Astronomy and Space Exploration in Science Education

SCIENCE ON STAGE 2019 CASCAIS

THE EUROPEAN NETWORK FOR SCIENCE TEACHERS

Graz International Bilingual School| Graz| Austria

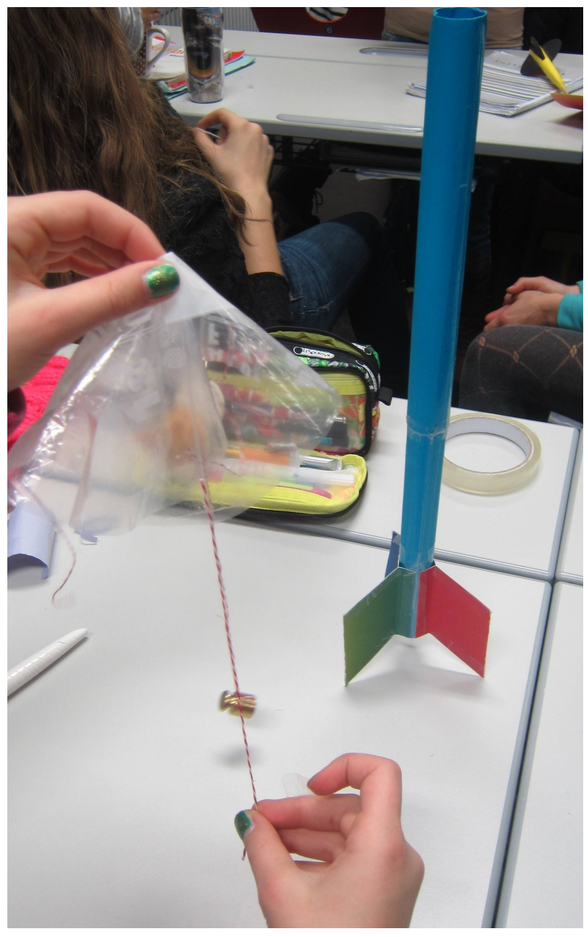
Patrícia Raposo-Weinberger, Ursula Schatz

gibs Graz International Bilingual School

Paper Rockets@Gibs

This hands-on project involved students from year 3 (11 years old) and enable the students to learn Newton's laws of motion and the physics of aerodynamics.

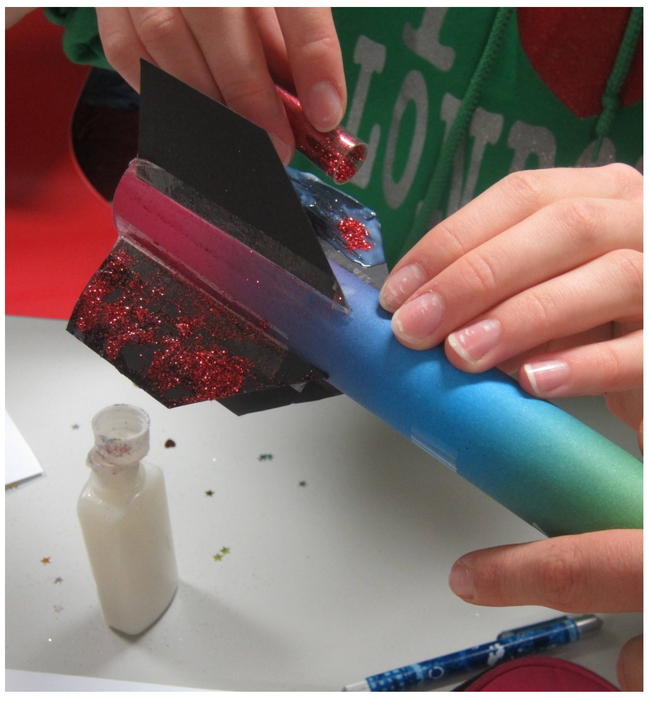
Another aim of this project was to promote skills that included problem solving, decision making and group work.



The students decided the design, the size of the rocket and the shape of the fins.

The final step of this project included the observation of the flight path and determination of the vertical distance travelled by the rocket.

This project is being developed since 2012 with a significant impact in the physics lessons, reflected in the engagement and motivation of the students.



References

https://www.grc.nasa.gov/WWW/K-12/TRC/Rockets/paper_rocket.html

https://www.esa.int/kids/en/learn/Technology/Rockets/How_does_a_rocket_work

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Ivo Jokin, Municipal center for extracurricular activities, Baykal village, Bulgaria

Planetarium - a tent in the classroom and outside

The project presents an integrated approach to non-formal learning in physics and astronomy, ecology and fine art through the use of cheap materials and mobile phone applications. The main activity is to introduce the children and students to the starry sky - the constellations in different seasons of the year, the brightest stars, the polar star orientation.

The Planetarium is an ordinary tourist tent, which, on the inside, with the help of fluorinating paints, draws the constellations and their configurations. In the Planetarium, solar and lunar eclipses can be demonstrated using a flashlight, an inflatable beach ball (Earth model), and some fruit-orange, apple, etc. (moon pattern).

"Classroom under the Stars"

The project complements educational activities with the Planetarium.

Goals:

- to popularize and disseminate among students the knowledge and achievements of astronomy;
- to create and develop interest in astronomy observation and practice through various interactive methods and forms;
- to acquire skills for practical application of physical knowledge in explaining unfamiliar phenomena, conducting and planning experiments.

Conclusion:

- the use of non-standard tools, interactive methods and a research approach increase the cognitive interest in astronomy;
- an interdisciplinary approach to non-formal science education

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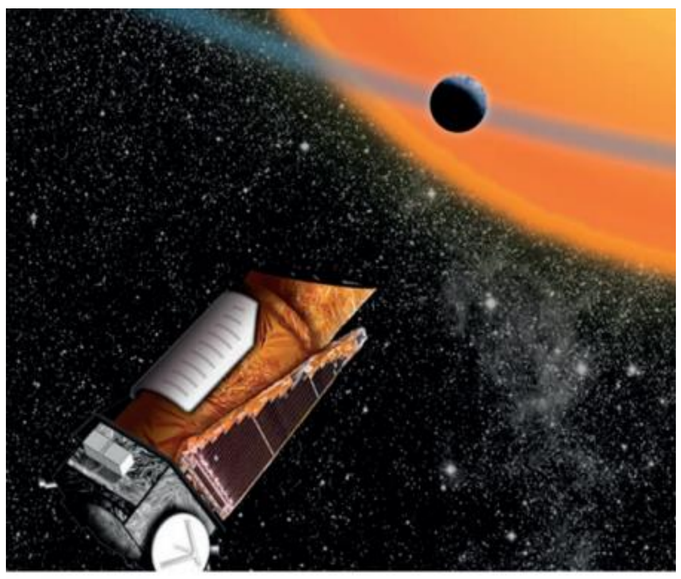
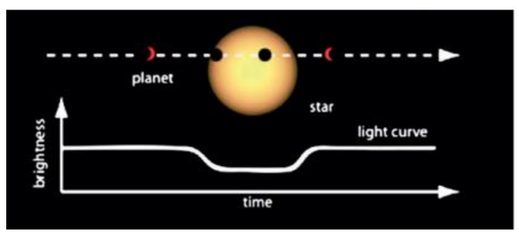
Ole Ahlgren | Roende Gymnasium | Roende | Denmark

