

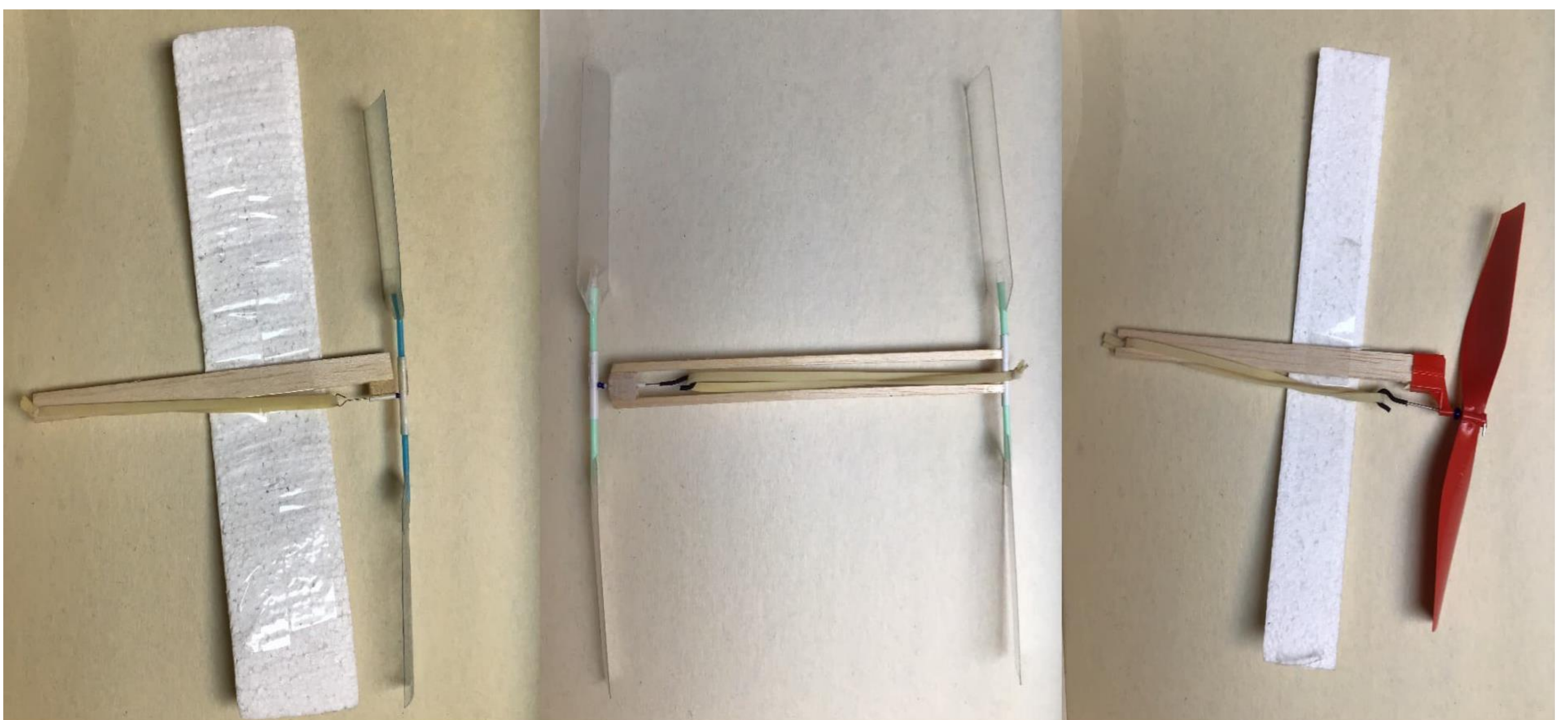
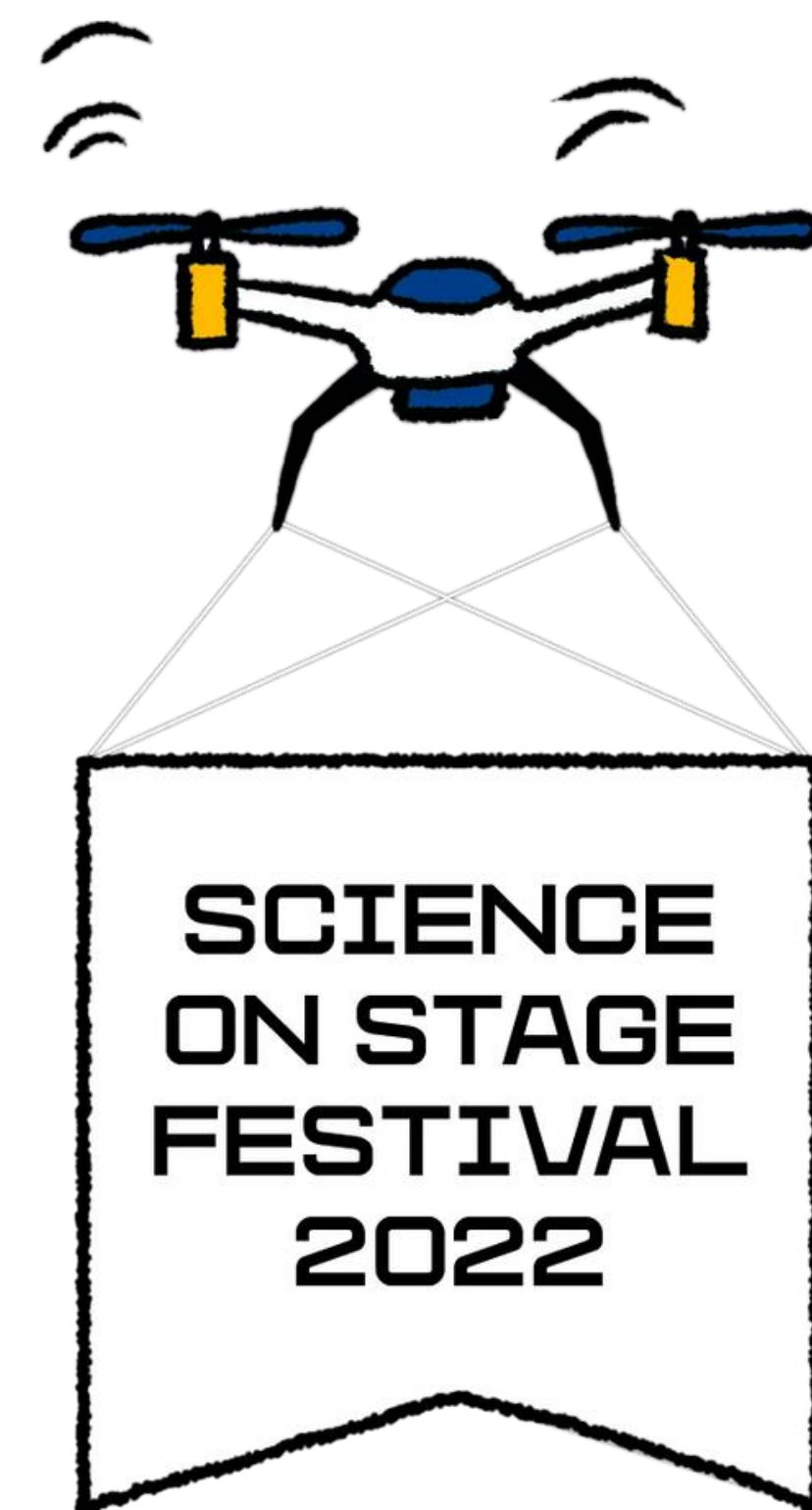
SUSTAINABLE DEVELOPMENT GOALS IN EDUCATION

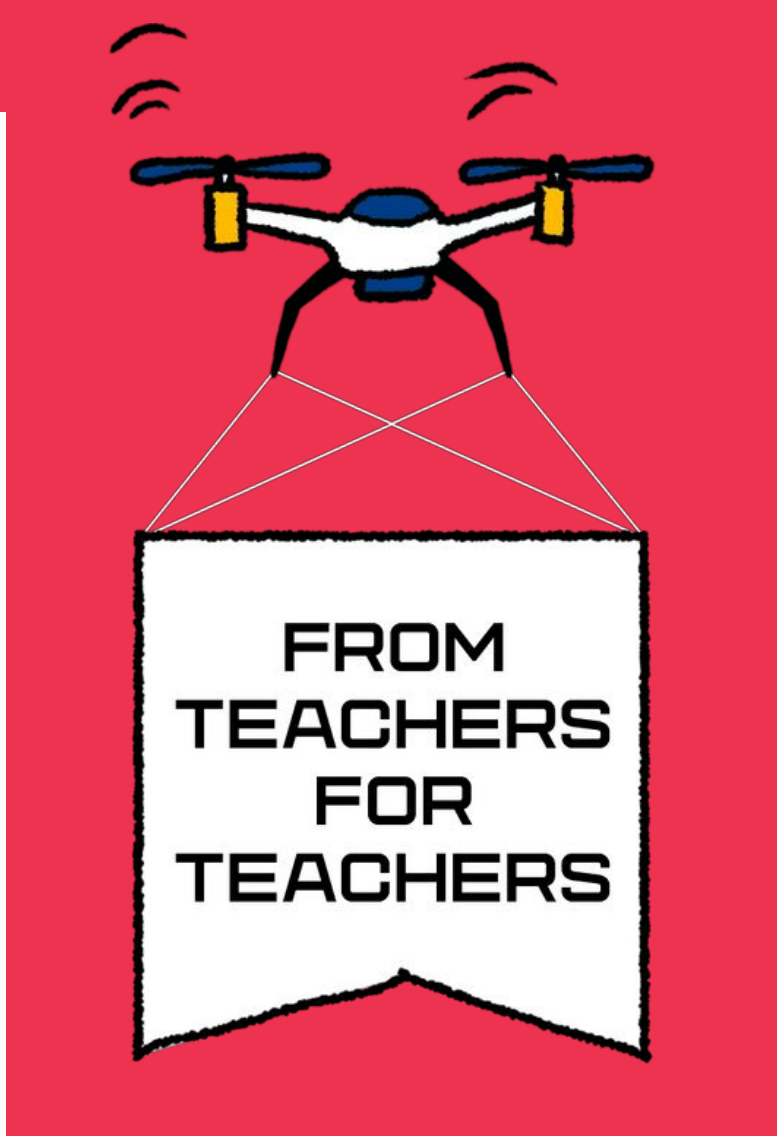
Zdeněk Hubáček | Gymnázium Krměříž | Kroměříž | Czech Republic

Rubber band powered helicopter

The rubber band powered helicopter is a very useful **school project** suitable for a **wide age range**.

The design brings out **many intersections between technology and physics**. The aim is to show pupils that it is necessary to have a science background to make a rigid lightweight structure that can fly easily and is stable and powerful. It is surprising to a large number of children how easy it is to build a **propeller from a cotton bud, a PET bottle** and a piece of wire. The finished helicopter is a useful tool for the physics classroom, showing the **transformations of mechanical energy**.





Sustainable Development Goals in Education

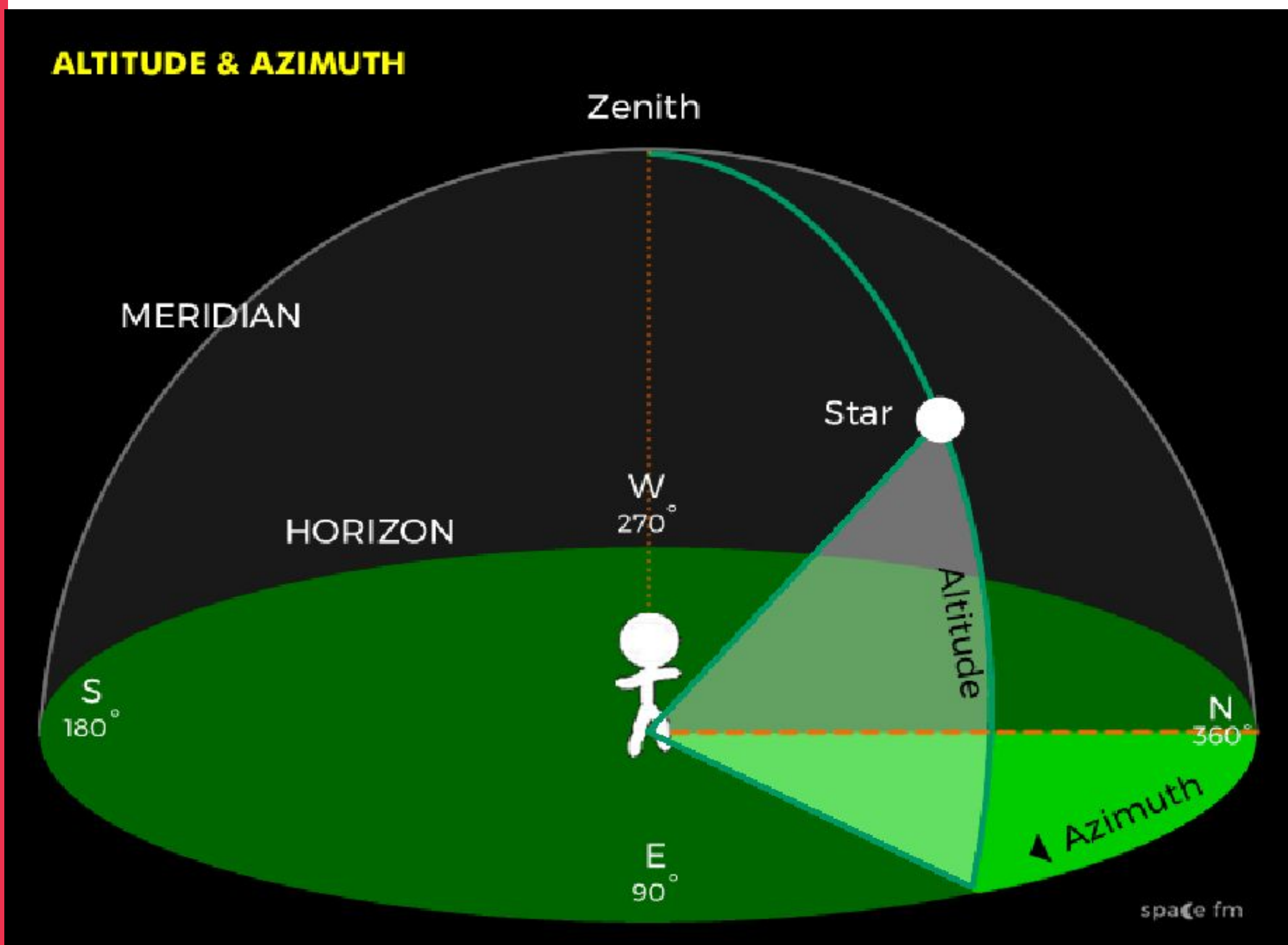
Name: NEKTARIOS KOURAKIS | School: Gel Vamou | City: Chania | Country: Greece

Sun path finder-Astrophysics lab tool

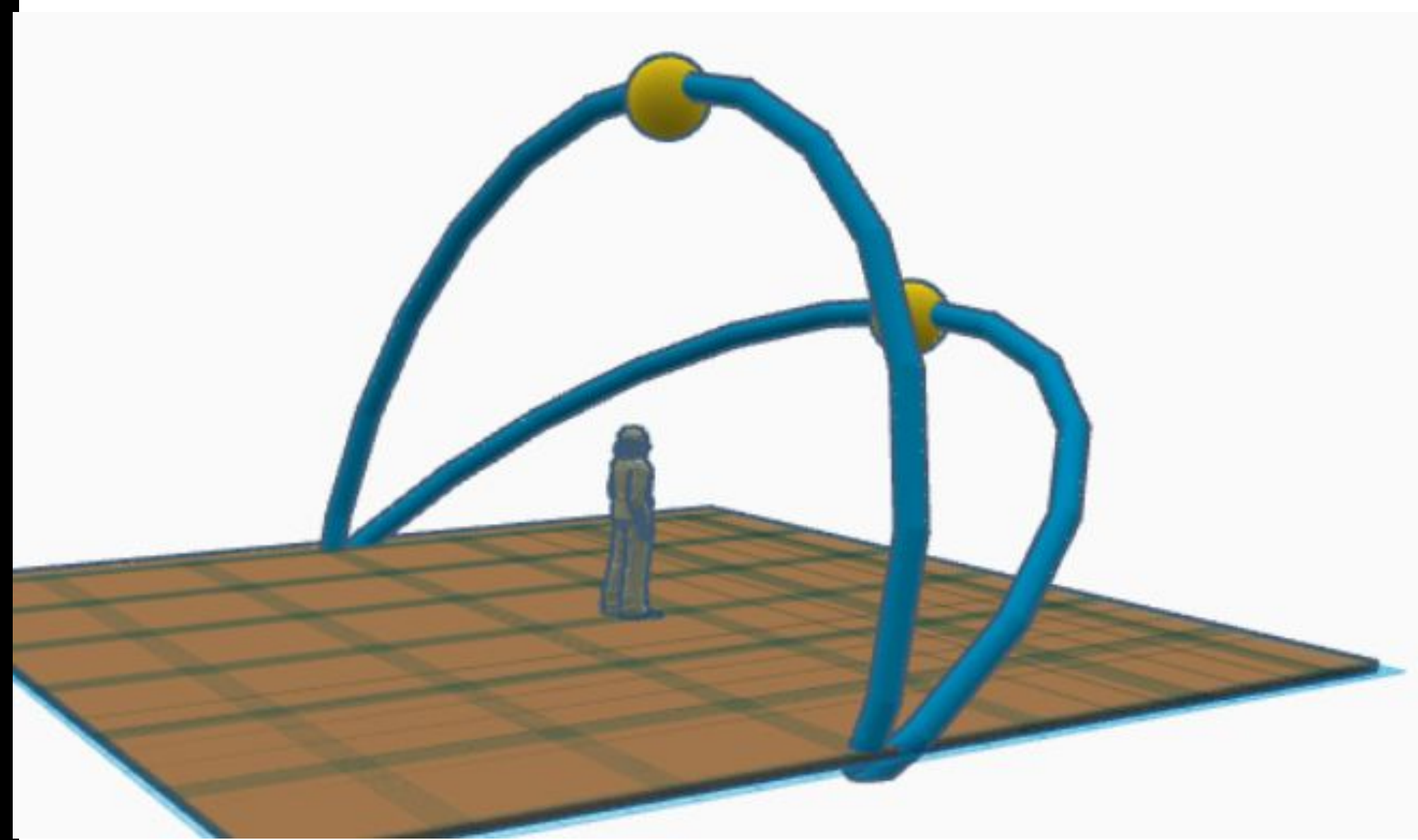
Solar tracker =MEASURE ALTITUDE AND AZIMUTH

