (21<sup>st</sup> century process skill)

### CIRCUMSTANCES

- high school students from class 9 (age 14)
- 13 mathematics lessons (4 per week)



### ICT TOOLS

netbooks, projector, internet, MS OneNote, MS PowerPoint, scrumblr.ca, powtoon.com

Financial theory is not including in Hungarian mathematics curriculum. In this project students pick up basic financial theory and mathematical statistic with team-work.

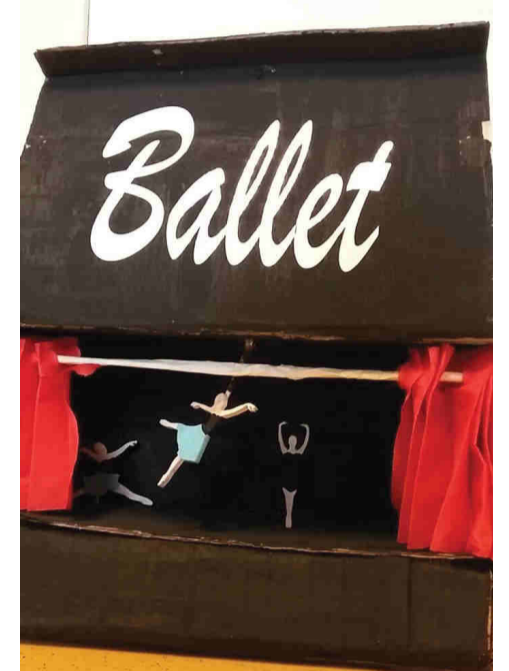


Saskia van der Jagt & Martijn Hoogland | Coornhert Gymnasium | Gouda | The Netherlands

## Build your own automaton!

### Maker education for lower secondary school students

In this project, students design and build an automaton that can be used as a toy by children between 1 and 4 years old. An automaton is a machine or control mechanism designed to automatically follow a predetermined sequence of operations.



After **formulating design principles** and **sketching their ideas** for such an automaton, the students make **computer drawings** of each component. These components are cut by a **laser cutter**. After **building their prototype** the students **reflect** on their design principles and **improve** their automaton.

Follow us on FB: [nl-nl.facebook.com/coornhertmakereducation](https://nl-nl.facebook.com/coornhertmakereducation)



A project wherein lower secondary school students learn to use graphics software to design and laser cut their own automaton. In six weeks from an idea in mind to a real moving object.