Searching for exoplanets

The transit method and how it can be simulated

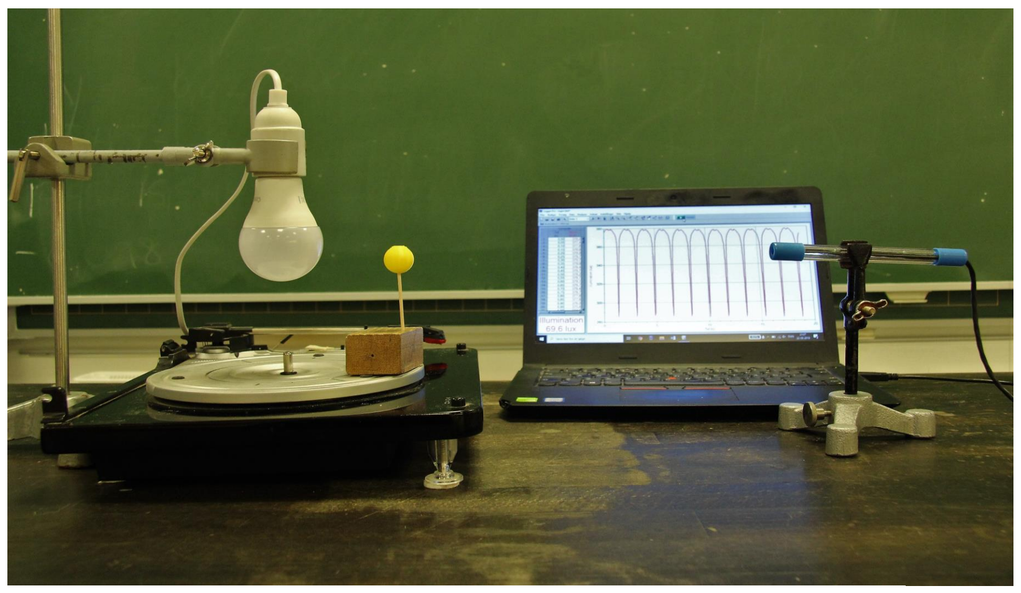
We now know about 4000 exoplanets. Most of them are found by the transit method by measuring the brightness of the star as the planet moves in front of the star. The Kepler satellite has found a large number of exoplanets this way

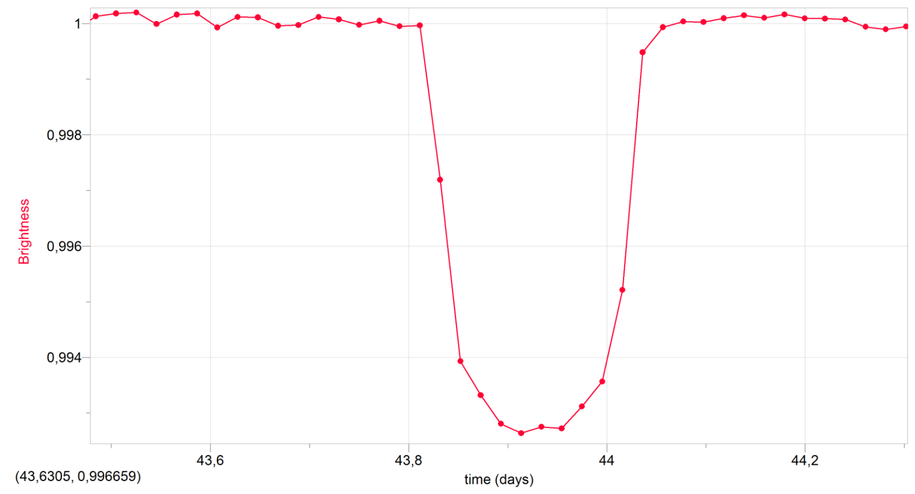




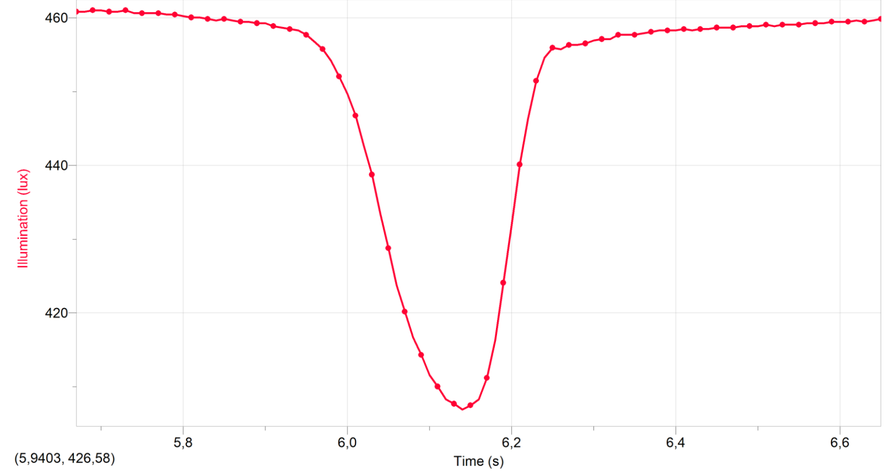
The Kepler Satellite and the principle of the transit method

The transit method can be illustrated with a gramophone, a bulb, small spheres and a light sensor. As the gramophone rotates the sphere orbits the bulb and the light curve is measured by the light sensor.





Typical light curve for an exoplanet and planets in the Kepler-47 planetary system



Simulated light curve for spheres recorded by the light sensor

Analyses of the light curves, combined with spectroscopic measurements of the star, gives information about the exoplanets orbit time, diameter, distance from the star, mass, density and temperature. Many of the exoplanets are earth like and maybe habitable.

This simple experiment illustrates, how it is possible to find planets around other stars and ultimately search for life in the universe. It is suited for both primary and secondary school.

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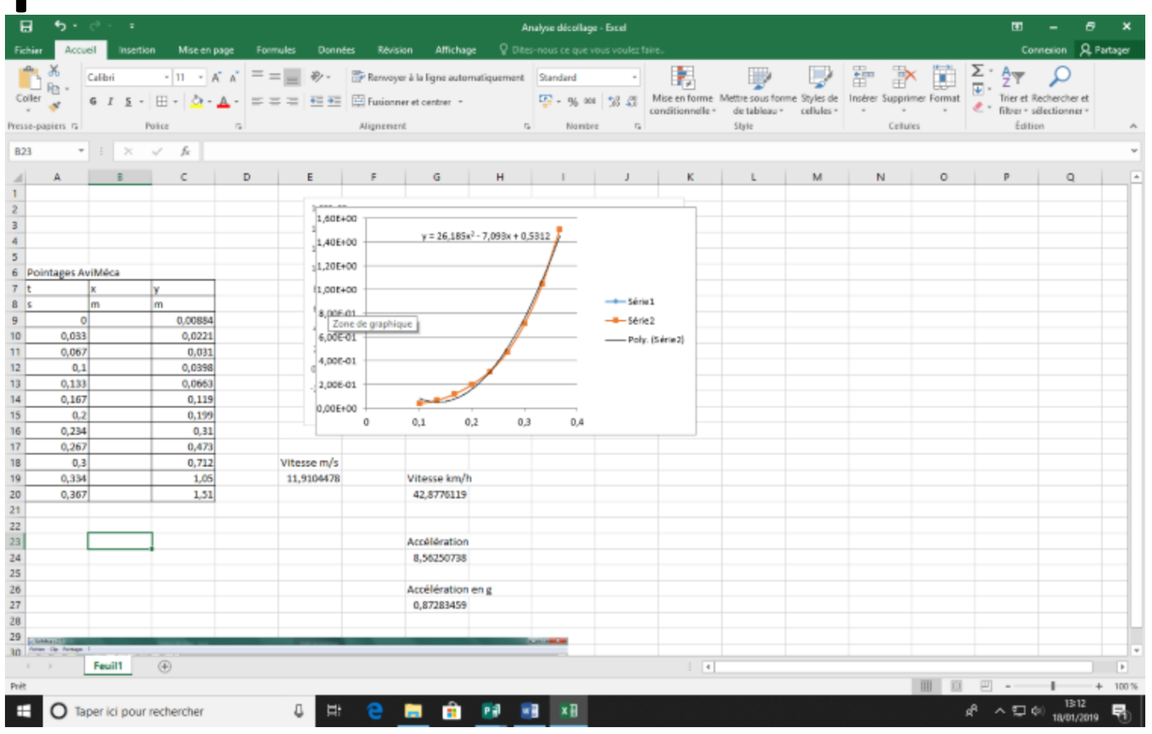
Seconde professionnelle | Lycée Saint Joseph | Vannes | France
Pierre-Yves ROYER and André LE NOA