An indirect way of showing the movement of the Earth around the Sun

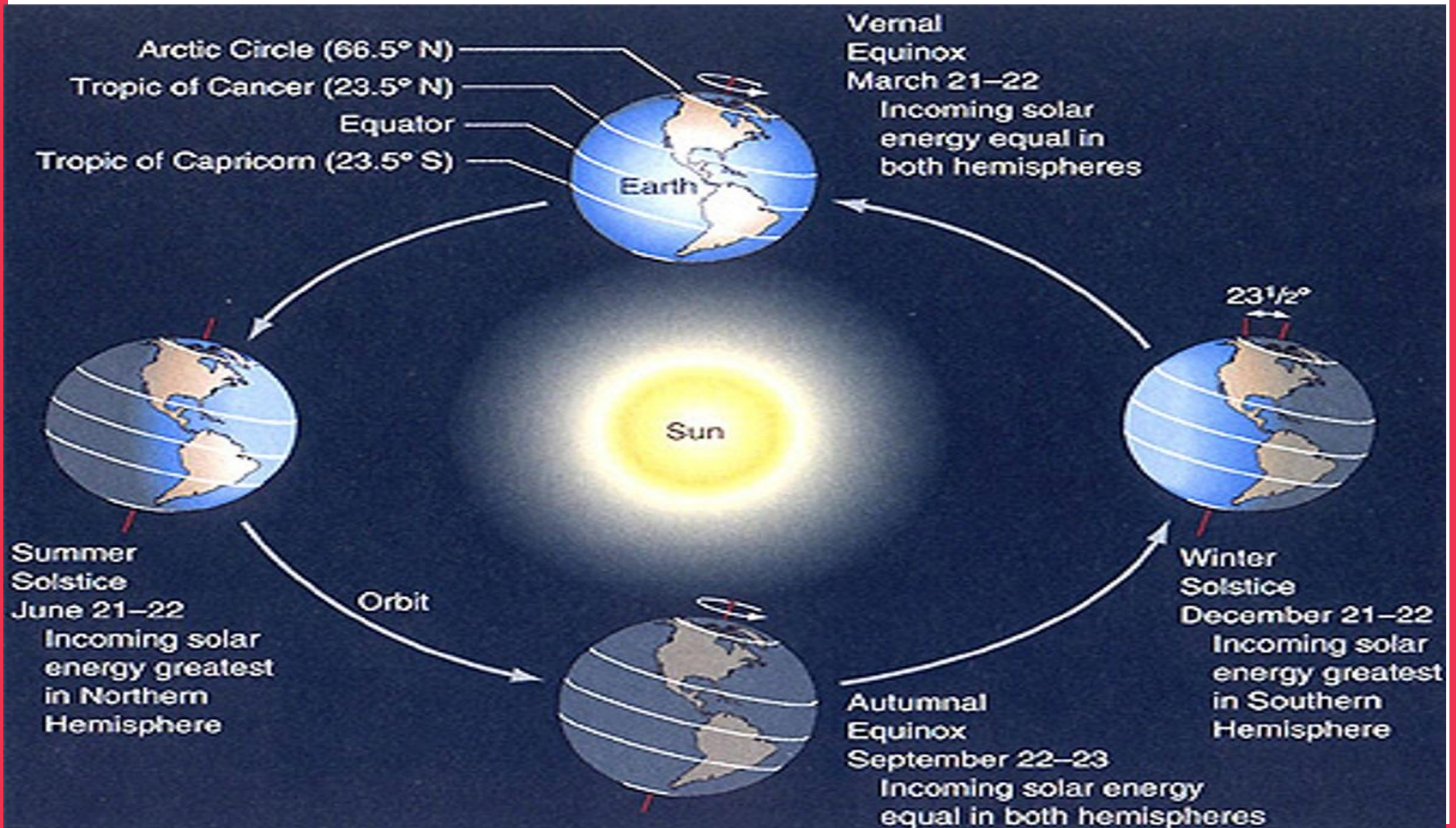
Conclusion: after measurements of two days , at least 1 month apart - here January 22 and May 22 - we draw in 3D the arcs that the Sun tracks across the horizon, see below and *

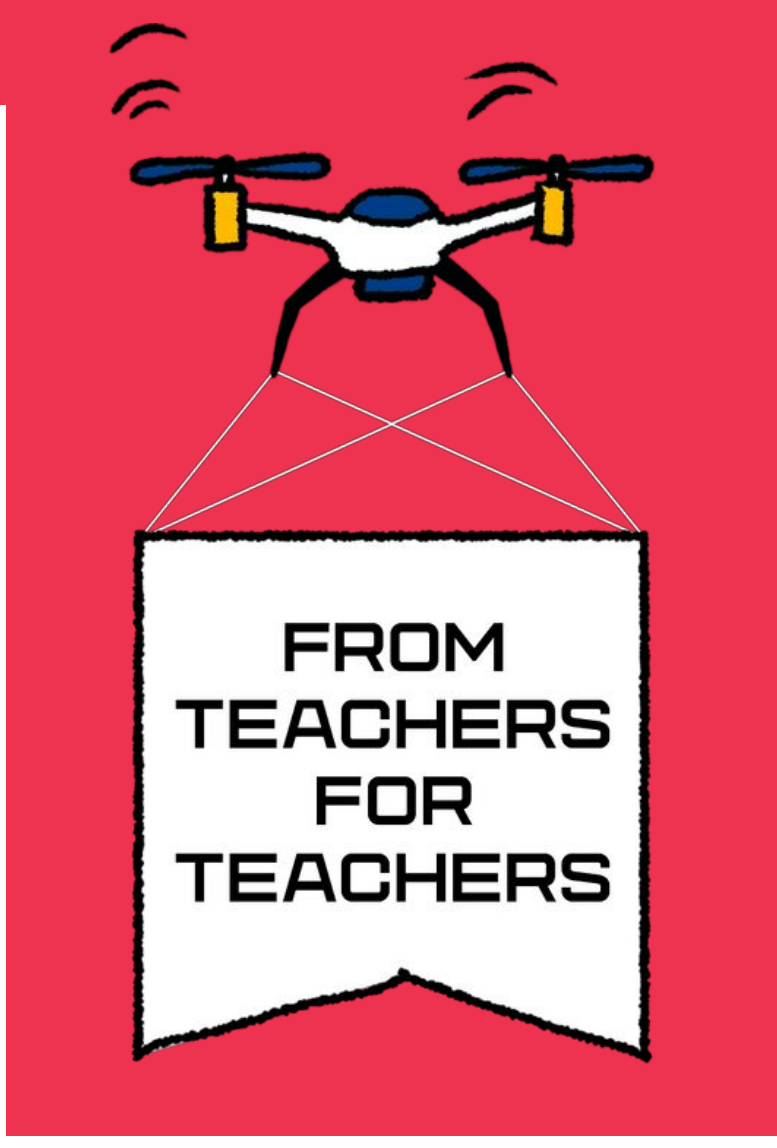


Place Vamos



* we interpret the results with the following information - image





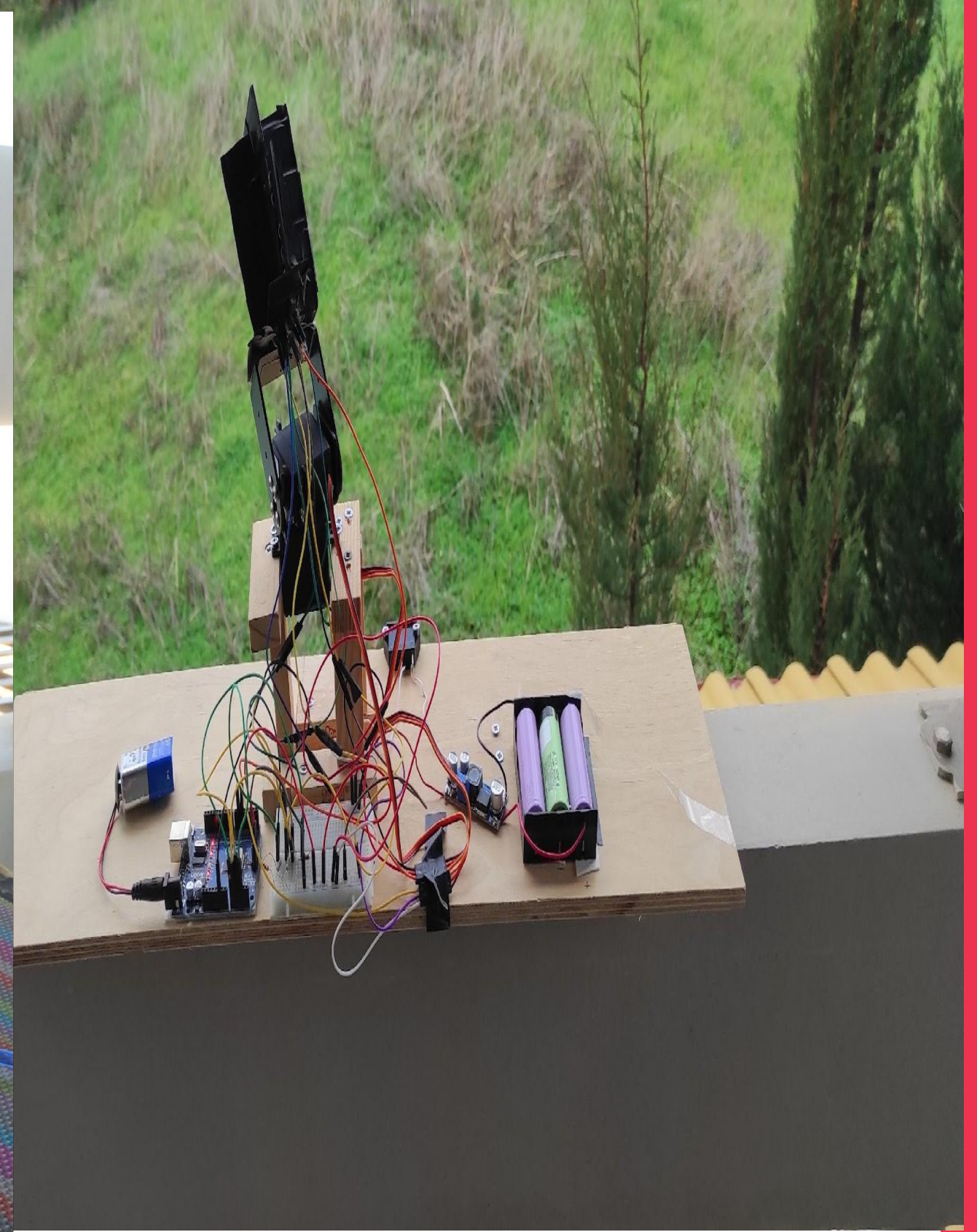
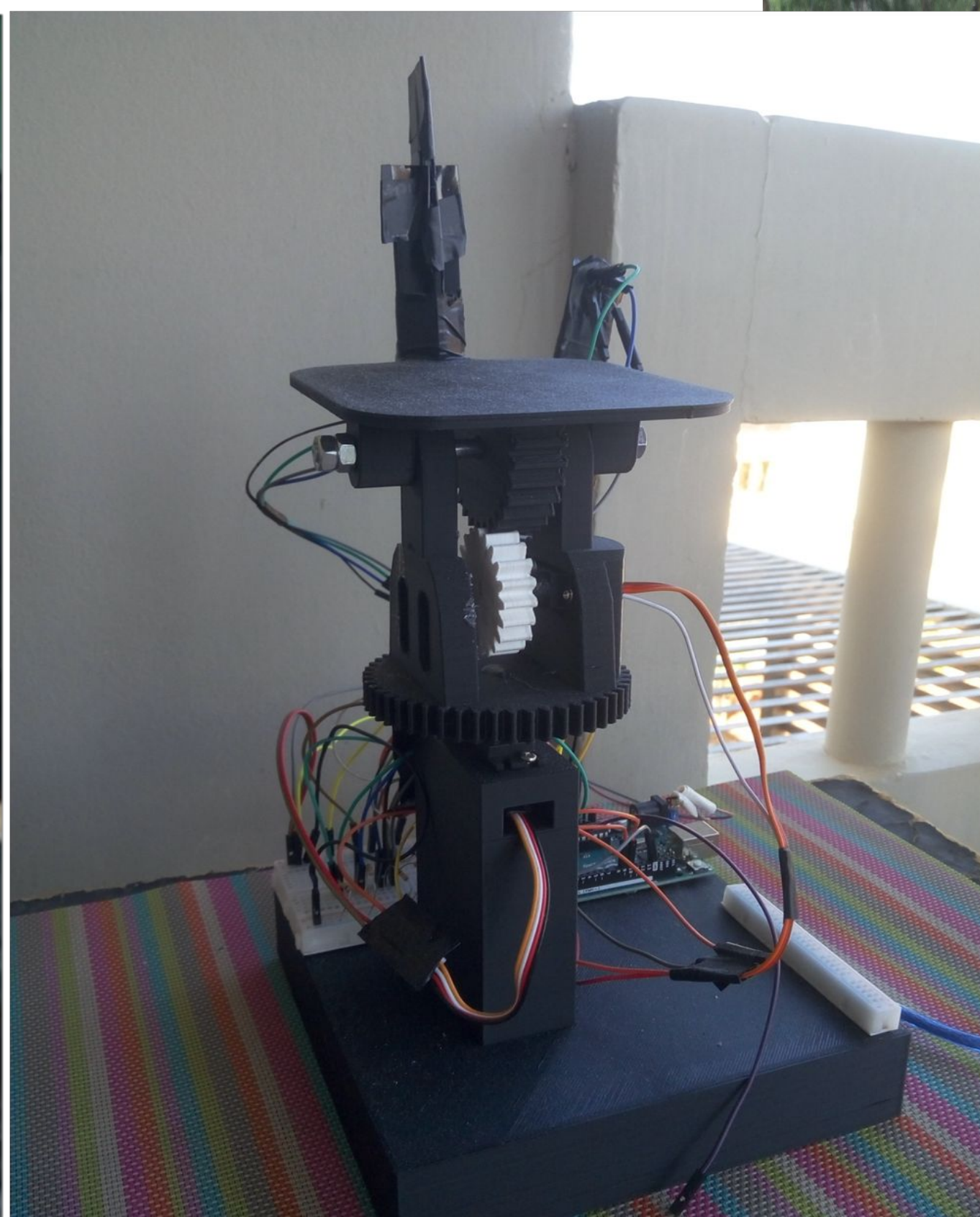
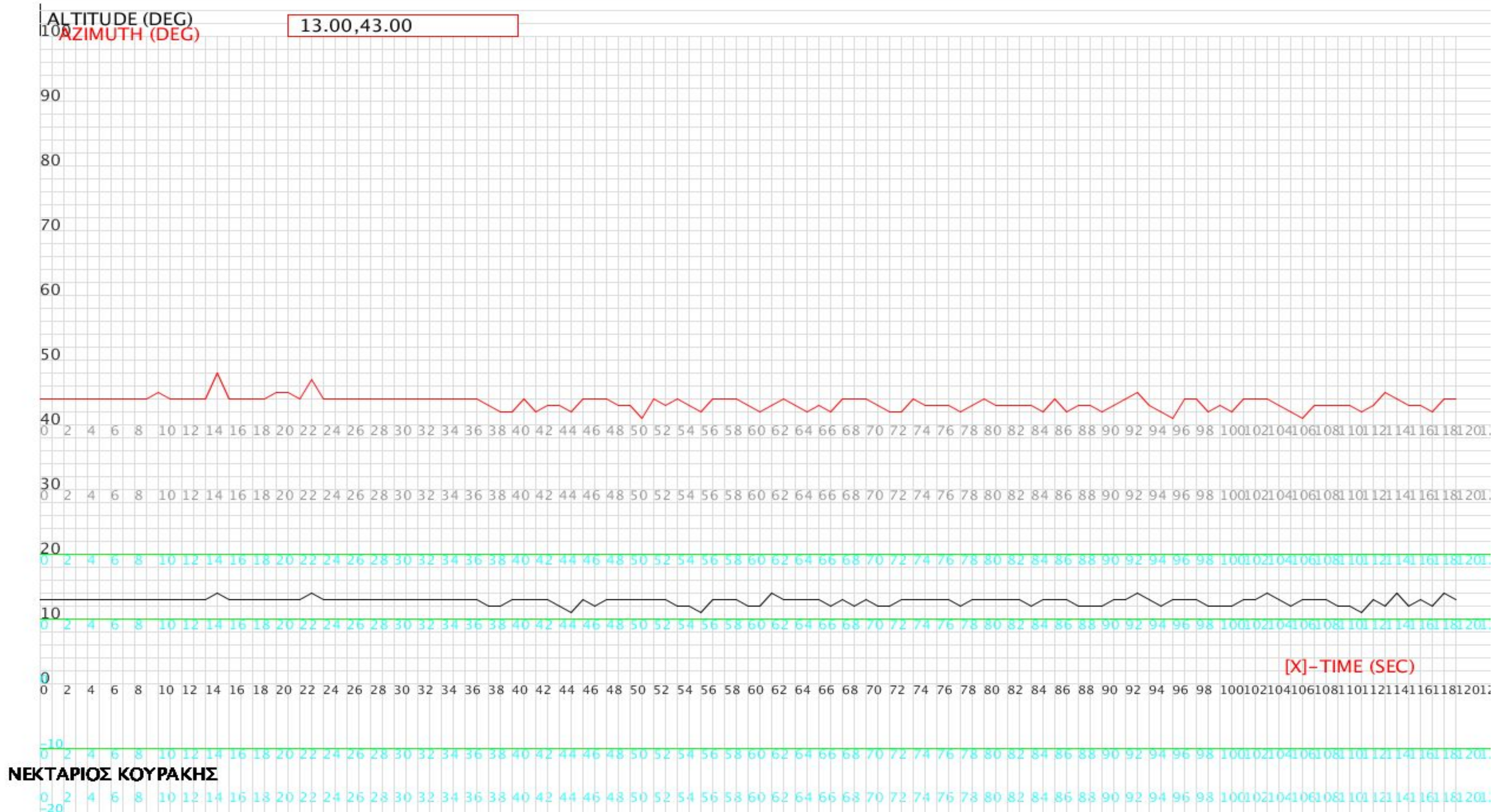
Sustainable Development Goals in Education

Name: NEKTARIOS KOURAKIS | School: Gel Vamou | City: Chania | Country: Greece

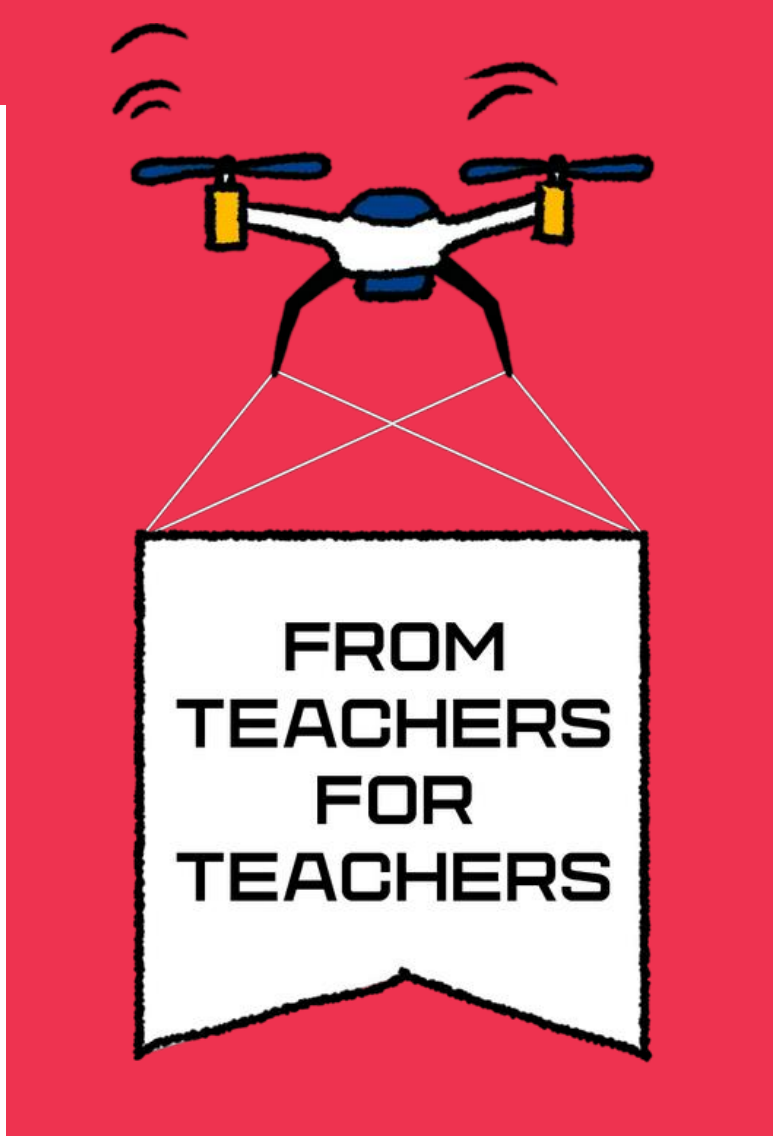
Astrophysics lab tool

Solar tracker = MEASURE ALTITUDE AND AZIMUTH

I create in processing ide (open software like arduino ide) a graph , to record the result .See the picture below



Also this is a real solar tracker that works outdoors and not just indoors for demonstration purposes.