Jonas Hall | Rodengymnasiet | Norrtälje | Sweden

## Weighing Jupiter

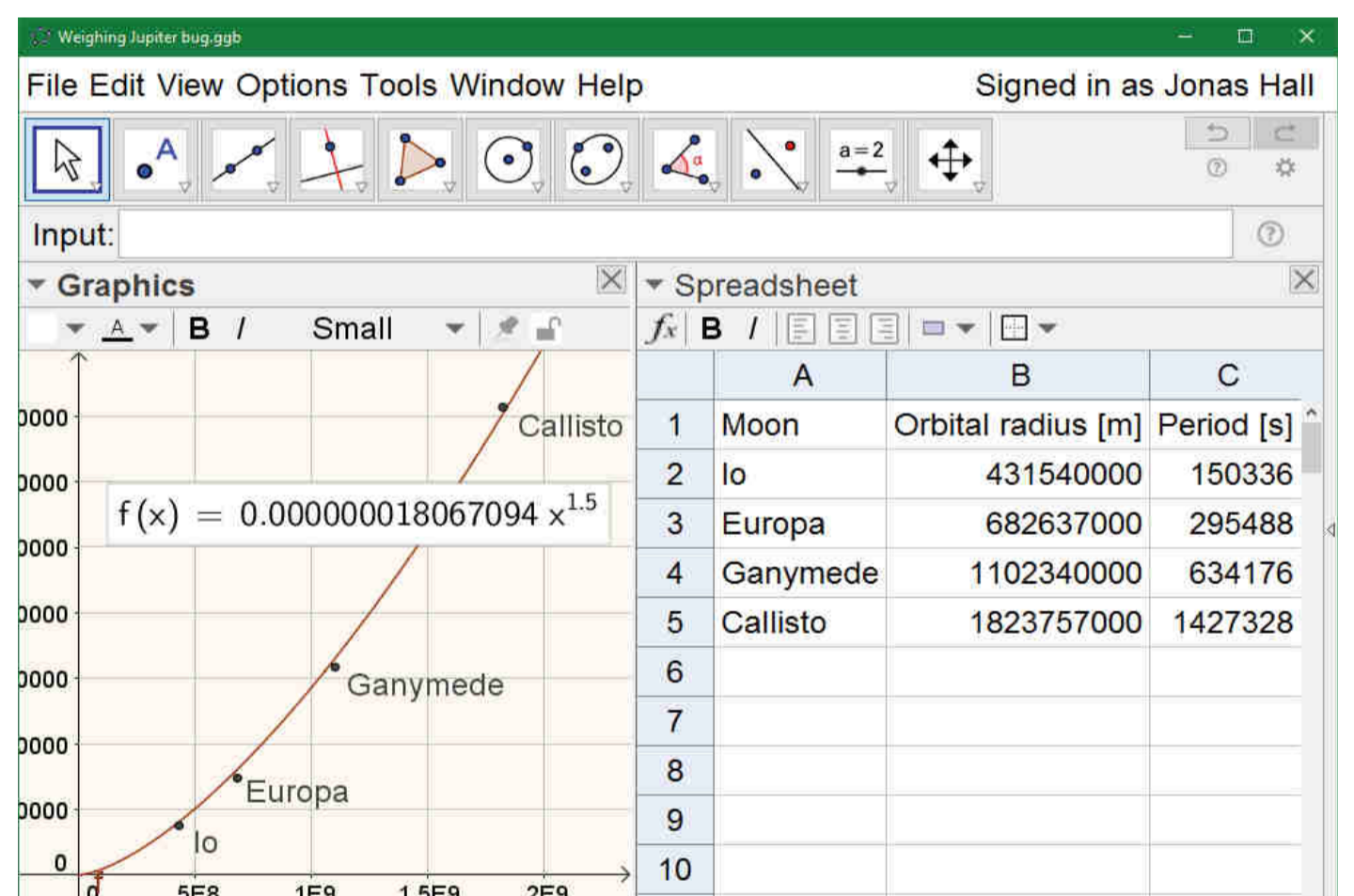
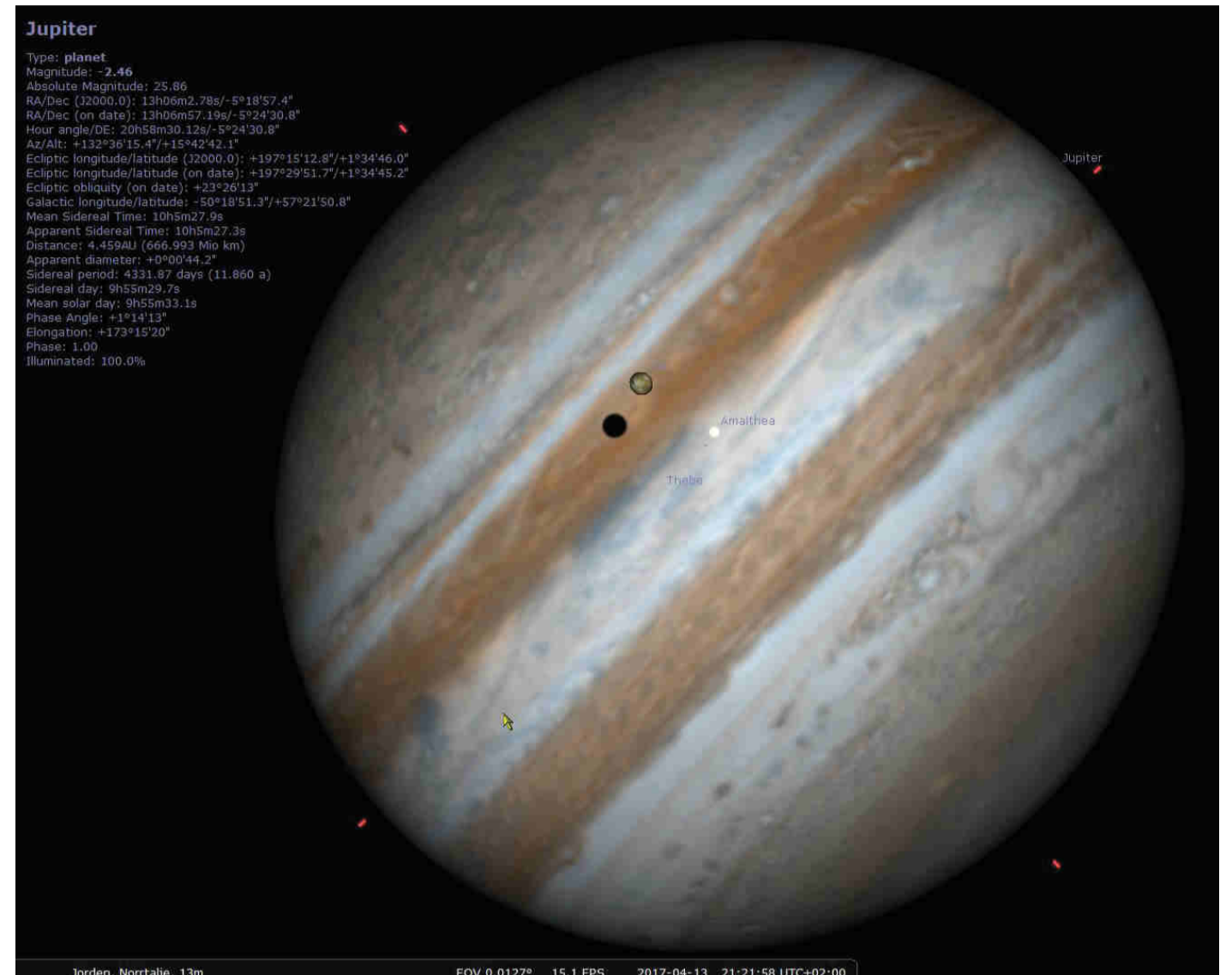
Using simulated observations in Stellarium, W|A & GeoGebra

The Mad Mathematicians  
Mathematical Consultancy Bureau  
 $e^{\pi i} + 1 = 0$

What does Jupiter weigh? How do we know?

By measuring the orbital periods and orbital radii of Jupiter's largest moons in the free planetarium software **Stellarium** combined with accurate distances from **Wolfram Alpha** we get data from which we can calculate the mass using a power regression based on Kepler's third law in the free mathematics laboratory **GeoGebra**.

Accuracies of  $\pm 1\%$  has been achieved with students.



This is a fun and fast way of learning how the scientists can determine astronomical objects' masses without having to travel to observatories or staying up late at night.

111%  
Great!

**Conclusion:** This is ICT used at its very best, combining three great pieces of software to a single powerful learning exercise easily adaptable for different levels.