Dreaming stars to live better on Earth

Micro-rocket project by students of professional second

The students designed micro-rockets, they made them using computer tools and a 3D printer, they made them take off from the Meucon aerodrome by respecting the security measures, and later in class they analyzed the flight data and they modeled the trajectories.



Students apply trigonometry, use software (Excel, AVIMECA, 3D printer) and connected equipment. They perform speed calculations from measurements in the field.

For a rocket to take off properly and climb to an interesting height, you have to design it, the students were motivated to have the best rocket ... they did maths and physics while having fun.

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1st Vocational Lyceum of Salamis GREECE

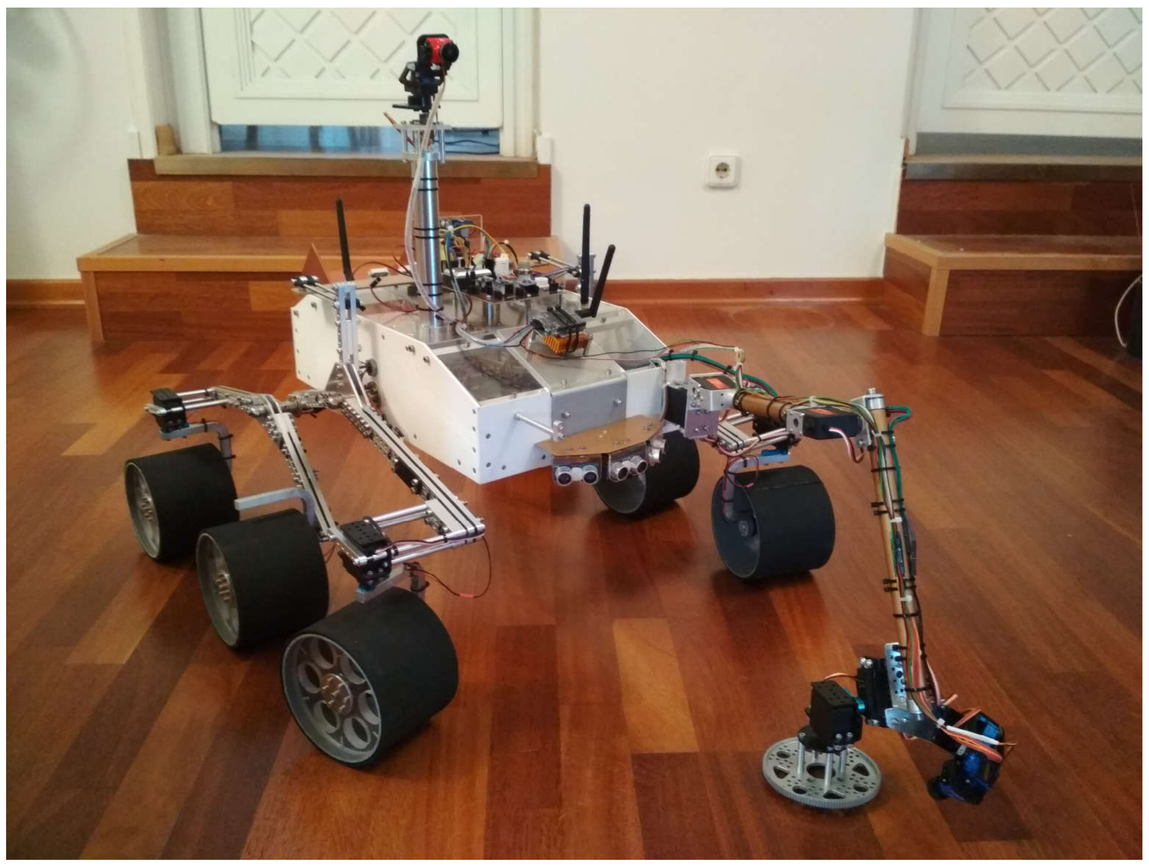
Teacher: Petros Poutos

From Earth … to Mars

Brief Description

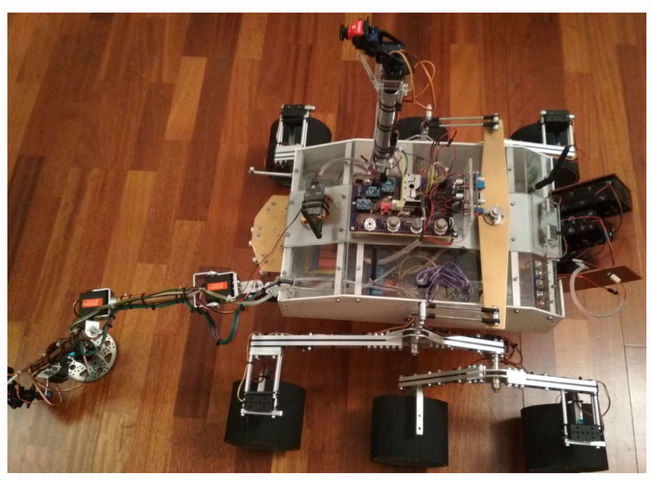
It's a full STEM project. It was designed and manufactured to introduce students to sciences and technologies involved in exploring other planets through an impressive and interactive simulation.

In particular, it helps to understand the ways and techniques of driving, acquisition and transmission of data, from special robotic vehicles which used to explore other planets. At the same time it helps to understand the broadcasting via artificial satellites.



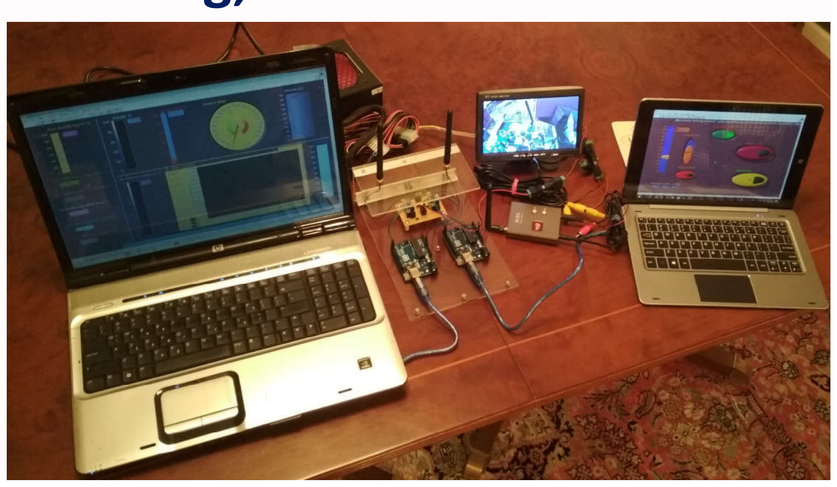
Consists of

Robotic Vehicle (Mars Rover)



Model of Satellite with active Transponders

Video , Readings and Driving, from monitor and PC



Capabilities

Remote driving of robotic rover from PC (direct or via satellite)	On-screen measurements with graphs and virtual instruments via LabView software
Receiving video from two cameras (main camera , robotic arm camera)	Robotic arm with tool base and sensors. Rocker Bogie suspension (6WD)

Many Sensors (dust sensor, Gases sensors, atm. pressure, temperature, humidity, UV, IR and visible light radiation, air quality, color recognition, etc.)