Sustainable Development Goals in Education

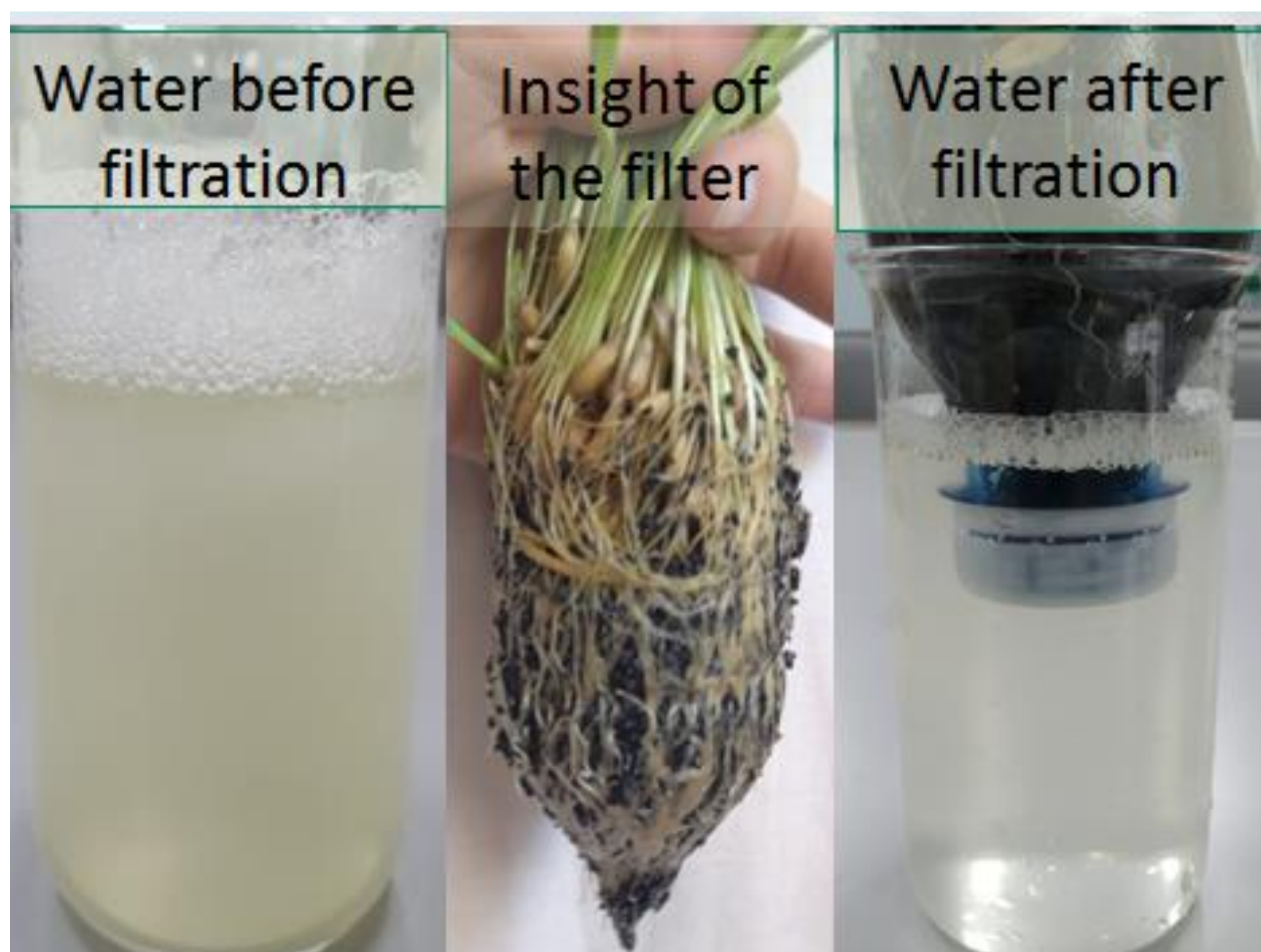
Zakanova Assel | NIS | Pavlodar | Kazakhstan

Water in the steppe – filter is the step

Small particles of plastic are found in cosmetics, clothes, and the water we drink. We have created an environmental filter that can trap microplastic particles in water.

- The **filter consists** of activated carbon and timothy grass seeds;
- The hull is made of clay and **can be used several times**

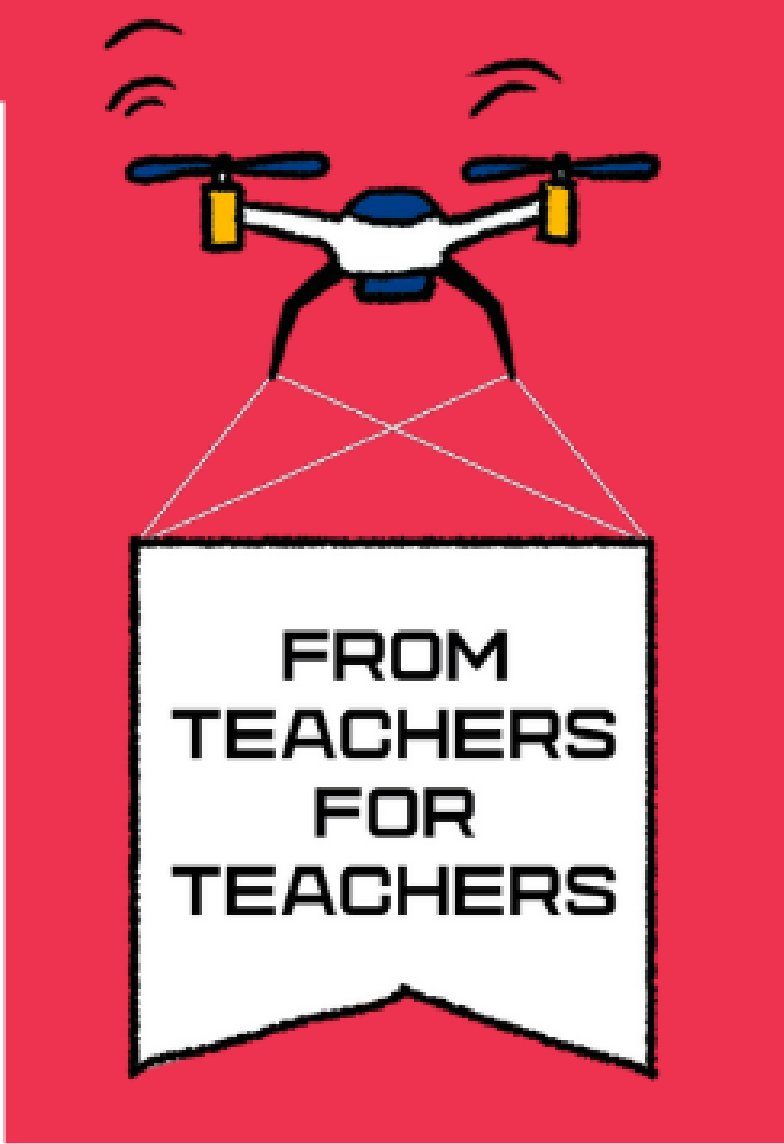
A special feature of the filter is "integrity". The roots of the plants are entwined with activated carbon. This allows the granules to fit snugly and improve filtration.



Colorimetry			
Before filtration		After filtration	
Abs = 1.135	$\lambda_1 = 340 \text{ nm}$	Abs = 0.080	$\lambda_1 = 340 \text{ nm}$
Abs = 0.854	$\lambda_2 = 546 \text{ nm}$	Abs = 0.024	$\lambda_2 = 546 \text{ nm}$
Abs = 0.847	$\lambda_3 = 628 \text{ nm}$	Abs = 0.027	$\lambda_3 = 628 \text{ nm}$
Abs = 0.789	$\lambda_4 = 800 \text{ nm}$	Abs = 0.029	$\lambda_4 = 800 \text{ nm}$

Conclusion: Our eco-friendly filter clean water from pollution.

- The filter does not harm the environment.
- Each person can make our eco filter.
- The eco filter does not require special filtration products and costs cheap.



SUSTAINABLE DEVELOPMENT GOALS IN EDUCATION

projects that show how STEM can contribute to achieving the SDGs

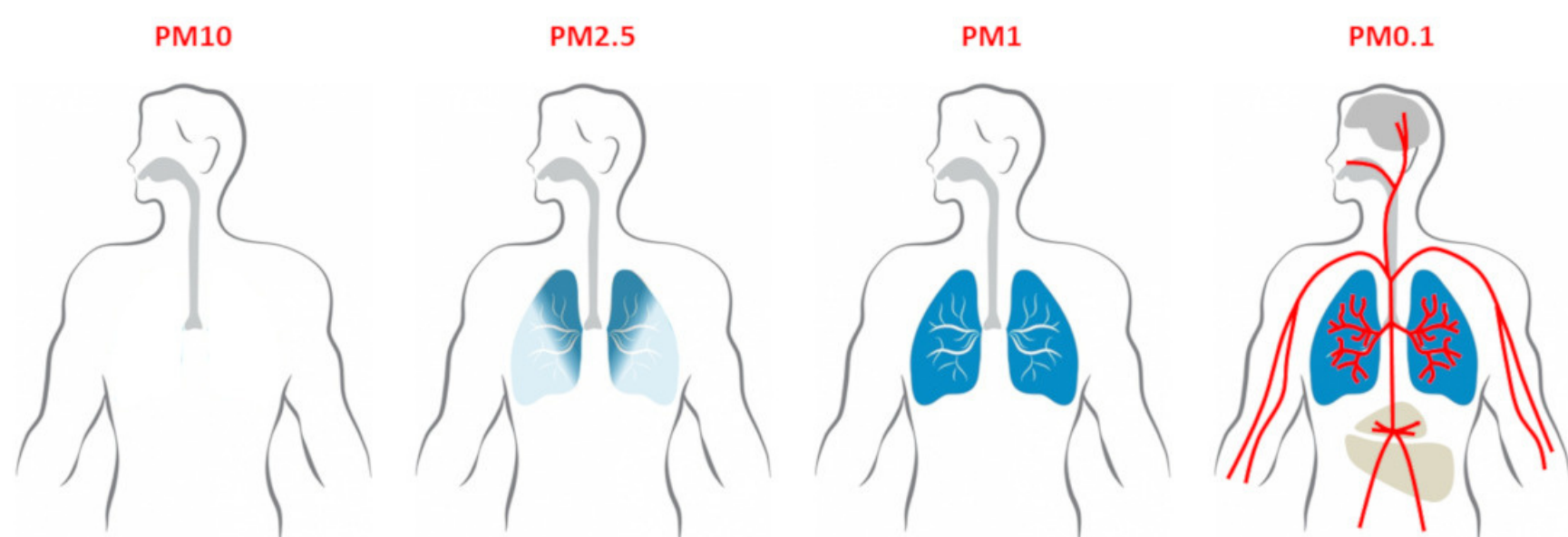
Maike Vollebregt, Joris ten Barge & Ton Reckman | Helen Parkhurst | Almere | The Netherlands

Students research the amount of particulate matter in the air and its effects on health, with a sensirion SPS30 sensor

In September 2021 the WHO (World Health Organization) issued a new advice about air pollution. Because major health problems arise from air pollution, even if the air quality meets current legal standards. More than 8 million people worldwide die prematurely because of poor air quality, according to the WHO. In Europe this concerns 440,000 people and in the Netherlands 12,000. With this project we try to make young people more aware of the air in their environment. After all, our air makes the earth habitable. Without air there is no life for us, while the current air quality can make us sick this very moment.

The WHO guidelines work with a classification based on size, because it says something about the ability to penetrate into the human body. Particles larger than 10 µm get stuck in your upper respiratory tract. Particles with a size of 2.5 to 10 µm remain in the mucous membranes of the airways. Particles smaller than 2.5 µm can penetrate deep into the lungs and can enter the bloodstream through the alveoli.

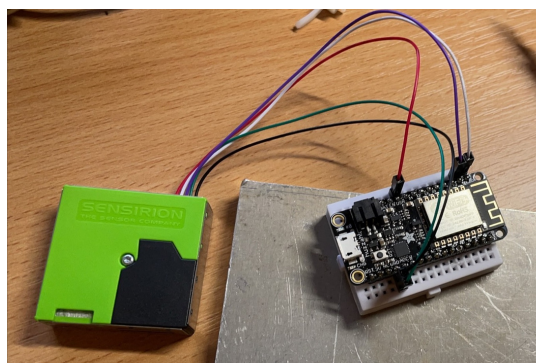
Particulate matter does not only have an impact on humans, but also on all other organisms and on our natural living environment. In general you can say that there is a correlation between climate change and air quality also. The relationship is complex and a lot of scientific research is still needed to understand the relationship. We know that certain pollutants such as (black) elemental carbon give rise to an increase in temperature through heat adsorption. Elemental carbon is part of particulate matter and mainly comes from incomplete combustion processes. More particulate matter also leads to more clouds: it gets warmer under the cloud cover, but the white clouds at the top reflect the heat radiation from the sun back into space, thus cooling them down.



Methods

Idea

Students make a team of four persons. Every team member chooses the role of an expert. For example; one is a doctor, the other an environmentalist, another a data analyst and an engineer. Within their expertise they do small research. They ask themselves a research question for example; what's the influence of particulate matter on human health or how does a sps30 sensirion sensor works or what are sources of particulate matter in the school surroundings? They will also look at the various emission sources; the natural sources, but also the anthropogenic sources.



Plan

The particulate matter sensor that students use distinguishes between particle sizes of PM2.5 (all particles smaller than 2.5µm) and PM10 (all particles smaller than 10 µm). After the exploration, students formulate a research question. They have to make a research plan (method), e.g. they look at the influence of wind on particulate matter movement (sometimes several hundred kilometers), in relation to the location of their sensor.

Implement

When their work plan is approved by the teacher, students can assemble their sensor kit (sensor, microcontroller, power supply, cables, housing). They learn to program the microcontroller and adapt it to their situation, for example to program their WiFi access. With a power bank and their phone's hotspot, they can use the sensor kit at any desired location in their city and in the field to collect their data. Material is available for this.

Analyse

Students analyze their own data and compare their data with the data of the Grafana website. They also make a graphical overview of the most interesting results.

Evaluate

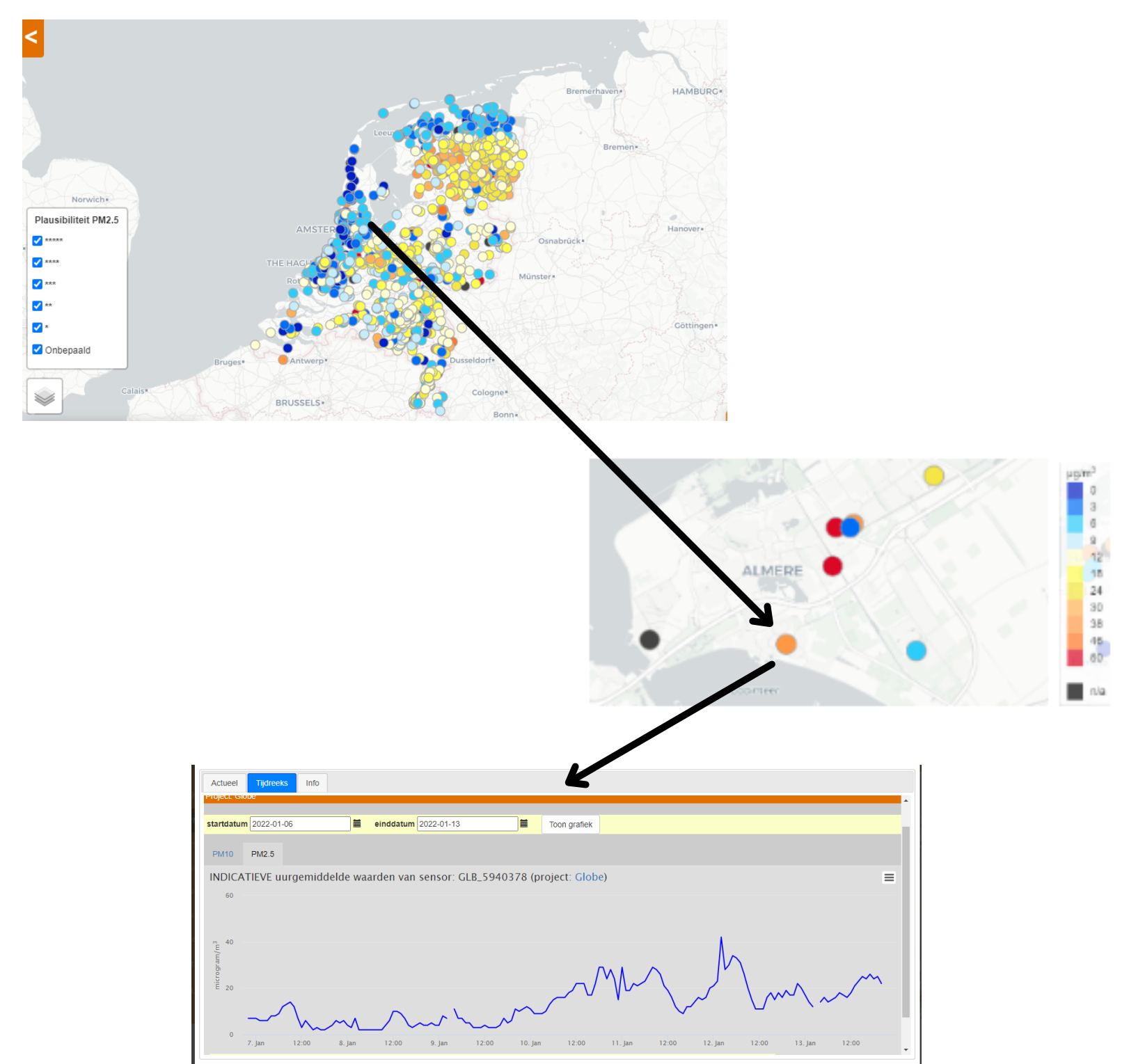
Based on the results, they work as a team to decide how they can contribute to reduce the amount of particulate matter and improve air quality. For instance, they can approach the school, their parents, the (sub)municipality, the local government and discuss their data and conclusions, with the aim of reducing the amount of particulate matter.