Ed. Benefits

Interdisciplinary approach and educational service in various fields of teaching	Familiarizes students with new knowledge and technologies
Innovative and Dynamic project with wide margins of upgrading	Understanding of Engineering Design Process (EDP)

Provides students *Skills for the Future*

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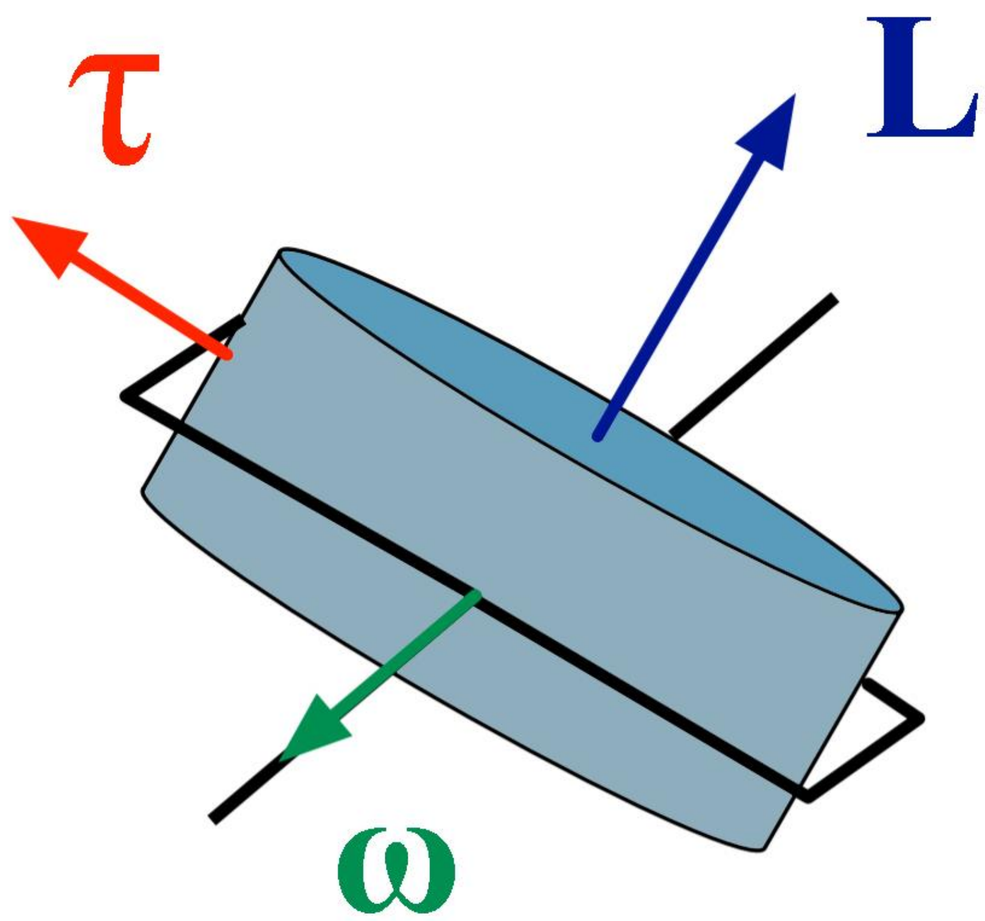
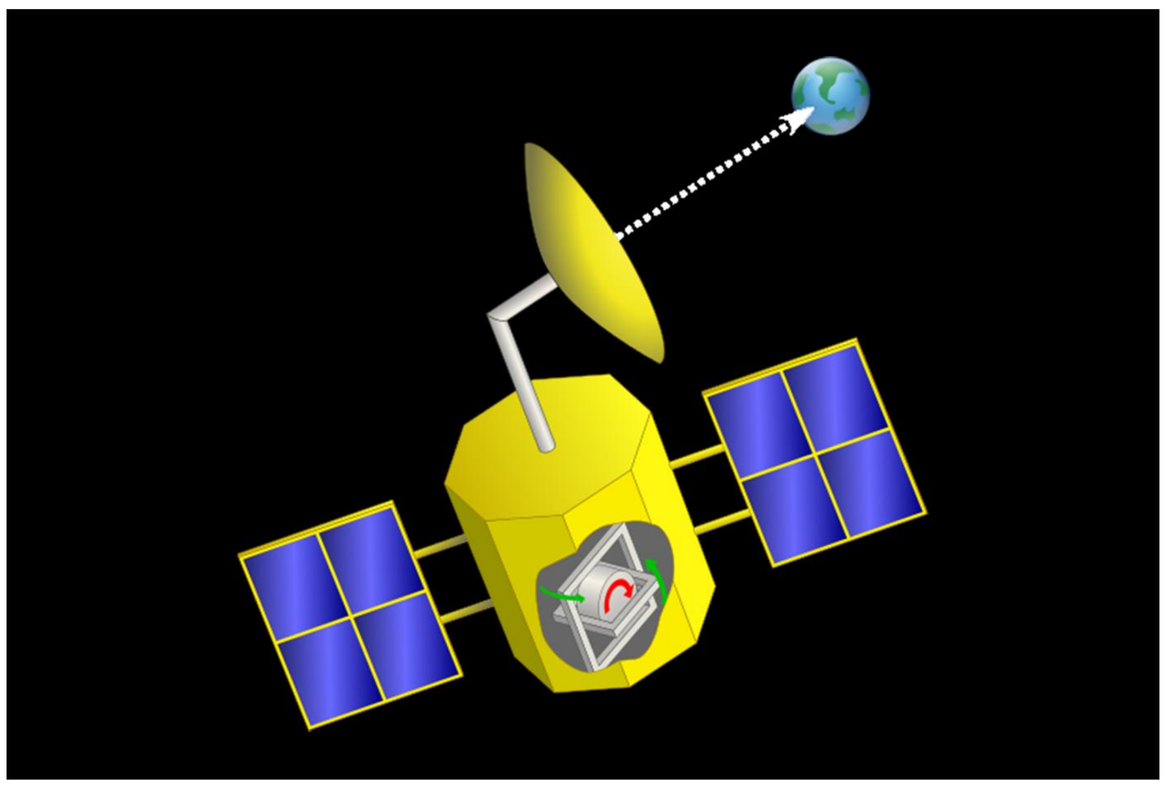
Astrinos Tsoutsoudakis| 1st Laboratory Center for Science Education | Heraklion, Crete | Greece