Results

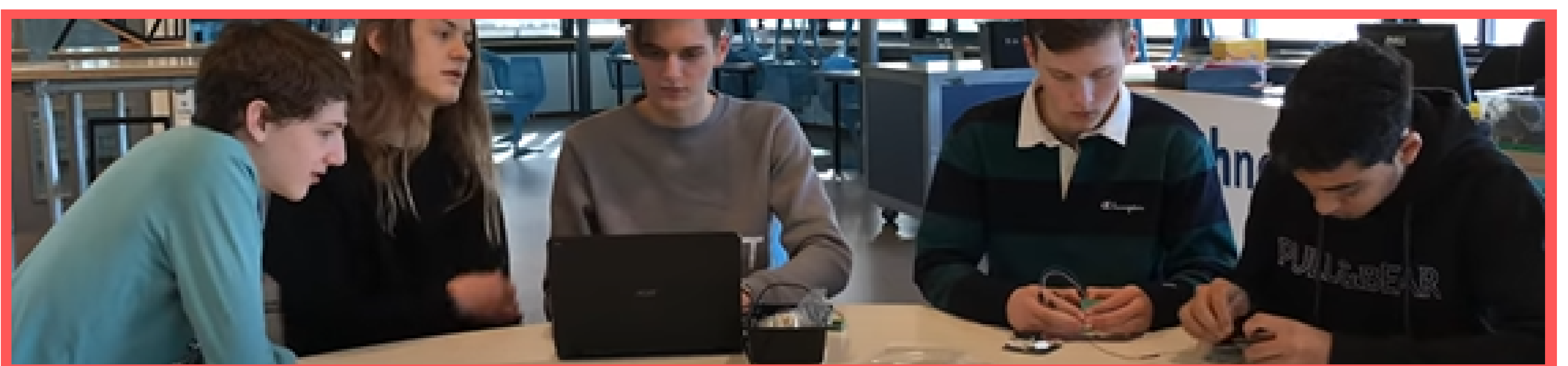
The RIVM (National Institute for Public Health and the Environment) in the Netherlands has been measuring the particulate matter concentration in the atmosphere since 1992 at a number of official measuring points. European sister organizations of the RIVM make comparable measurements. This makes them an important institute in research into particulate matter. They collect all kinds of data about our living environment. They do this to monitor the quality of our living environment. The data collected by students in the Netherlands, with their sensor kit, ends up in their database.

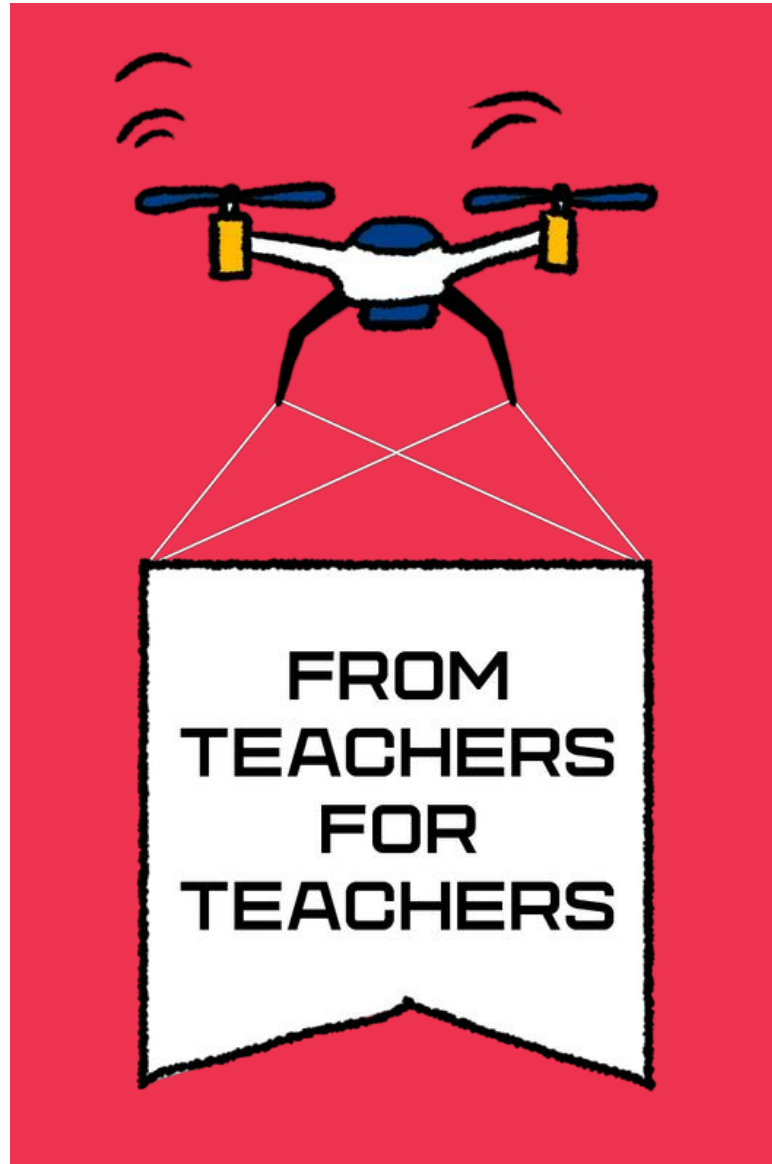
<https://samenmeten.rivm.nl/dataportaal/>



Conclusion

The Netherlands has since 2020 an agreement of clean air between the central government and the local government. Those participants has the ambition to reduce the particulate matter of 50% in 2030. The particulate matter project is now running by several schools in the Netherlands.





Gimnazija Kranj



Sustainable Development Goals in Education

Dr. Rok Rudež, | Gimnazija Kranj | Kranj | Slovenia

Nuclear fusion energy as motivation and real-life task for students and can be included in the school curriculum

Introduction

One of the goals of The European Commission is to reduce EU greenhouse gas emissions by 55% by 2030 compared to 1990-levels. The nuclear fusion realized through the ITER project is a promising and ambitious project to produce self-sufficient, green, and reliable (not weather dependent) energy. The fusion energy will be reviewed as a real-life task and will show where could be included in the school curriculum.

What is fusion?

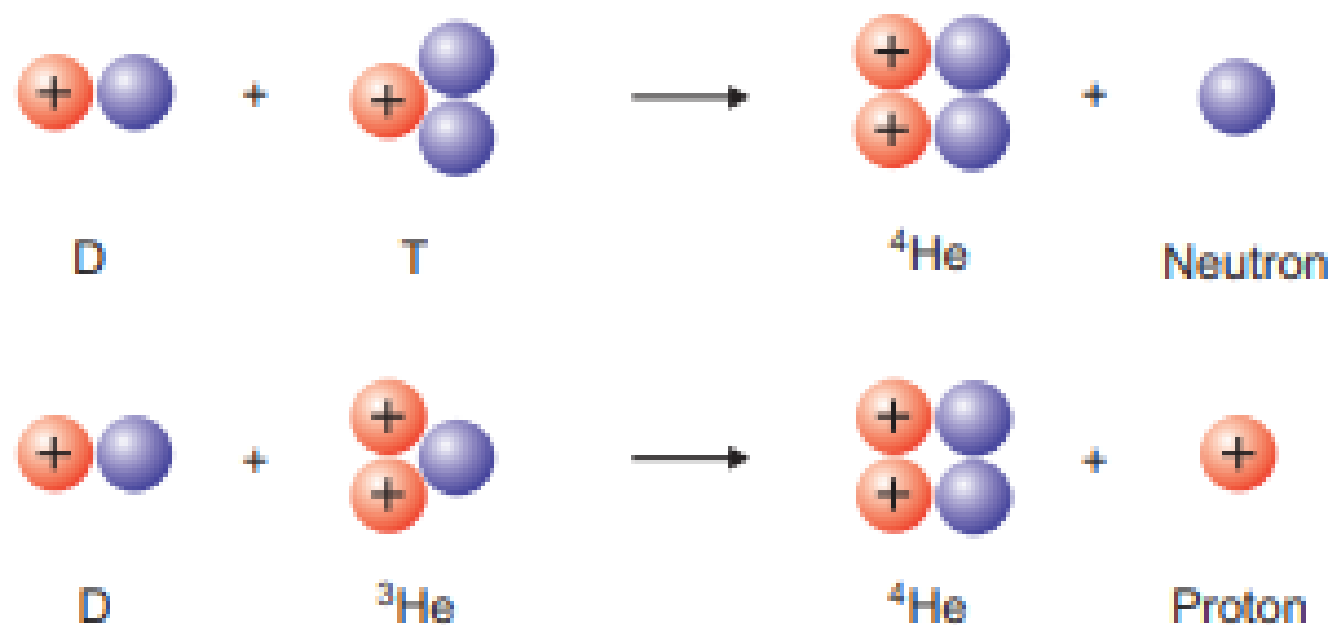


Fig. 1: Fusion reaction equation [1]



Fig. 2: Plasma made in tokamak [2]

Fusion reactor

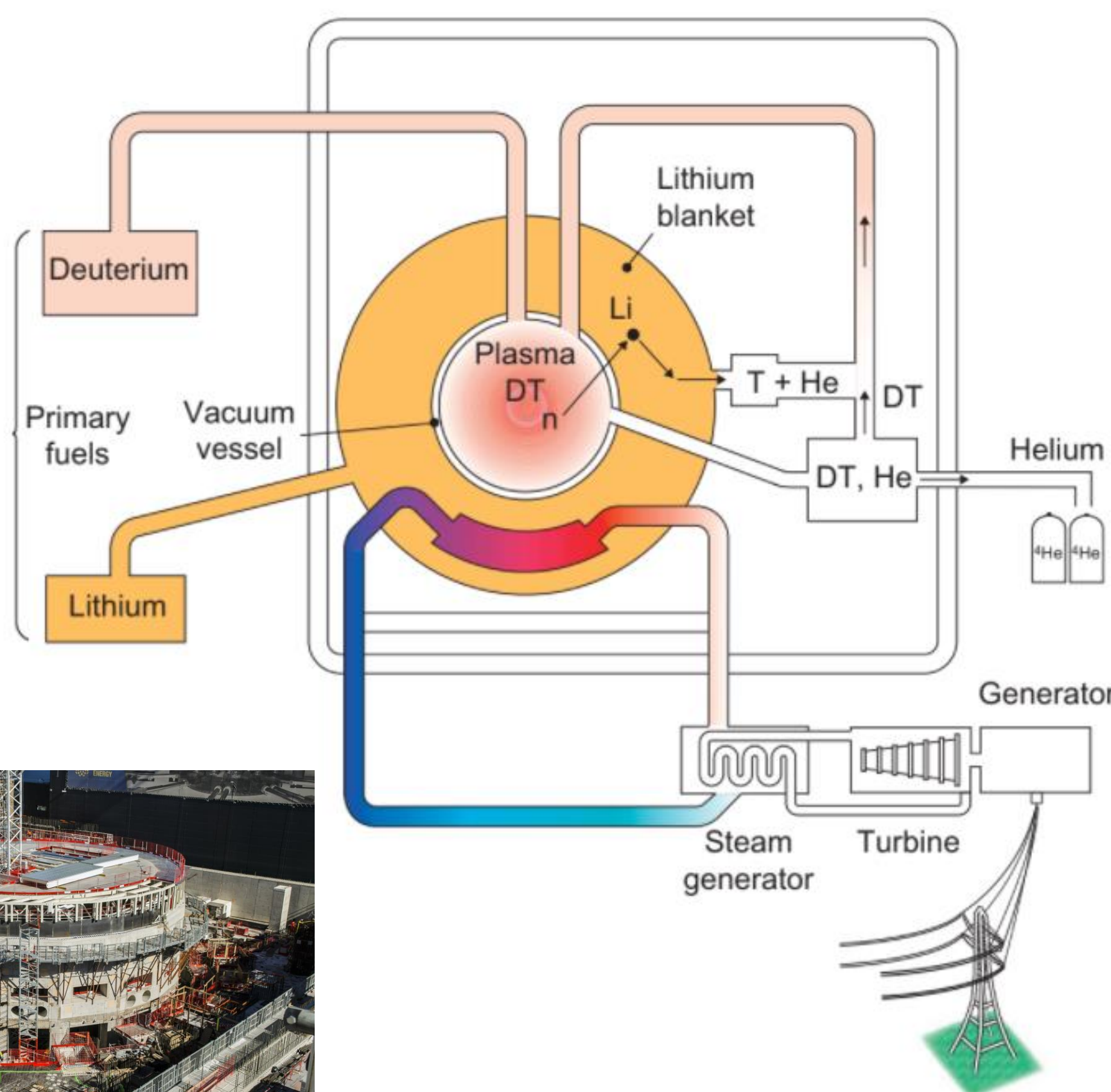


Fig. 4 Fusion reactor scheme [1]

How to get fuel?

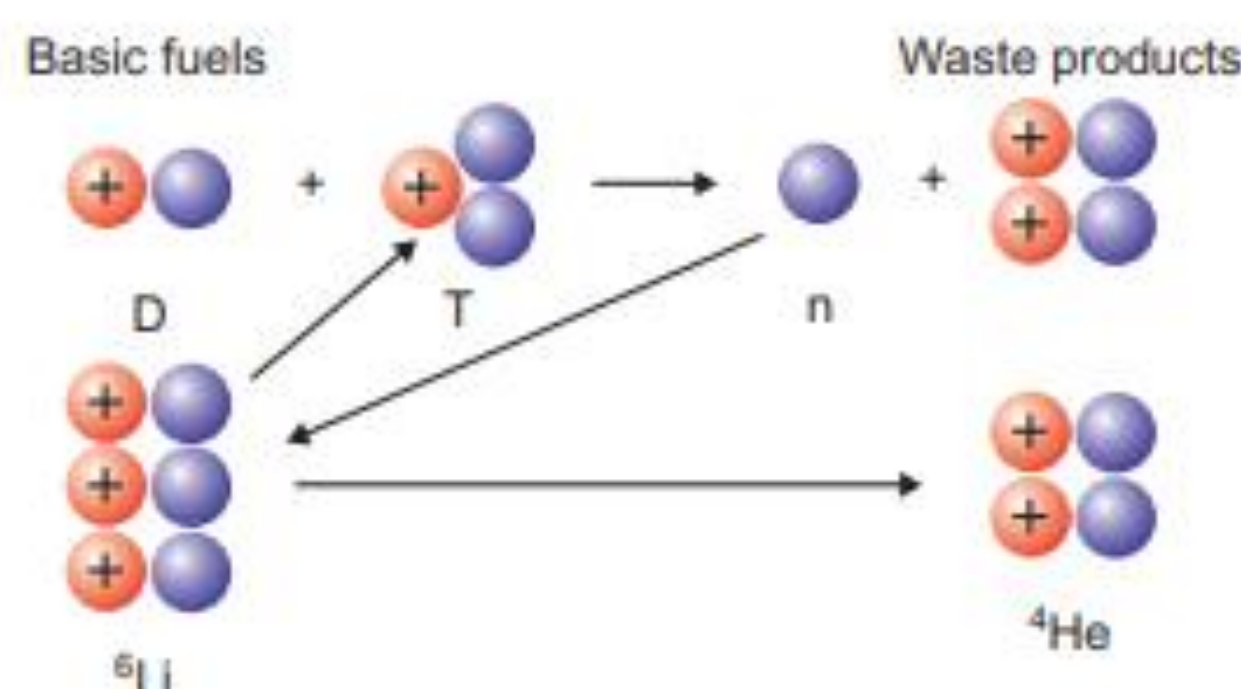


Fig. 3: Fuel recovery equation [1]

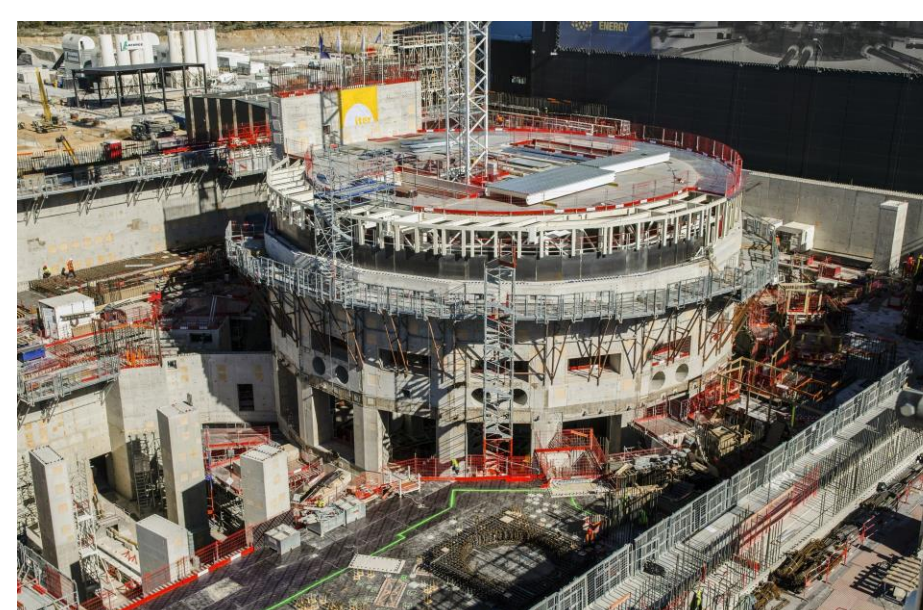


Fig. 5: ITER tokamak located in France [3]

Conclusion:

- student is able to construct equations for fusion reaction,
- student can explain fusion reaction in terms of enthalpy,
- student understands the role of the isotope in a fusion reaction and fuels recovery,
- Student is able to compare fusion and fission reaction,
- student can critically evaluate the risks as well as benefits of fusion reaction and fusion reactors.

[1] Fusion, The energy of the universe, McCracken G., Scott P., Elsevier, 2012 [2] Sciencealert, online: What Is Nuclear Fusion, And Why The Hype? (sciencealert.com), 15.1.2021 [3] ITER France, online: ITER in France, 15.1.2021



Sustainable Development Goals in Education

Pernilla Berglund | NTI | Uppsala | Sweden

Ecosystem services in city and school

Why are plant walls in city and school **blossoming**?

More than half of the world's population lives in urban areas. On 25th September 2015, UN member states adopted Agenda 2030. The agenda contains 17 sustainable development goals (SDGs). Goal number 11 focus on sustainable cities. **Ecosystem services*** and **nature-based solutions**** provide environmental, social and economic benefits and help build resilience to climate change in cities.

* *Ecosystem services* are services provided by ecosystems that contribute to human well-being.