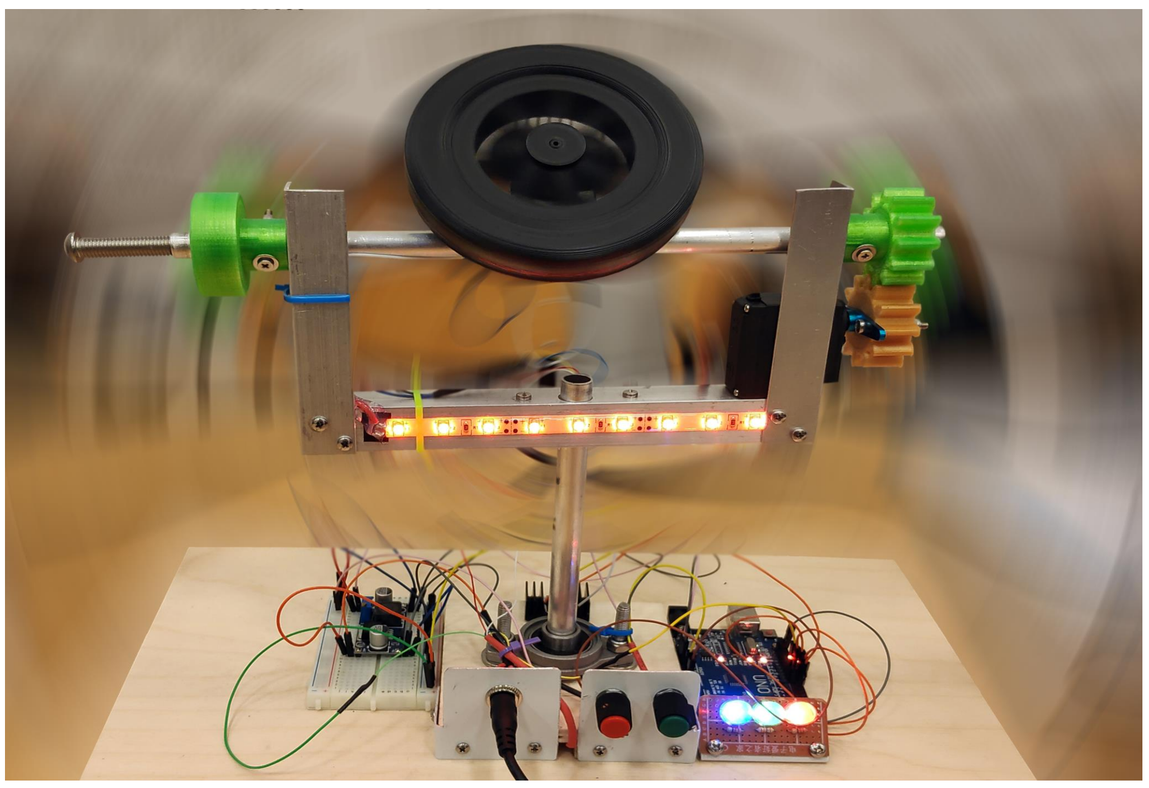
Control Moment Gyro

A single gimbal control moment gyroscope

A **control moment gyroscope (CMG)** is a device generally used in spacecraft attitude control systems. A **CMG** consists of a spinning rotor and one or more motorized gimbals that tilt the rotor's angular momentum. The most effective **CMGs** include only a single gimbal. As the rotor tilts, the changing angular momentum causes a gyroscopic torque that rotates the spacecraft. Single-gimbal **CMGs** can apply very large torques for minimal electrical input thus reducing the propellant use for rotational maneuvering.







The **ISS** employs a total of four **CMGs** during normal flight mode operation. The objective is to hold the space station at a fixed attitude relative to the surface of the Earth.

Although a **CMG** provides control about the two axes orthogonal to the gyro spin axis, triaxial control still requires two units. A major drawback is the additional complexity, which increases the number of failure points.

Astronomy and Space Exploration in Science Education

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Grazyna Linder | I Social High School of STO in Slupsk | Slupsk | Poland

Earth and its satellites threats coming from space

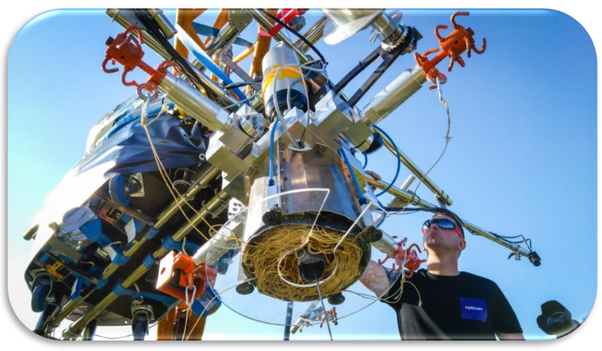
Meteorites

- ➢ Collecting with a neodymium magnet;
- ➢ Recognition:
  - Observation using a magnifying glass,
  - Density determination,
  - HNO_3 pickling,
  - Reaction in contact with DMG,
- ➢ Observation of meteor showers and defining the ‘falling stars’ radiant.

Collection of specimens

Interaction with neodymium magnet

Astronomy topics that are most interesting for students:
Evolution of stars,
Solar activity and its impact on Earth,
Cosmic threats to life on Earth and early detection mechanisms,
Conditions on Mars and what life could be like for humans,
Human body in the space.



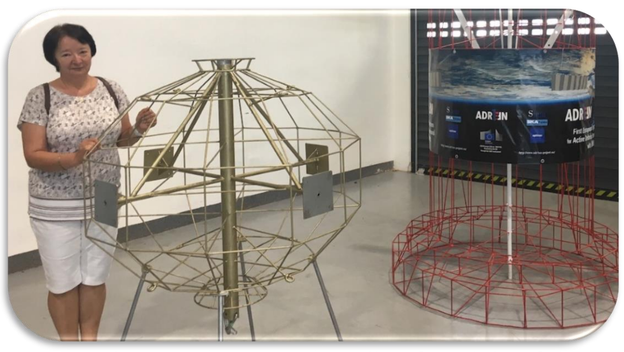
Space Dustcart with net

Model of the Ariane rocket body
(left – *dr Agata Sochaczewska Team Manager, OptiNav*)

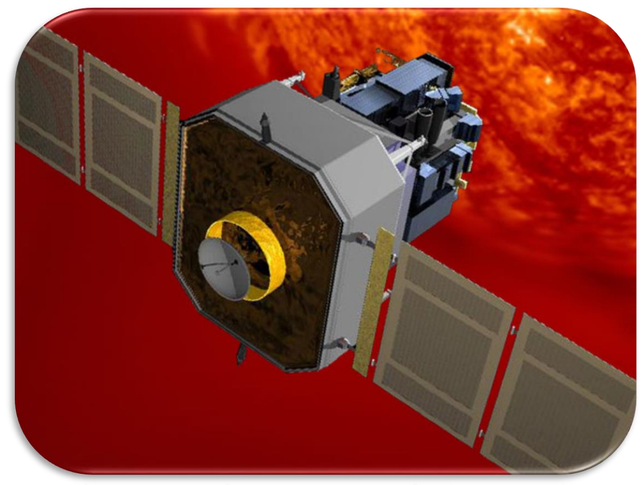
Space Debris

- Space Dustcart,
- Removal of inactive satellites,
- Removal of other small parts, space station remains and ejected rocket parts.

Establishing contact with OptiNav – observation of the ‘debris fishing’ net trials.



Alouette-1 inactive satellite (*model 1:1*)



Artist's Concept of SOHO spacecraft observing the sun.
Credit: NASA/A. Lutkus/H. Zell

„Natural” Threats

- Observation of the solar activity by counting the sunspots.
- SOHO satellite data analysis
- **Sol**ar **O**rbiter SolO data analysis

Solar Orbiter *[ESA]*
https://space.skyrocket.de/doc_sdat/solar-orbiter.htm

Teaching approach transformation by changing passive education to active learning as means of raising the students’ interest in science. Introduction to observation methods, basic research activities and finding sponsoring institutions.

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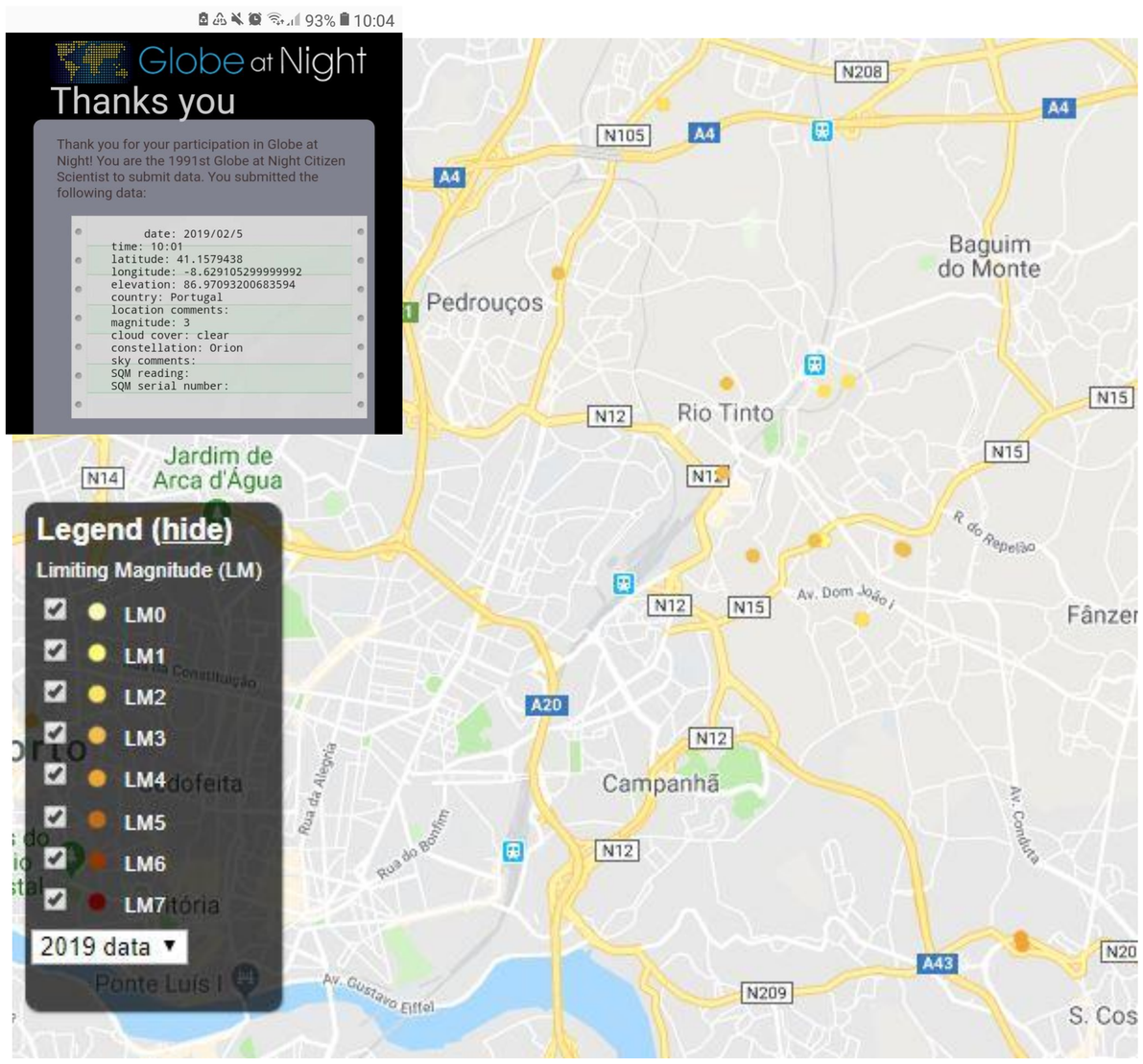
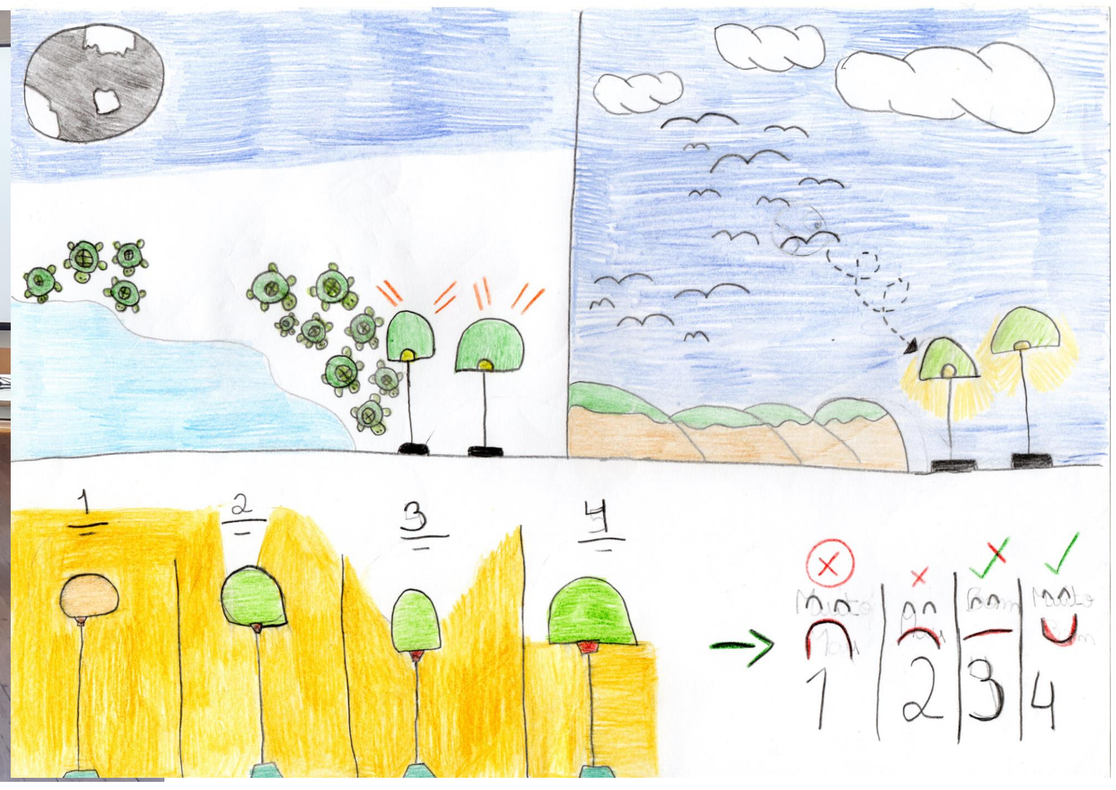
Carlos Pinto| Agrupamentos de Escolas de Rio Tinto | Gondomar | Portugal

Astronomy with art

Acting in the community through art



This project promotes the vertical articulation between students of different levels trough inquiry and the use of arts for learning astronomy and acting in the community. It can be used for designing interdisciplinary projects. Also at the beginning, using Stellarium, students can learn astronomy by developing group and inquiry collaborative activities. The main theme was light pollution.