** *Nature based solutions* are solutions inspired by nature that ensure ecosystem services

The aim in this learning scenario is to explore ecosystem services in city and school (figure 1 and 2)



Figure 1. Plant wall, Uppsala city



Figure 2. Plant wall, NTI gymnasiet Uppsala

Explore ecosystem services in city

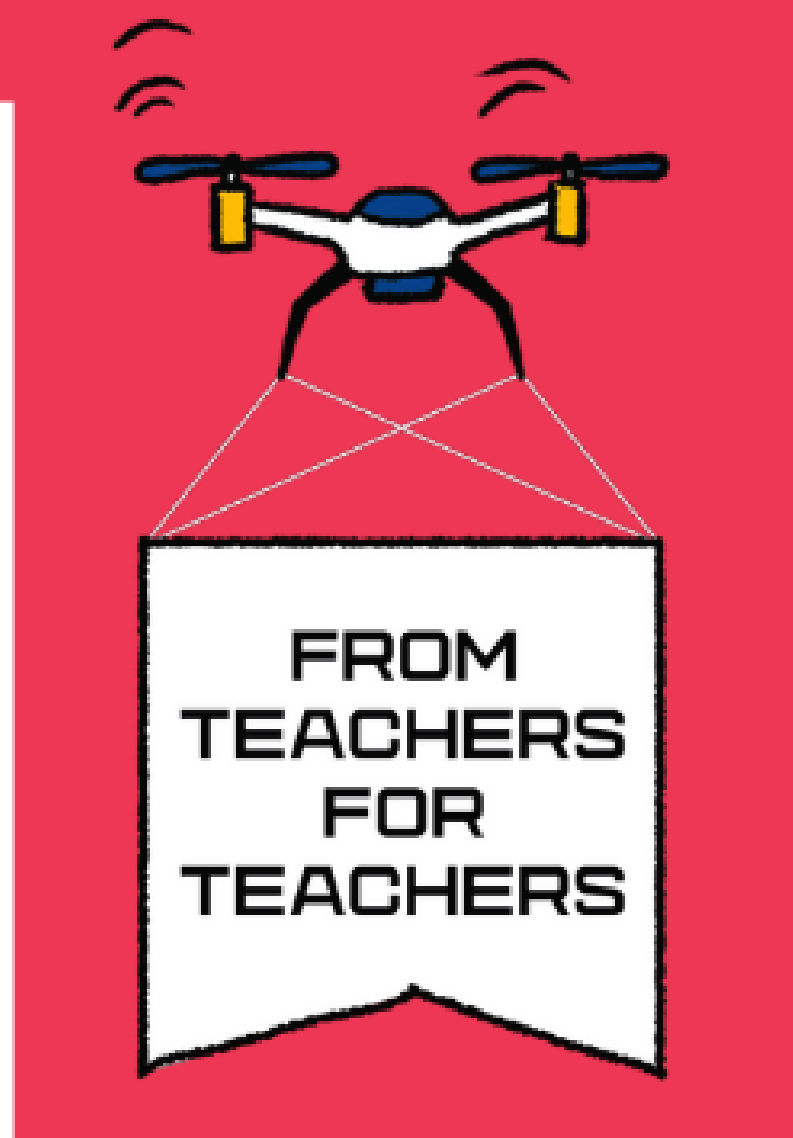
- ✓ Reduce carbon emission, remove air pollutants and attenuate rain water
- ✓ Reduce ambient noise and temperature
- ✓ Increase well-being and support ecosystem services (pollination etc.)

Explore ecosystem services in school

- ✓ 3D print material, add plants and nutrients
- ✓ Program UV-light and water supply
- ✓ Measure pH, CO₂, temperature in real time by using PASCO

Conclusion: The project is **blossoming** since it contributes to future citizens and 21st skills:

Communication, Critical thinking, Creativity, Collaboration



SUSTAINABLE DEVELOPMENT GOALS IN EDUCATION

projects that show how STEM can contribute to achieving the SDGs

YINA SALAMANCA | DALARÖ SKOLA | STOCKHOLM | SWEDEN

CHEMISTRY UNDER YOUR SKIN

KEMI UNDER DIN HUD

<http://www.atsstem.eu/sweden/dalarno-skola/>

Tattoos are a cultural phenomenon that has been around for millennia and certainly in Europe they have recently experienced a renaissance.

Through a series of **easy analytical experiments**, various tattoo inks are examined regarding their chemical and physical properties. The potential consequences of these will then be used to contextualize tattoos regarding the **pupils' personal lives and decision making processes**. Based on the **UN's Global Goal 3**, the project is focussed on **Education for Sustainable Development (EDS)**, with the intention of developing the pupils' **capability of association and critical thinking**.

SUSTAINABLE DEVELOPMENT GOALS

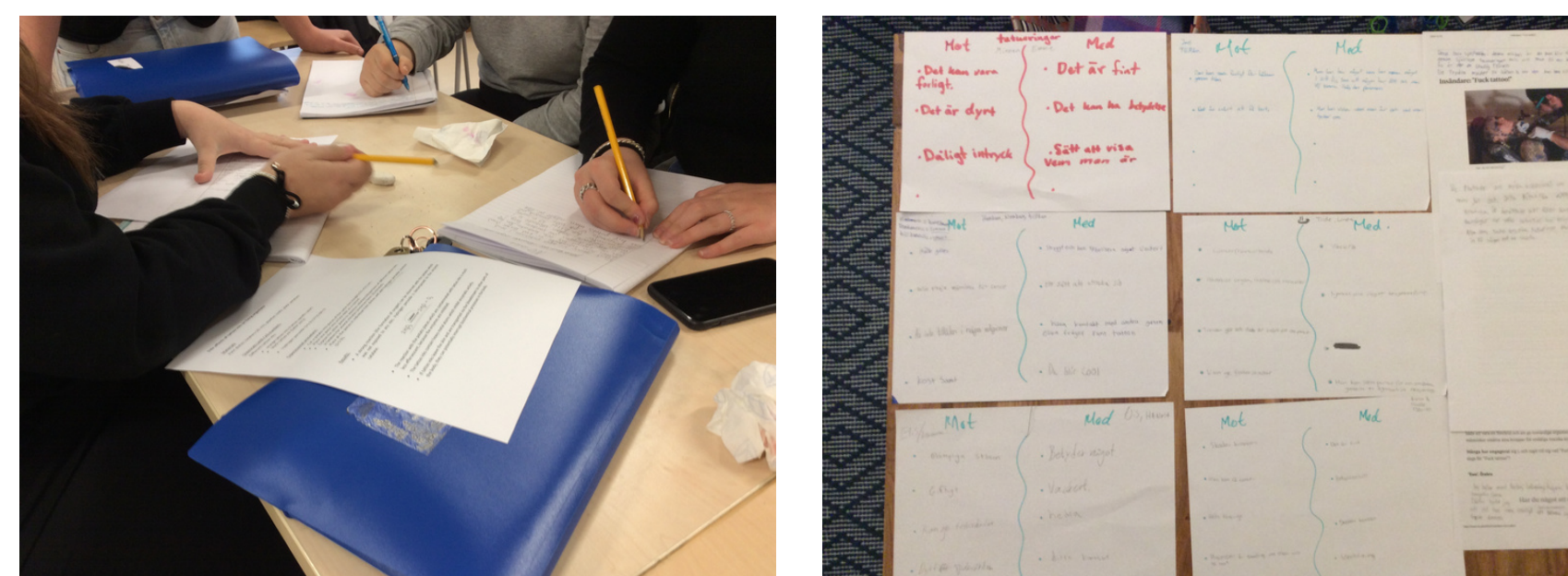


What did we do ?

- **Created** interest in the students.
- Experiments for **investigation** tattoo inks.
- **Discussion** using the observations and the results from the experiments relate them to specific literature on the subject.

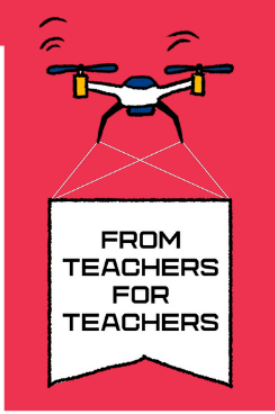


J. Chem. Educ. 2015, 92, 1, 129-134



http://www.atsstem.eu/wp-content/uploads/2020/11/ATS_STEM_brosura_A4_WEB.pdf

How do teachers work with social issues with scientific content in their teaching?



SUSTAINABLE DEVELOPMENT GOALS IN EDUCATION

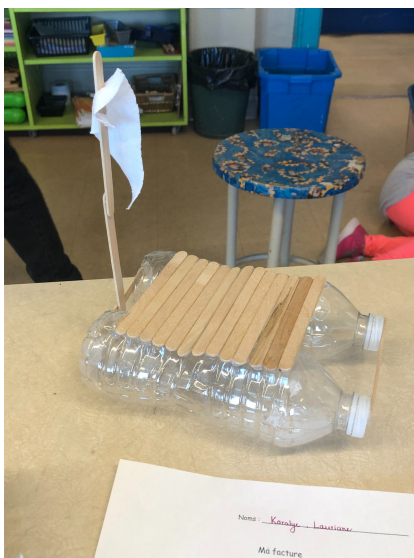
projects that show how STEM can contribute to achieving the SDGs

Élisabeth Jobin / St-Paul / Trois-Rivières / Canada

Basic boat building materials vs the environment

Preserving the environment for future generations is a very important issue. What better way to address this than by getting students involved in a miniature boat building project where they can choose and compare different construction materials.

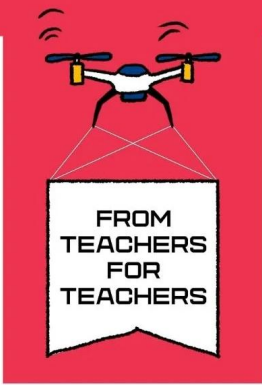
For example, the students will look at the use of different materials and determine which ones are produced at higher costs on the environment.



Also, the students will examine the negative aspects the use of these materials will have on the environment.

An engineer will then be invited to class. He will present his profession and talk about the importance of choosing the right materials when designing important structures, such as ships.

The students will then construct model boats using different materials which will be tested in class.



SUSTAINABLE DEVELOPMENT GOALS IN EDUCATION

François Bonny | Middle school Jean l'Herminier | La Seyne-sur-Mer | France

Reduce the digital divide

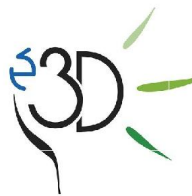
By recycling used computer

With all the digital work requested by teachers, **it is extremely penalizing today for our students not to access a computer at home, it will be worse tomorrow.**

Our circular economy project enables the delivery of **5,000 computers** to students in the South of France region.

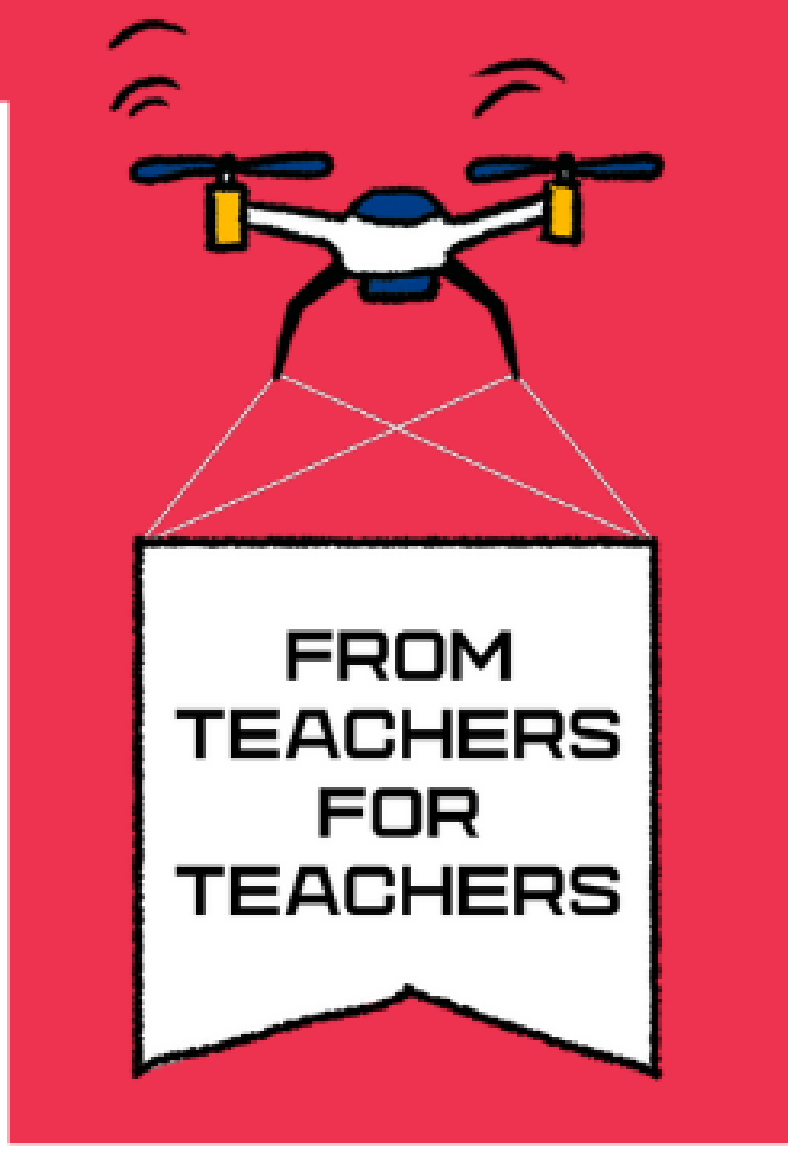
We collect used computers from middle and high schools and screens from large companies such as la SNCF.

Computers are repaired and rebuilt under Linux in a hundred of workshops.



Our Linux





SUSTAINABLE DEVELOPMENT GOALS IN EDUCATION

projects that show how STEM can contribute to achieving the SDGs

Ketevan Ediberidze | J.L.C Tavadze and Company School Anabasisi | Zestaponi | Georgia

No Polyethylene!

- Project aim: making packaging material from starch.
- The largest amount of polyethylene is used for making the packaging material.
- The packaging material, which is produced from starch, we can use instead of polyethylene. For making packaging material, we used starch, water, glycerin, vinegar or citric acid and food dyes. The Combination of these abovementioned ingredients, modified starch and it happened at high temperature. From given mass, we made the packaging material which we think is one of the alternative ways to replace synthetic materials with bioplastics.

Process of making bioplastic



This bioplastic looks like polyethylene.

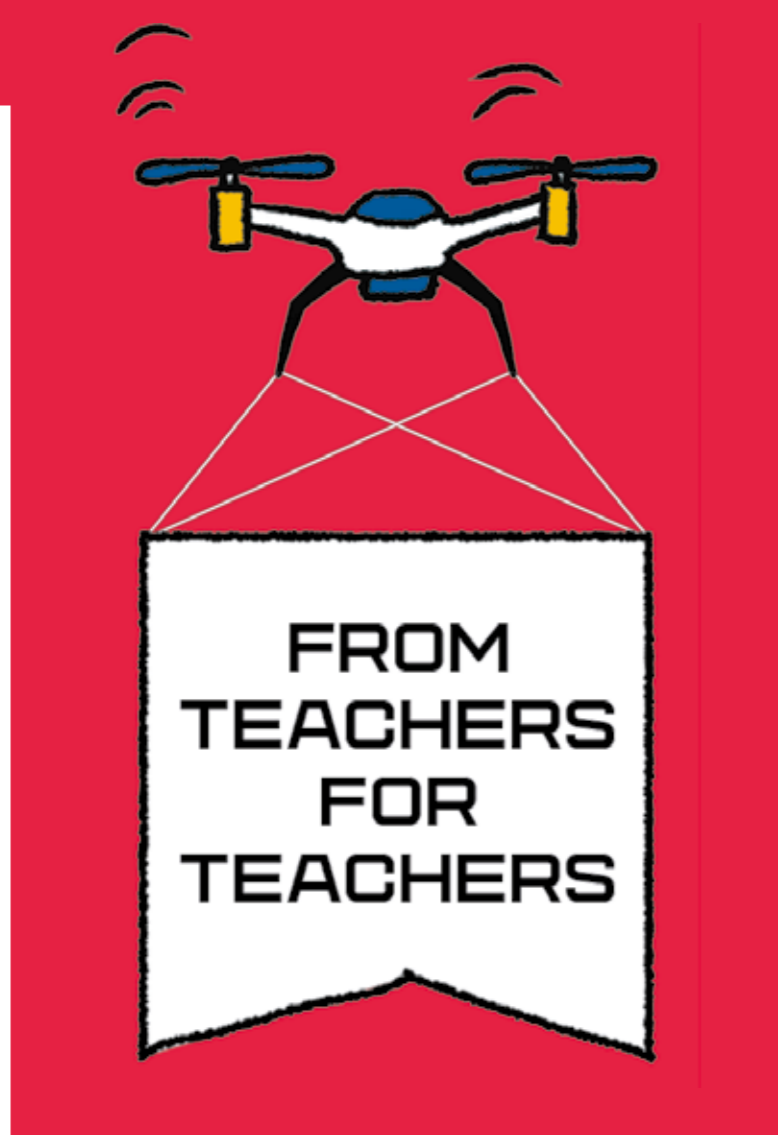


Czech Republic flag made of bioplastics.



Georgia flag made of bioplastics.

The packaging material, which is produced from starch, is environmentally save. It does not change food flavor. It does not dry food products. It is airproof. One of its advantages is also the following: It is easily decomposed with the help of water and microorganisms that are in our soil.



SUSTAINABLE DEVELOPMENT GOALS IN EDUCATION

Daniela Heinrich-Stiller | Lahntalschule Biedenkopf | Germany

Become a researcher with cornstarch

optional classes chemistry

With harmless chemicals such as starch and water, students can become researchers themselves. With simple devices and chemicals, students can first work out the recipe for making a starch film themselves. Students learn how important a positive error culture is and how to learn from eventual mistakes.

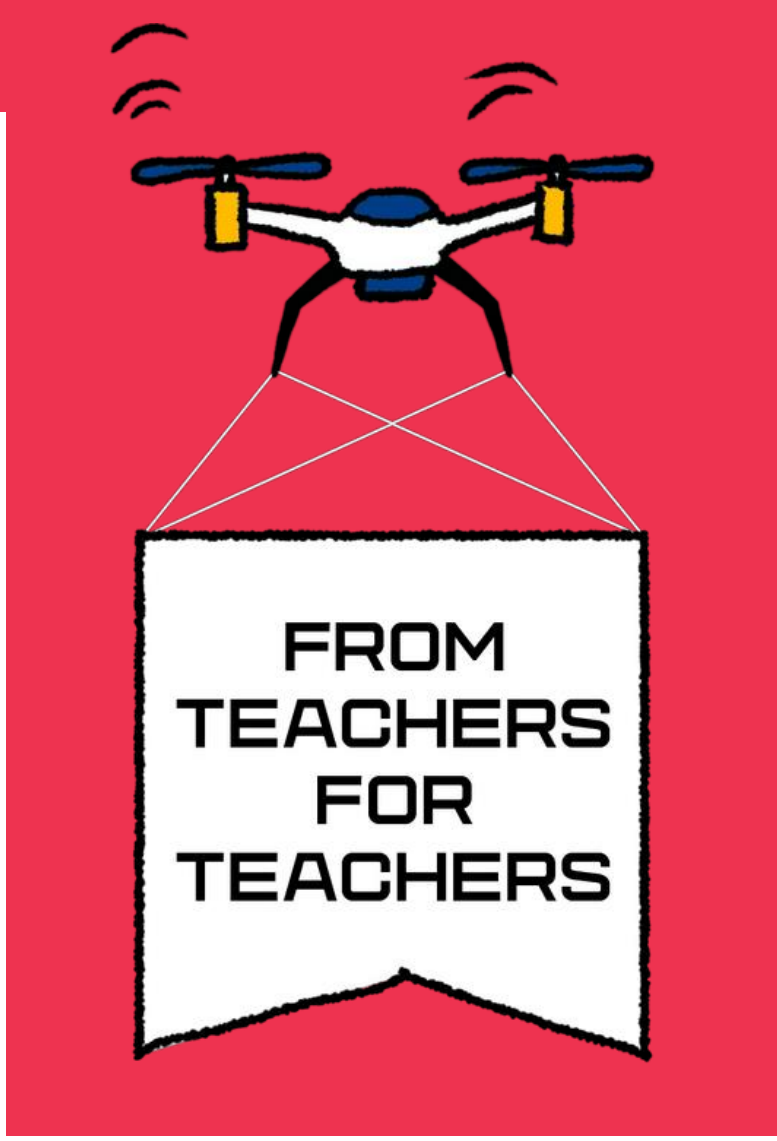
The basic problem is to develop a film that is biodegradable. In order to create different properties of the film, students are given time to think about suitable additional materials that they process and later interpret their observations accordingly. Of course, students can also explore the decomposition of their film in nature.