The project can increase students motivation for astronomy and the use of innovative methodologies in the classroom, including ICT and arts.

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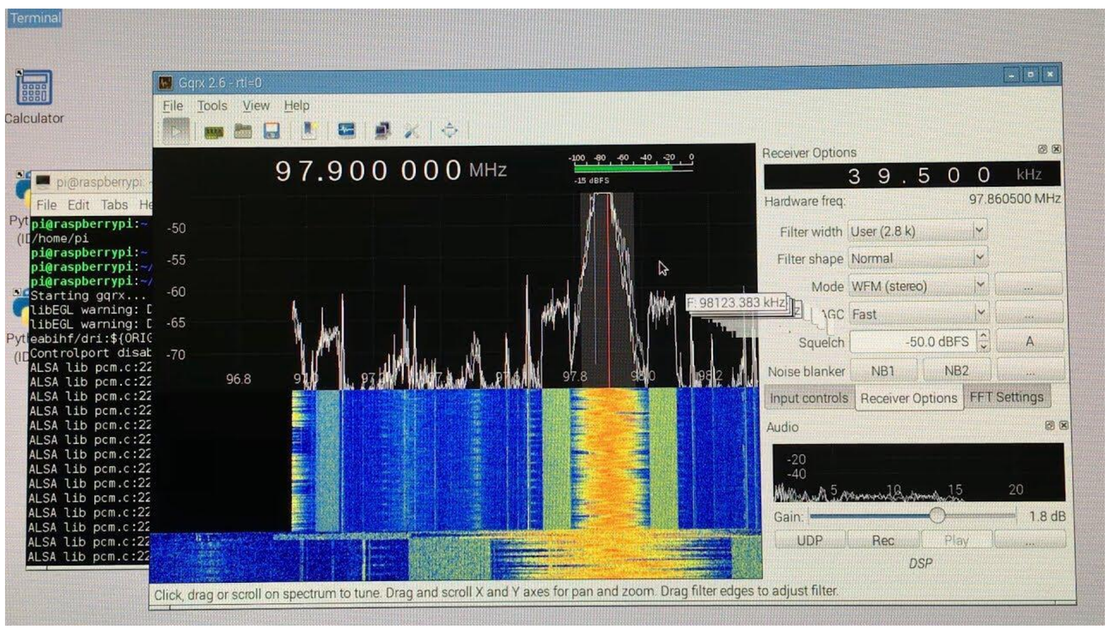
Marc Llorenç Batlle Aixalà| Torre Vicens School | Lleida| Spain

RADIO STATION CONNECTED TORRE VICENS

The project Radio Station connected Torre Vicens aims to achieve the following objectives:

- Develop STEM competences in an educational project.
- Study the different types of orbits and the LEO, MEO and GEO satellites.
- Design and implement a low-cost station that allows connecting with some LEO satellites. The components used were essentially three: an antenna, a receiver (rtl-2832) and a SDR (a computer software used to decode waves).
- Find and listen some radio stations.
- Track some LEO satellites (Low Earth Orbiting Satellites).
- Follow the ISS (International Space Station).



At the end of the project, students developed STEM competences designing a radio connected station with low cost materials. They discovered the different orbit satellites and connected and listened some low earth orbiting satellites.

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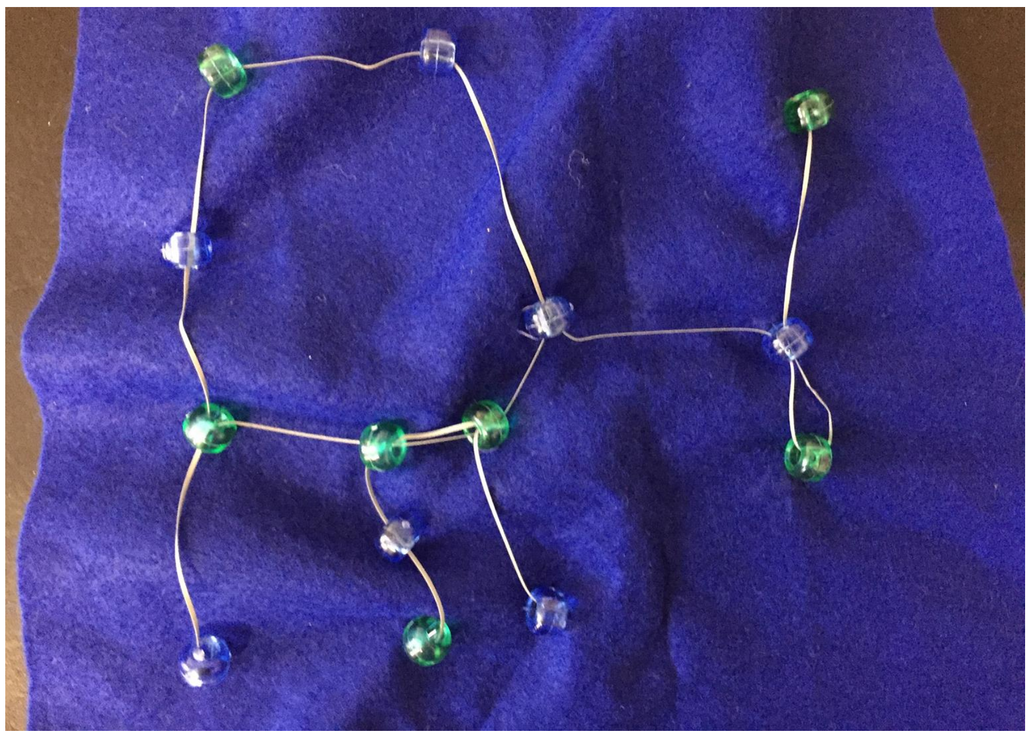
Emma Lindahl | Älghults friskola | Älghult | Sweden

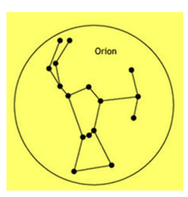
DIY Stargazer -

Let´s bring the stars to Earth!

This project is based on a few creative activities made with cheap, easy-to-find materials. By taking the stars closer to Earth young students is given a chance to get fascinated about the universe as well as learning about light, stars, lenses and how to use binoculars.

It starts with creating your own stargazer out of a paper roll. It continues by teaching about the stars fascinating lives, the stories we have created about the constellations and ends with a playful quiz outdoors where you need your binocular skills. Come try out yourself!





Can you match each colour to it’s proper constellation? Take a pair of binoculars and do the quiz!

Let’s add the A to STEM and make it STEAM,
by using more creative activities in our classrooms.