In most cases, the observations can be explained with technical findings. For example, due to different polarities, the starch mass cannot be mixed with oil. However, glycerine or sugar gives you a smooth film, because these substances are integrated into the starch matrix via interactions and act as plasticisers. This allows students to try out different additives and explain the results through research or expertise.

In my project example, students even applied for a **patent** on their invention.



Honey in a starch matrix, as a disinfecting and cooling pad for burns.



Sustainable Development Goals in Education

Bouliari Georgia, Physicist

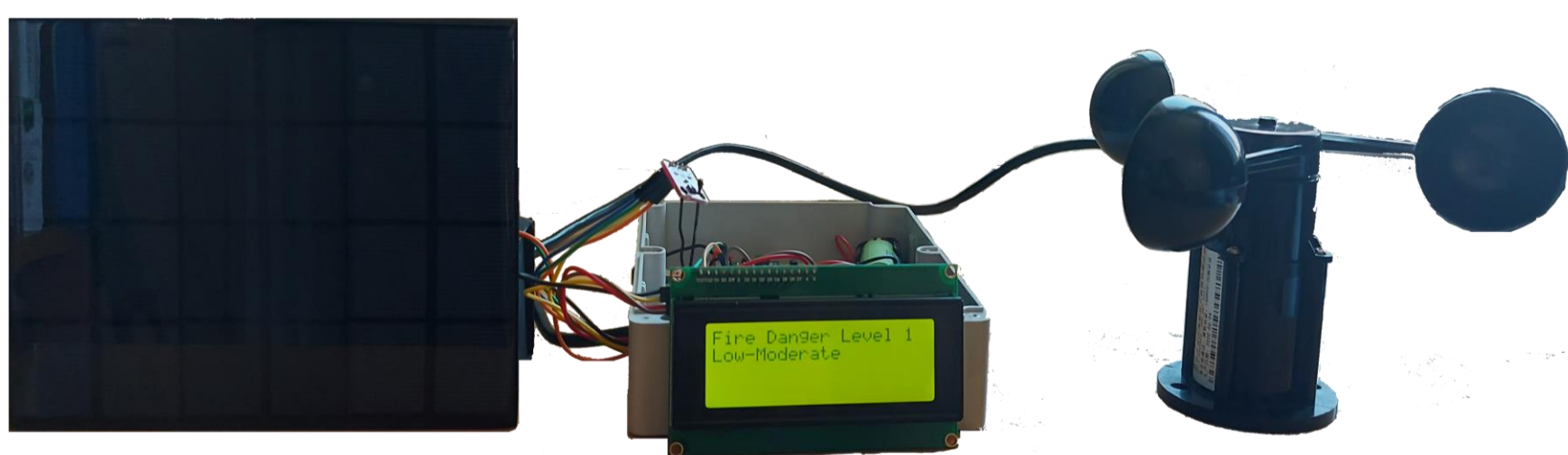
2nd General Lyceum | Kalivia-Lagonisi | Greece

Students: Vasileiadis Vasileios, Kokkinis Evangelos, Osmani Kleidi

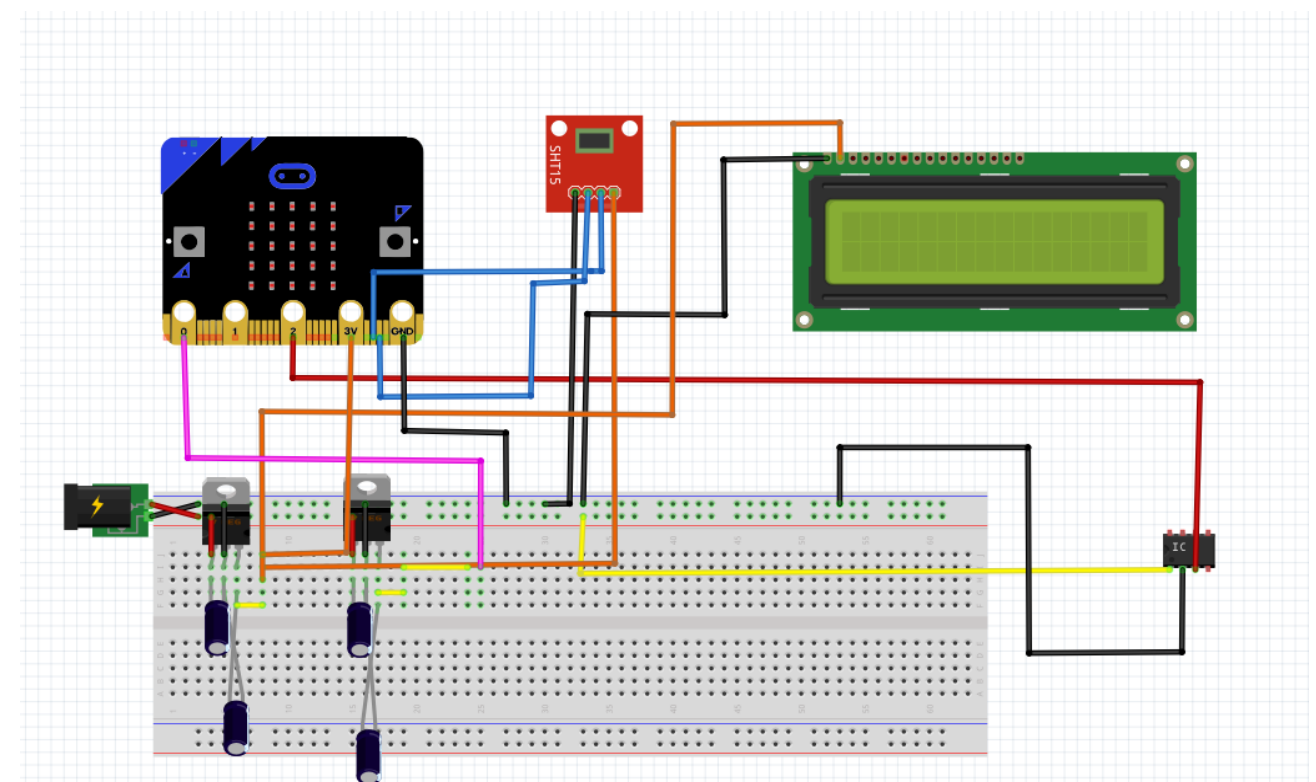
FIRE START FORECASTING SYSTEM

(FSFS)

- Satellite systems are often used to predict wildfires (meteorological stations and the civil protection data).
- Our team thought to build an autonomous fire prediction-information system, which collects local data for more reliable information.



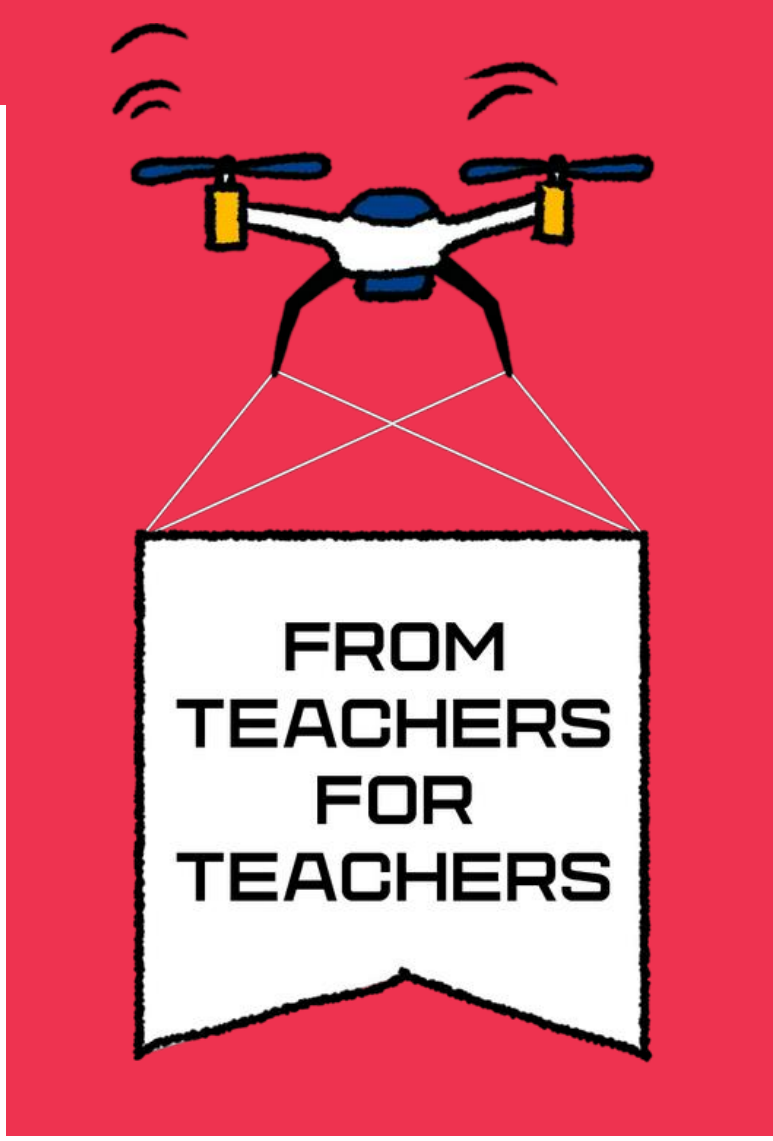
- The device relies on temperature and wind sensors to collect the real-time data, which is then used to calculate the fire danger index, based on the Mark 5 indicator (improved form of McArthur's model), one of the most reliable indicators for predicting the onset of fires.
- The processor running the system is a Microbit BBC V2 which is coded in Micro-python, while also having various I2C protocols. The index is then presented on an LCD screen alongside other helpful real-time information, such as local temperature, wind speed and humidity.
- A solar panel and a lithium battery are securing the system's autonomy rendering it applicable everywhere.



The Fire Start Prediction System (FSFS):

- Provides us with reliable information and valid data about the real conditions of the area.
- Has the ability to inform a large number of people and sensitise them on the subject of fires.
- Can mobilize a part of people to help the firefighting means both in the region and in the country.
- s easy to implement and quite cheap, compared to other similar systems (i.e. portable weather stations), which do not provide the degree of risk of starting a fire.

Wild fires are an extremely serious problem not only endangering human lives but also the fauna and flora of every region, destroying the environmental equilibrium. Preventing them is the no. 1 step in saving countless lives.



Sustainable Development Goals in Education

Jennifer Egan | Goatstown Educate Together Secondary School | Dublin | Ireland

Air pollution, evidence from satellite data & human habits

During Covid 19 Lockdown in Ireland, students had a unique opportunity to **measure air pollution levels** when people could not and did not move around and drive their car longer than 5km.

They used real world satellite data from [EO browser](https://aqicn.org/map/europe/) and <https://www.epa.ie/environment-and-you/air/> to gather data and analyse trends and pattern in air pollutant levels and link the trends to human behaviour.

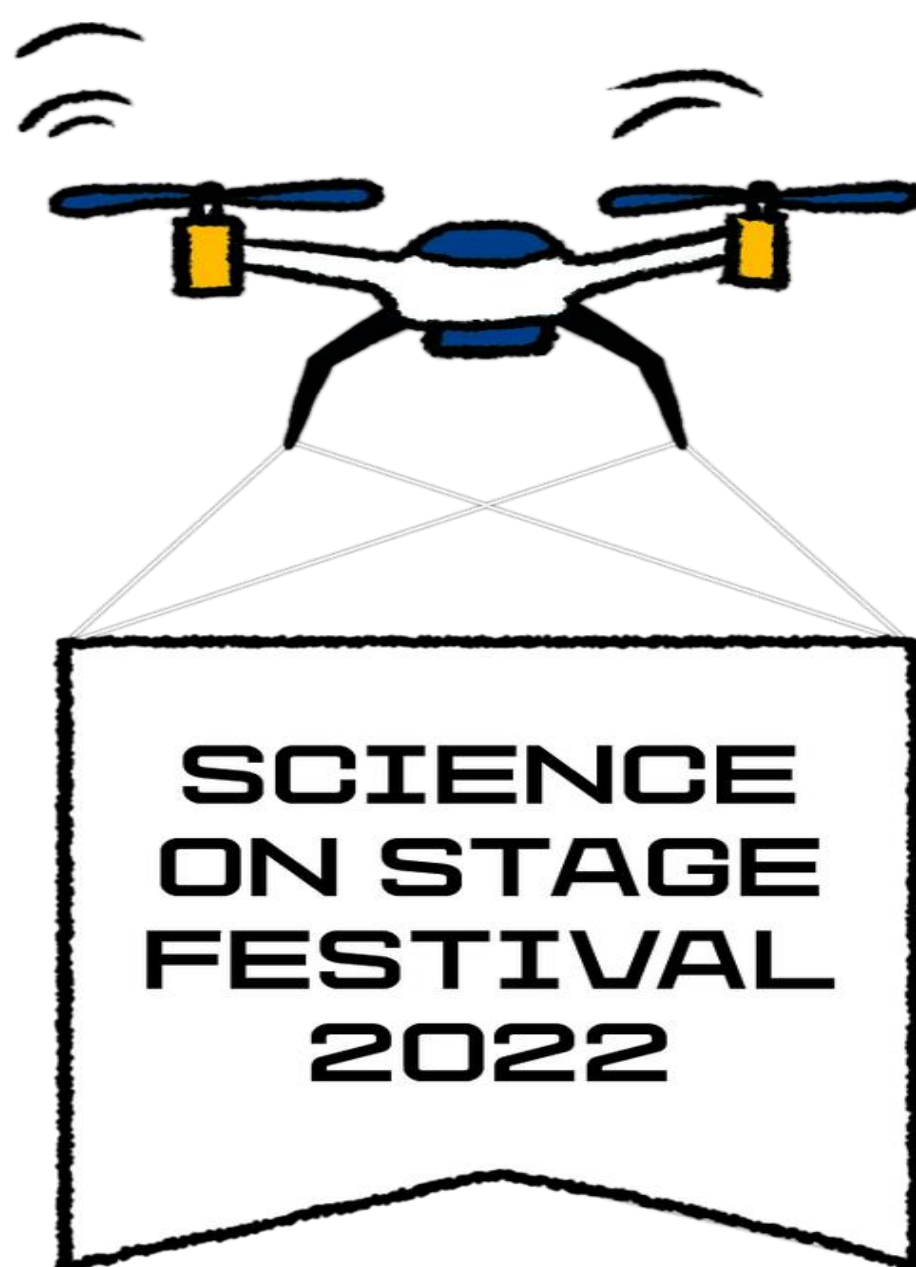
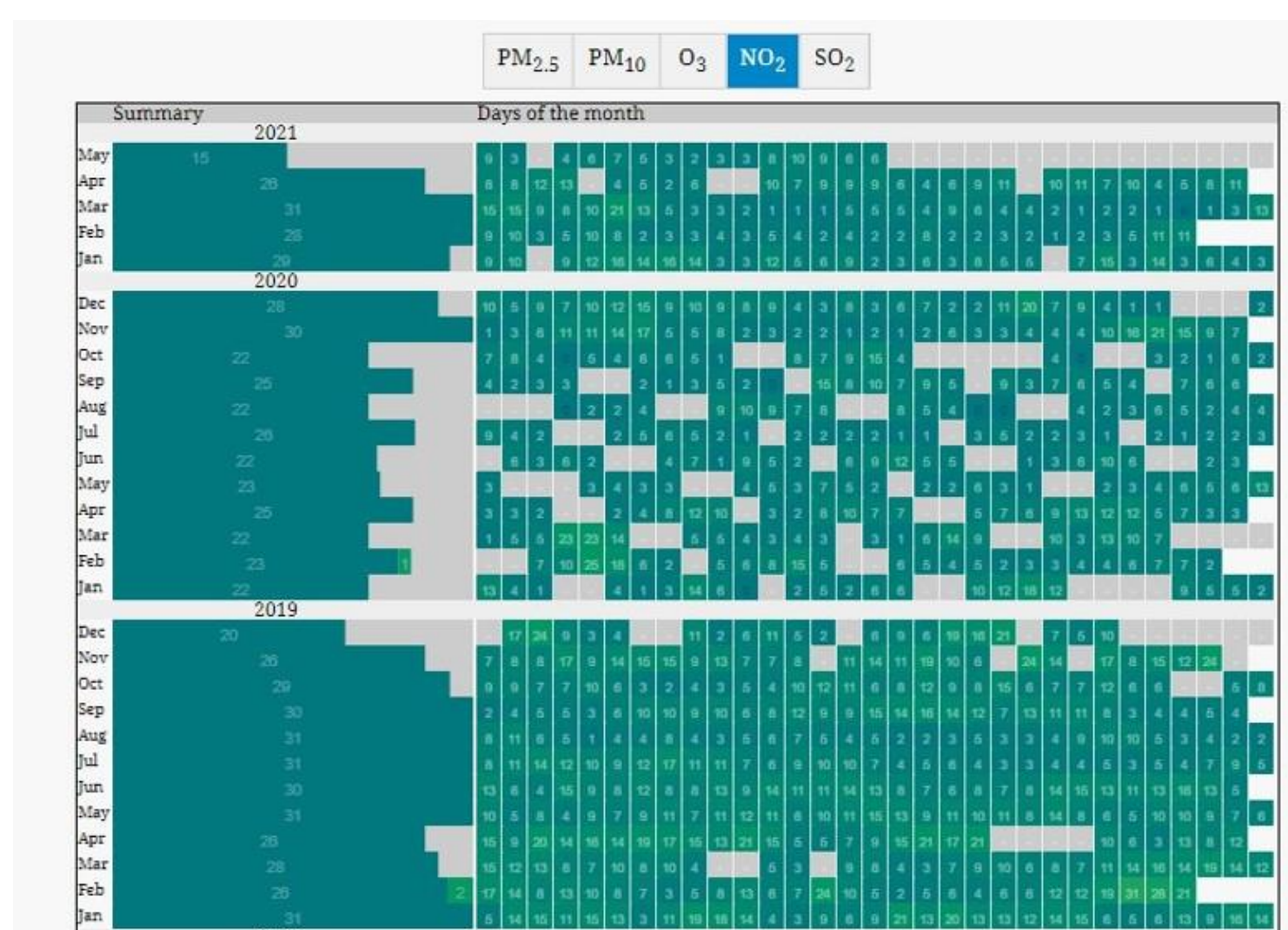
For example, students found that the levels of NO₂ were higher in 2019 compared to 2020.

Students made **pollution catchers**, using paper plates and Vaseline, to find and remove particulate matter from the air outside our school.

Students looked at **plants** and their ability to remove carbon dioxide from the atmosphere using our **CO₂ monitors** that are in our classrooms to measure ventilation during the COVID-19 pandemic.

Students then measured the **greenhouse effect** of carbon dioxide using beakers, clingfilm, vinegar and bicarb, a lamp and a thermometer.

Despite the endothermic reaction between vinegar and bicarb, the carbon dioxide generated trapped the heat from the lamp.





SUSTAINABLE DEVELOPMENT GOALS IN EDUCATION

projects that show how STEM can contribute to achieving the SDGs

VALENTINA FAZIO - FABIANA DALMONTE | I.C. CARCHIDIO-STROCCHI | FAENZA | ITALY

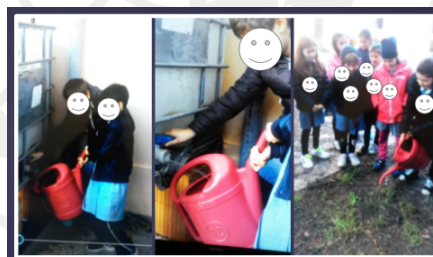
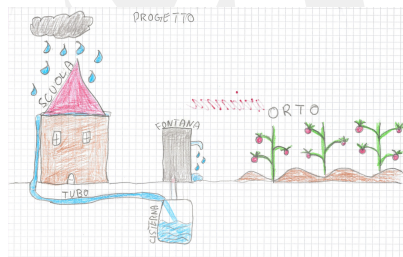
THE SUSTAINABLE LIFE GAME

SUSTAINABLE DEVELOPMENT GOALS (SDGS) - AGENDA ONU 2030 IN EDUCATION



PROJECT GOALS IN EDUCATION

- **Engage** the students attention in a challenging way.
- **Increase** pupils' technological skills: understand and solve problems and implementing ideas.
- **Include** all students: all activities are intuitive and accessible
- **Learn** contents of Agenda 2030 goals
- **Test** knowledge
- **Acquire** new competences



INNOVATIVE CONTENTS

The board game could be:

- **used** in the classroom or at home,
- **shared** to other teachers that could create their own copy and adapt the content to their classroom.

It allows pupils achieving **awareness in scientific knowledge** and deeply acquiring consciousness about the correct behaviour to protect the planet earth.

HOW IT WORKS

The game, developed on the [Deck.Toys platform](https://decktoys.com/), is an interactive board game that has different activities (cloze, drag&drop, jigsaw, memory...) based on five 2030 Agenda goals.

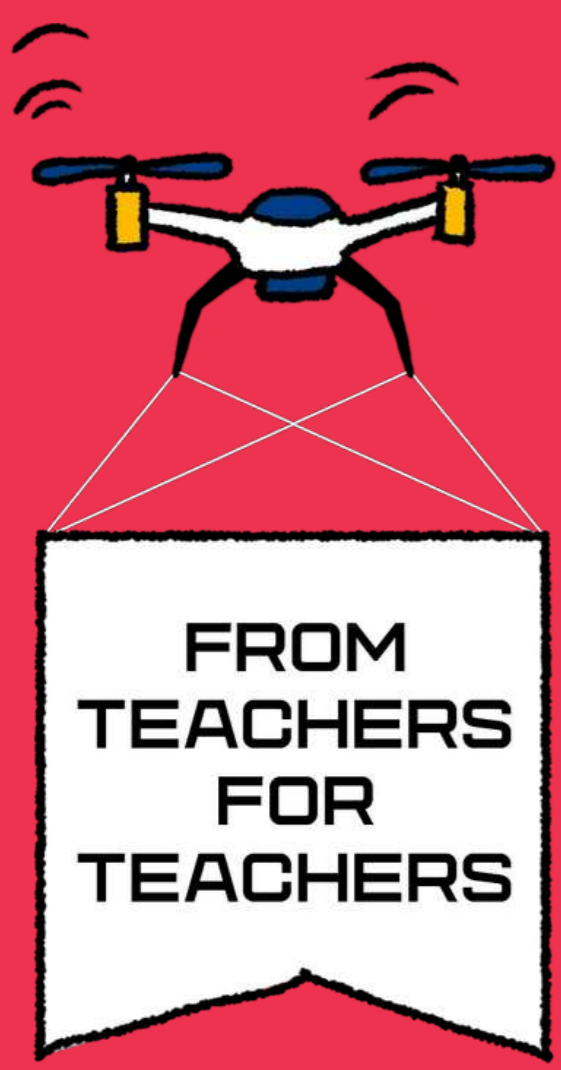
In the various steps, students **discover** how concretely they can change some of their daily experience behaviours to reduce the environmental impact. In the final stage, they elaborate a personal reflection on their lifestyle and tell how they can contribute to protect the environment. Students must complete all the activities to reach the next stage.

Teachers' role in this game is just to guide pupils through the various steps, stimulating thoughts on SDGs goals, cooperations, team work and sharing.



GAMIFICATION

"The role of the teacher is to create the conditions for invention rather than provide ready-made knowledge". (J. Papert)



Sustainable Development Goals in Education

Rita Limioli | IIS CARAMUEL RONCALLI | VIGEVANO | ITALY

“Environmental changes and biodiversity: man and natural selection at work!”

The aim of this project is to encourage **high school students** to verify how climate changes could cause the extinction of some species and the survival of more adaptable ones using an investigative, cooperative learning approach according to **IBL method**.

Learning project The project develops through different phases by which students

1 st phase Preliminary approach	• read up on climate changes
2 nd phase-Brainstorming	• suppose their possible consequences on biodiversity
3 rd phase Experimental design and analysis results	• verify the effects of UV radiation on model organisms (lettuce seeds, brewer's yeast) by experiments
4 th phase Environmental research	• search for UV resistant organisms (tardigrades)
5 th phase Drawing conclusions and dissemination	• communicate their experiments and results

Experiments with *Lactuca sativa* Tests on seeds put on a damp layer of cotton and treated with UV-C for different periods (1h or 2 h for day) .



Experiments with *Lactuca sativa* Tests on plants

Plants grown in two 24-cell seeding trays and exposed to UV-C (3h a day for 9 days). A negative control specimen is present.



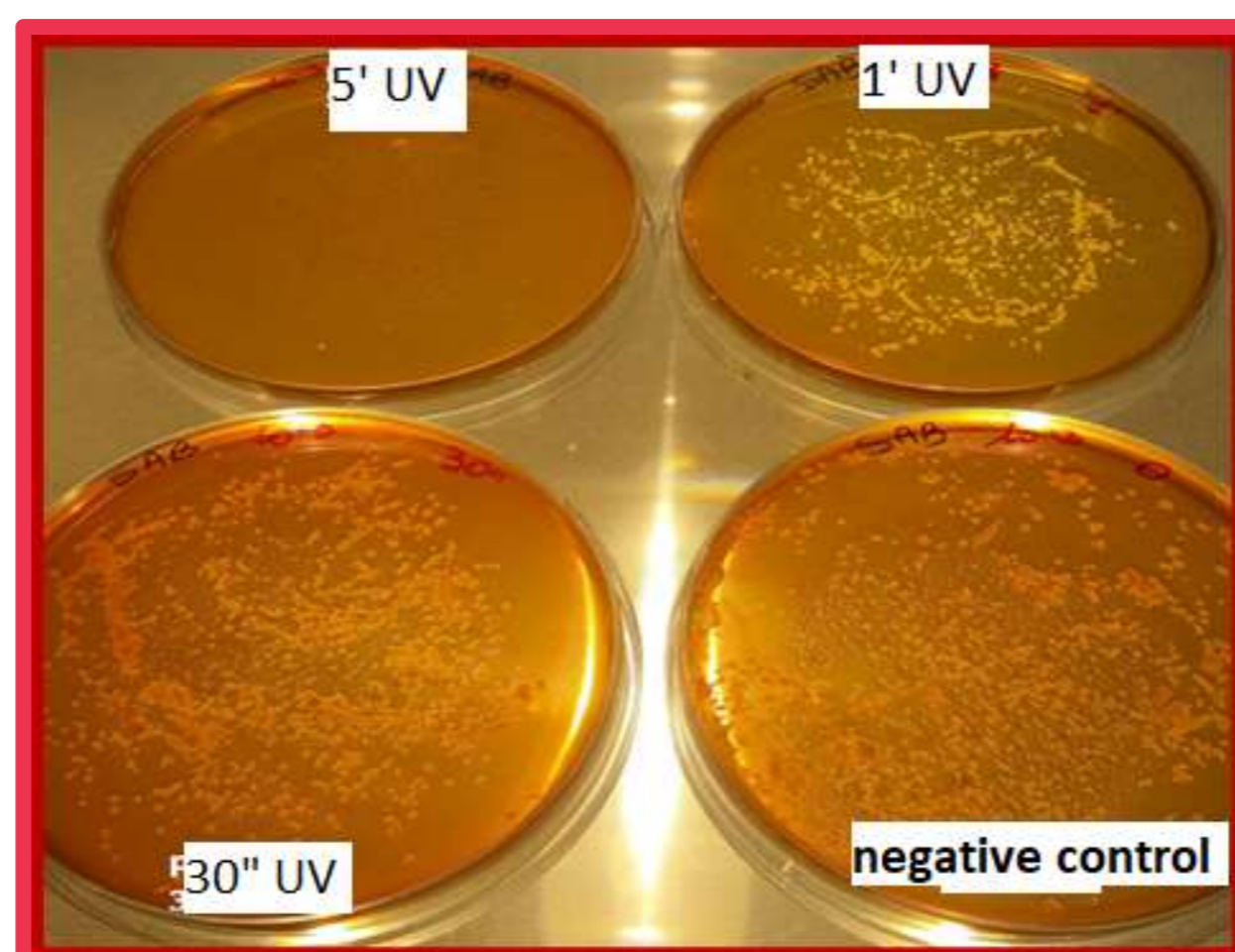
Not exposed to UV rays



Exposed to UV rays

Experiments with brewer's yeast (*Saccharomyces cerevisiae*)

Growth test carried out on diluted suspensions of *Saccharomyces*. Petri plates are irradiated by a single differential UV dose for different periods and then incubated for 48 hours at 20°C. A negative control plate is submitted to the same procedure.



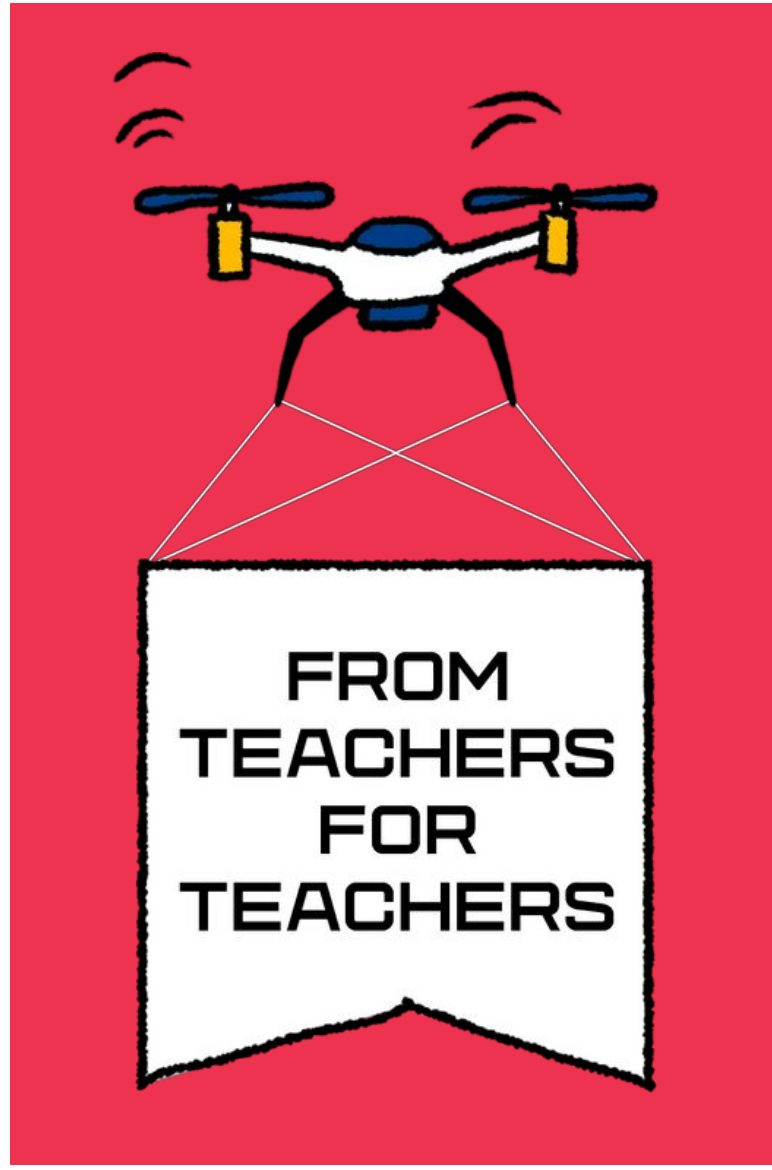
Search for UV resistant organisms: Tardigrades (usually named after water bears or moss piglets)

Tardigrades research can be carried out in a humid environment (for example in damp moss). Collecting few drops of water used to wet moss surface it is possible to observe tardigrades by a light microscope.



At the end of the project students will be able to understand how important the respect for environmental balance is with specific regard to abiotic factors and they will have the opportunity to play an active role in raising awareness of the goals of the 2030 Agenda.

A special acknowledgment to Maria Grazia Gobbi, Marina Gandolfo and Angela Colli for their precious collaboration.



Sustainable Development Goals in Education

Chiara Colucci, Alberto Conte, Jennifer McDermott | Deledda International School
| Genova | Italy

Tree Trails

How to map the CO2 captured from a city park

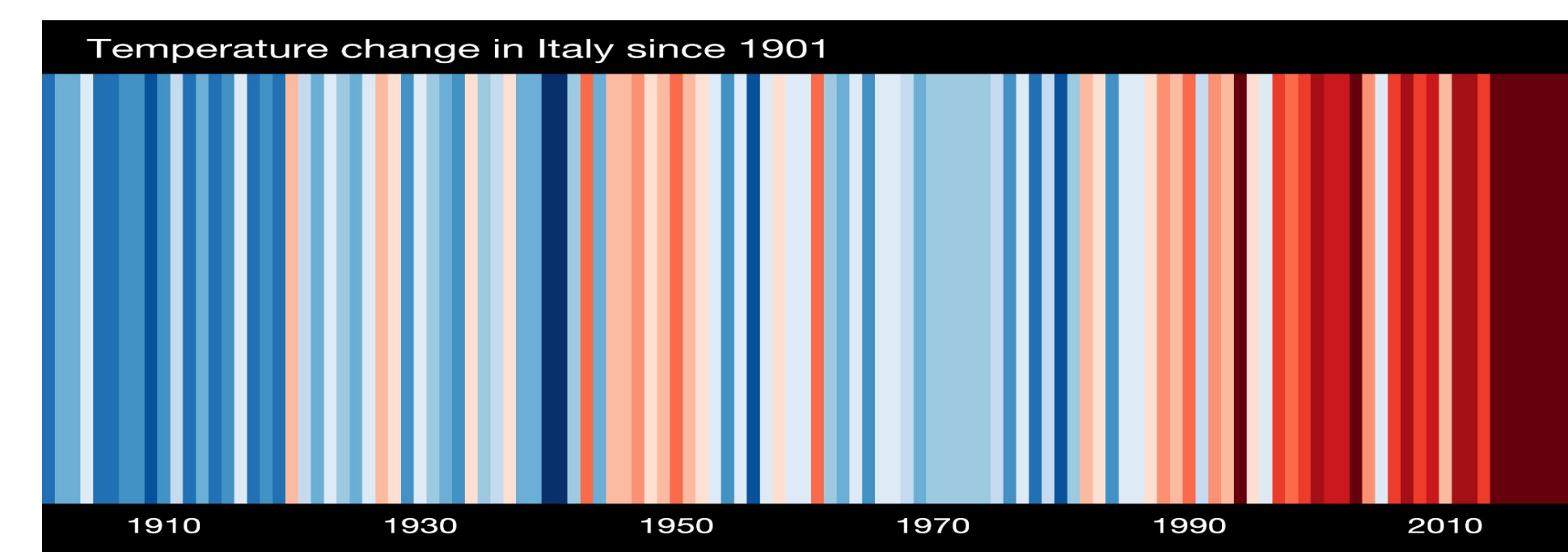
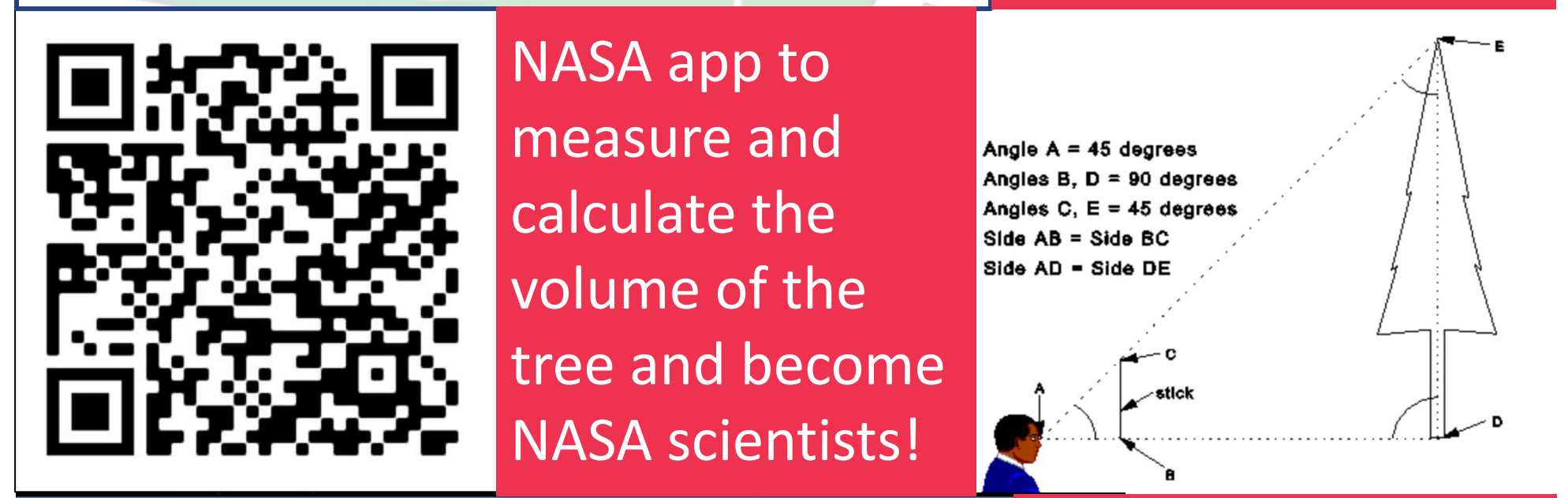
An inquiry based project where students investigate the link between **carbon dioxide**, **greenhouse effect** and **global warming**:

- **to what extent is it possible to capture CO2 which is already in the atmosphere?**
- **how much do trees contribute to CO2 sequestration?**

A **Fermi problem** applied to the playground area near the school which we relate to the calculation of **the volume of the trees**.