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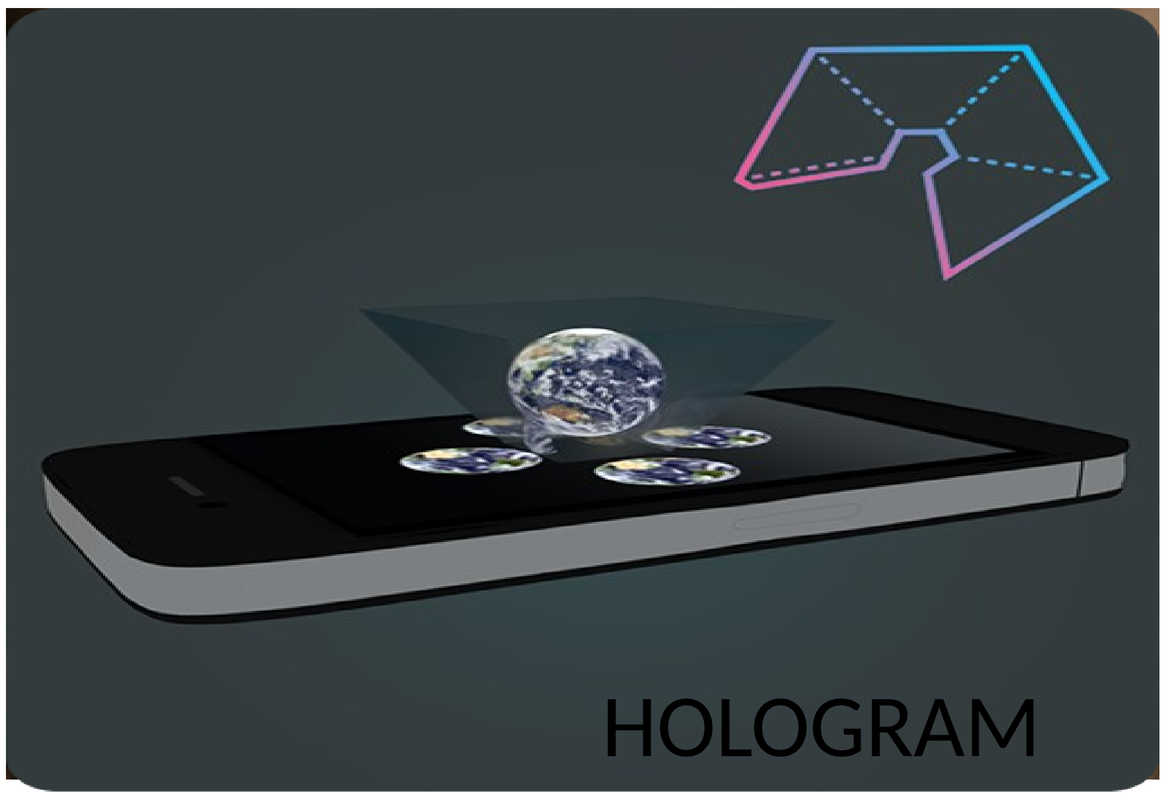
Ali Murat ÇİVİ | Silifke Science and Art Center | Mersin | Turkey

Understanding Space with AR

Get started now
It’s easy to start creating AR content using Vuforia Engine.
1-Install Vuforia Engine with the Unıty Editor
2-Create a new project and activate Vuforia
3-Import the Vuforia Engine Core Samples
4-Customize them with your own content.
It's that simple.

Programs used: Unity 3D (64 bit)
Vuforia SDK (Vuforia Engine 8.3)
https://developer.vuforia.com/downloads/sdk



<u>Benefit in Augmented Reality education:</u>
Active Learning with Augmented Reality. It provides active participation of the students to the classes. It increases students' motivation. It enables students to understand abstract concepts better. It allows students to learn with fun.

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Nataliia Naidon| School №1 | Horishni Plavni | Ukraine

THE SYSTEM OF SUN TRACKING

Creating an Arduino-based sun tracking system that directs the photocell plane perpendicular to the sun's rays

Human beings need more and more energy, which they get mainly due to depletion fuels. Renewable energy sources, including solar energy, have enormous potential.

GENERAL INFORMATION ABOUT THE SUN TRACKING SYSTEM

The solar tracker is an electromechanical device that tracks the movement of the sun in the sky and returns the photoelectric panel to the desired angle in the sun's motion.

STAGES OF CREATION OF A SOLAR TRACKER ACCORDING TO THE EDUCATIONAL DISCIPLINES

1.Drawings. Create drawing of design details.

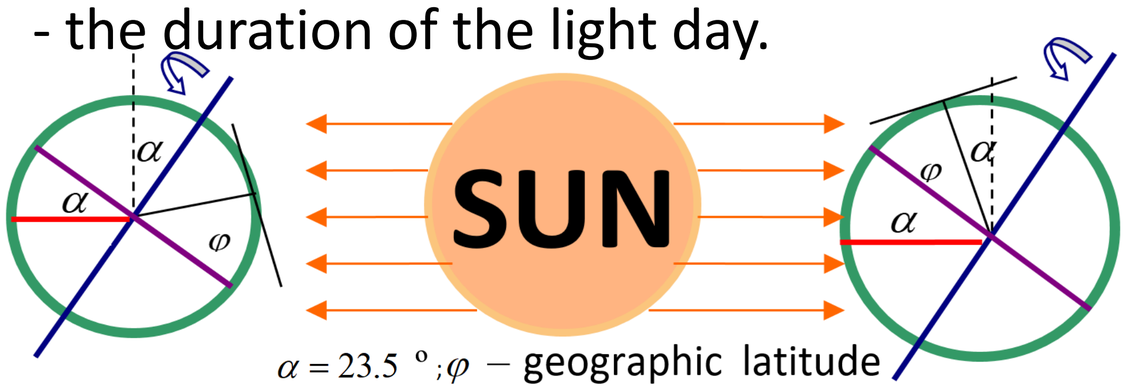
2.Handicrafts. Production and connection of details of a tracker from plywood according to the templates of drawings.

3. Informatics.

- connection to the design of electrical elements according to the scheme;
- writing software code for Arduino;
- testing the device.

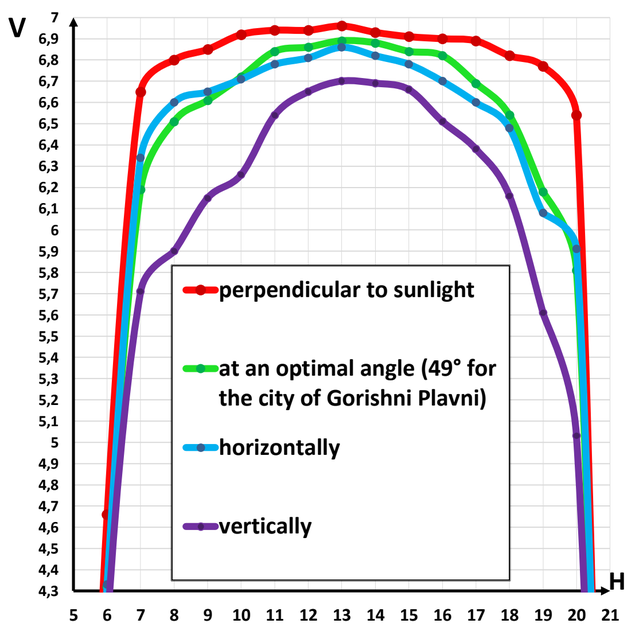
4. Astronomy. Research:

- changes in the height of the sun during the day;
- changes in the height of the sun during the year;
- the duration of the light day.



5. Physics.

Measurement of the energy generated by the photocell with a multimeter during the day with different Placement of the Plane of the solar cell relative to the sun's rays.



6. Mathematics.

Construction of charts and analysis of research.

The project identifies the way to increase the efficiency of using solar panels - installing the battery plane perpendicular to the sun's rays. It has been experimentally proved that the use of the sun surveillance system in modern solar power plants will be more efficient at 30%.

The project combines different disciplines, is not expensive (about $ 23), deepens knowledge and increases students' interest in studying subjects of the natural cycle.