Kids measure the diameter and the height of trees using different methods, such as a **NASA app** which enables them to be part of a **worldwide citizen science project**.

The activity is proposed for grade 7 but could be extended to a high school Math curriculum.



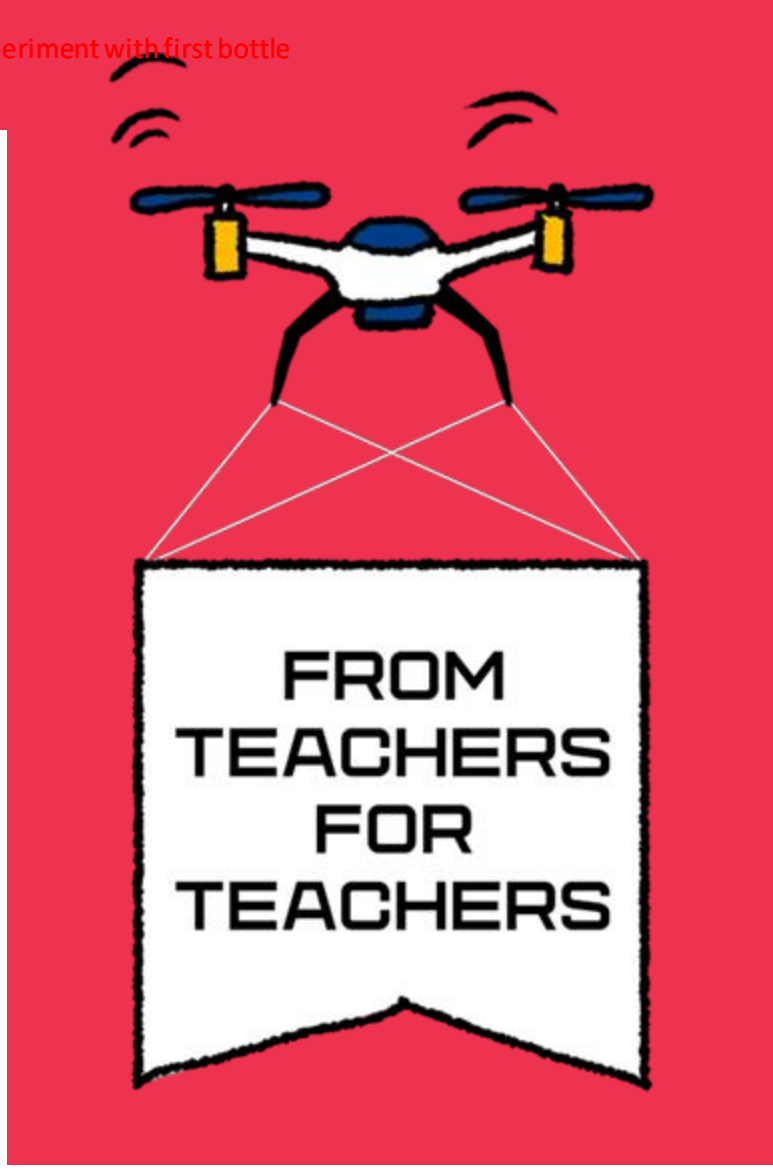
Source: <https://showyourstripes.info/l/europe/italy>

- 1. The investigation**
global warming
greenhouse effect
CO2 emissions
- 2. Practical Activity**
measuring the dimensions of trees to calculate the volume of the trees in the nearby park
- 3. Applying Math and Chemistry concepts**
from the volume of the tree to the CO2 stored in each tree
- 4. Final Discussion**
the importance of the green areas in the global warming issue

Key Points:

- **interdisciplinary:** **Biology** (photosynthesis), **Chemistry** (stoichiometric calculations), **Math** (geometric modelling of trees and their volume)
- **hands on:** students build their measuring instruments and carry out a field activity in small groups.
- **technology based:** Students use the smartphone with a NASA app, then they send their data to NASA.

CO2 emissions and their reduction are hot topics now: we are looking at the problem from a novel perspective. Moreover, the outdoor lab engages the students and creates a sense of belonging with the trees which is, ultimately, a sense of respect for the Earth.



Sustainable Development Goals in Education

Gulnaz Uspanova, Zhuldyz Mussayeva | Nazarbayev Intellectual school of Physics and Mathematics in Aktobe | Aktobe | Kazakhstan

Making bricks from plastic bottles

according to Hooke's law by stiffness

Research aim: process commonly used plastic waste and make bricks based on results of research work.

Hypothesis: Bricks made of plastic wastes are economically viable and reduce the number of Polyethylene (PE) bottles.

Research objectives:

- 1) Exploring plastic bottles that were selected by using Hooke's law;
- 2) Making environmentally friendly bricks using all the information about the plastic bottle.

Research methods: reading and collecting data from sources, systematizing, summarizing, and making recommendations, control.



Moving to the advantages and disadvantages of brick:

Advantages

- Reuse of plastic bottles
- Can be used for thermal insulation
- Cost-effective
- Can be made in different shapes, for decorative purposes
- Leads to a decrease in the total cost of other bricks
- Leads to the improvement of the environment
- Available resource

Disadvantages

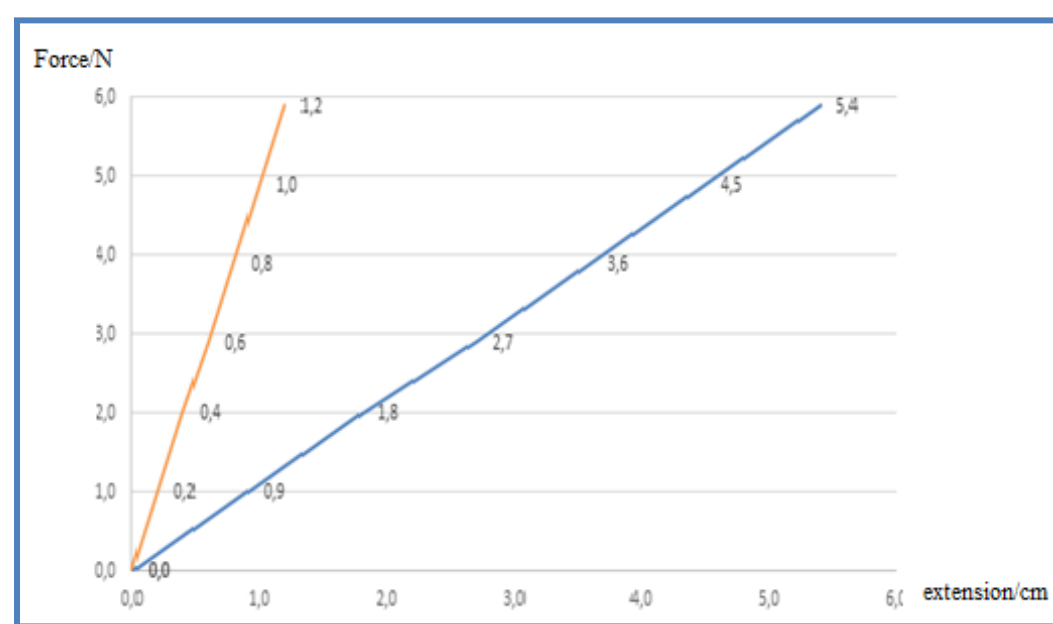
- Although plastic is hard, it can be deformed by pressure.
- It can be damaged by ultraviolet light.
- When heating plastic, large amounts of harmful gases are released into the air.

Table 1. The results of an experiment with first bottle

F=m*g/N	X/cm	k/N/cm
0	0	0
1,0	0,9	0,56
2,0	1,8	0,56
2,9	2,7	0,54
3,9	3,6	0,54
4,9	4,5	0,54
5,9	5,4	0,55
		average 0,55

Table 2. The results of an experiment with second bottle

F=m*g/N	X/cm	k/N/cm
0	0	0
1,0	0,2	2,50
2,0	0,4	2,50
2,9	0,6	2,42
3,9	0,8	2,44
4,9	1	2,45
5,9	1,2	2,46
		average 2,46



Graph 1. Study of stiffness.

Mixing proportion	1:2	1:3	1:4
1 brick (g)	1100:2200	850:2550	650:2600
2 brick (g)	2200:4400	1700:5100	1300:5200

Table 3. The proportion of soil to plastic bottles.

Plastic Brick 1:2	Maximum force, κH	Strength (compressive strength), kg/sm ²
1 version	165	78,07
2 version	136	42,93
3 version	112	31,13

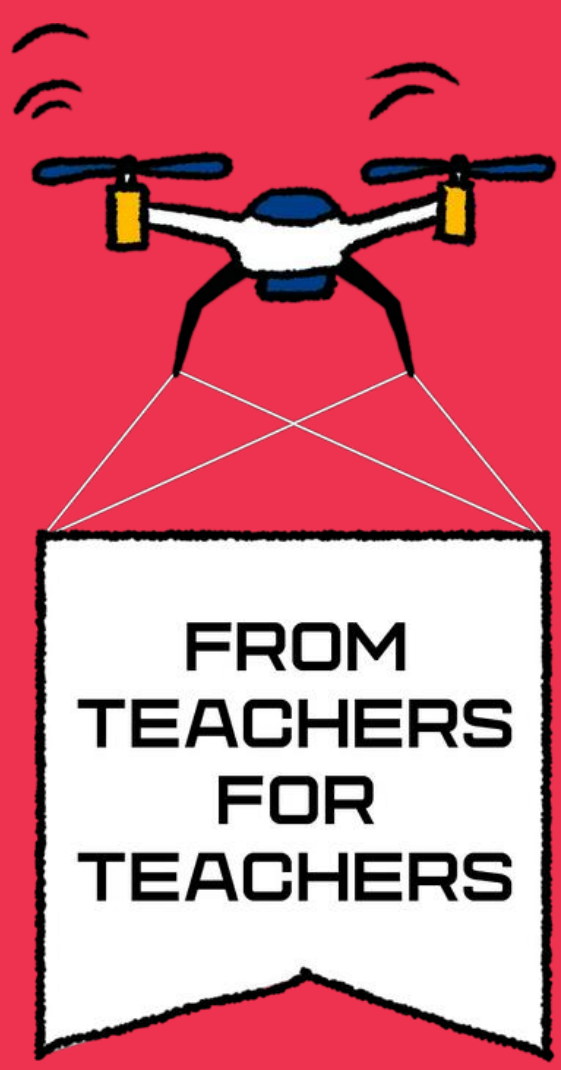
Table 4. The result of the test to determine the strength of the brick.

Brick 1:2	W1, kg	W2, kg	Water absorption, %
1 version	3.100	3.163	2,032
2 version	3.053	3.097	1,441
3 version	2,962	3,011	1,654

Table 5. The result of to determine water absorption of brick.



Conclusion: Among the raw materials needed for bricks, plastic is used for global issues. The amount of plastic used in the manufacture of bricks is considered in practice. In this regard, the recycling of used plastics ensures that it does not become a waste.



Sustainable Development Goals in Education

Ivars Bahmanis, Kaspars Antonevics

Jelgava Secondary school of Technologies | Jelgava | Latvia

A repeatable education model based on Industry 4.0 competencies, business and family values



- **Constructors** - wood, metal, plastic
- why the car wheels slip at the start and how to increase traction?
- **Programming** - Scratch, ScottieGo, Kodu etc.
- **Robotics** - BeeBot, ProBot, Dobot roboarms, Ozobot
- with self-built mechanisms (shovels, coin turning), production (laser engraving) - conveyor line, etc.
- **Electronics**
- joule "thief" (from "empty" batteries) etc.
- **Prototyping** - 3D: pens, printing, scanner
- houses, your own sculpture, electric car parts, etc.
- **Complex projects** - 3D, CNC milling/ laser cutting
- electric flashlight, rolling car races, ramps, detail and pressure experiments, paper bridge races (the most durable bridge of 4 A4 pages), etc
- **Filming, animation** – GIF, green screen (directing, lighting, angles, multiple cameras, acting, editing)

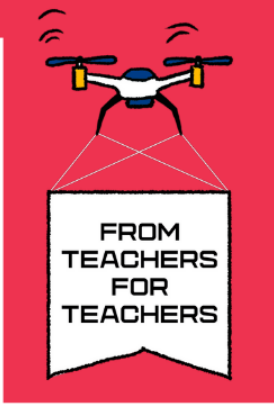


Each student:

- with parents create 2 to 3 technically creative projects at home;
- publicly introduce the project in their group;
- participates on the Technically Creative Works Day;
- in Parents' Day train parents on a previously learned topic.



All lessons with descriptions, photos, videos: facebook.com/itcentrs/



SUSTAINABLE DEVELOPMENT GOALS IN EDUCATION

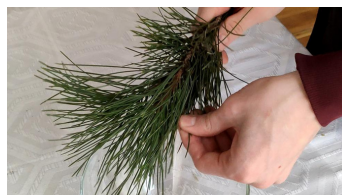
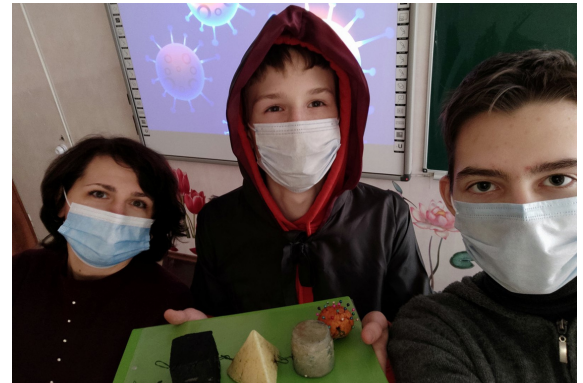
projects that show how STEM can contribute to achieving the SDGs

Liubov Morozova | Secondary school №11 | Pavlohrad | Ukraine

BIOPLASTIC. ECO - An Ecological lifestyle.

This teaching project demonstrates the teaching method based on technology of bioplastic production. Students determine the speed of the decomposition process in the soil and they try to attract the local people attention to the spreading an ECO -friendly lifestyle. Our students investigate the ecosystem of the local park for the presence of plastic (garbage) in the soil. During their research work an alternative to polymer - organic plastic has been created.

This substance of organic origin can be made by hand; it can be used to make things that are used temporarily. It is an environmentally friendly material which is confirmed by the rapid period of decomposition in the soil.



Nowadays STEM education is possible at the lessons and beyond. Students pay more attention to our environment and they have understood the negative influence of human activities, so they have proposed some new technologies which are environmentally friendlier. The example of such kind of it is bioplastic production, where natural colours are used for the protection of the human health.

Teaching technique, mentioned above has developed the responsibility of young generation for the ecological situation on the Earth.

The project forms ecological and imaginative thinking, stimulates aesthetic self-expression and increase the cognitive interests of the secondary school students.



Sustainable Development Goals in Education

Dr Samantha Ireland, Dr Andy McConkey | Queen Elizabeth Grammar School | Penrith | UK

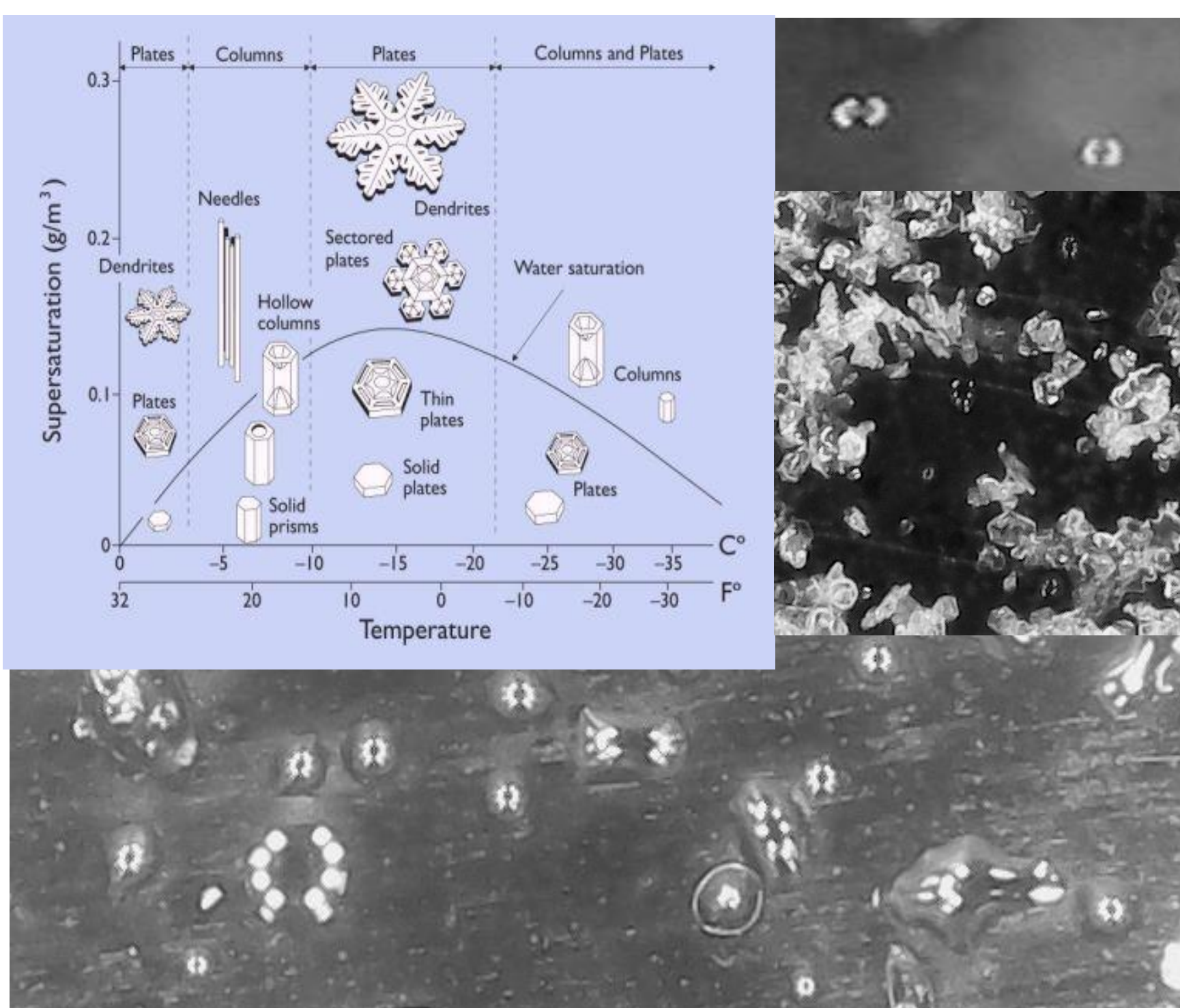
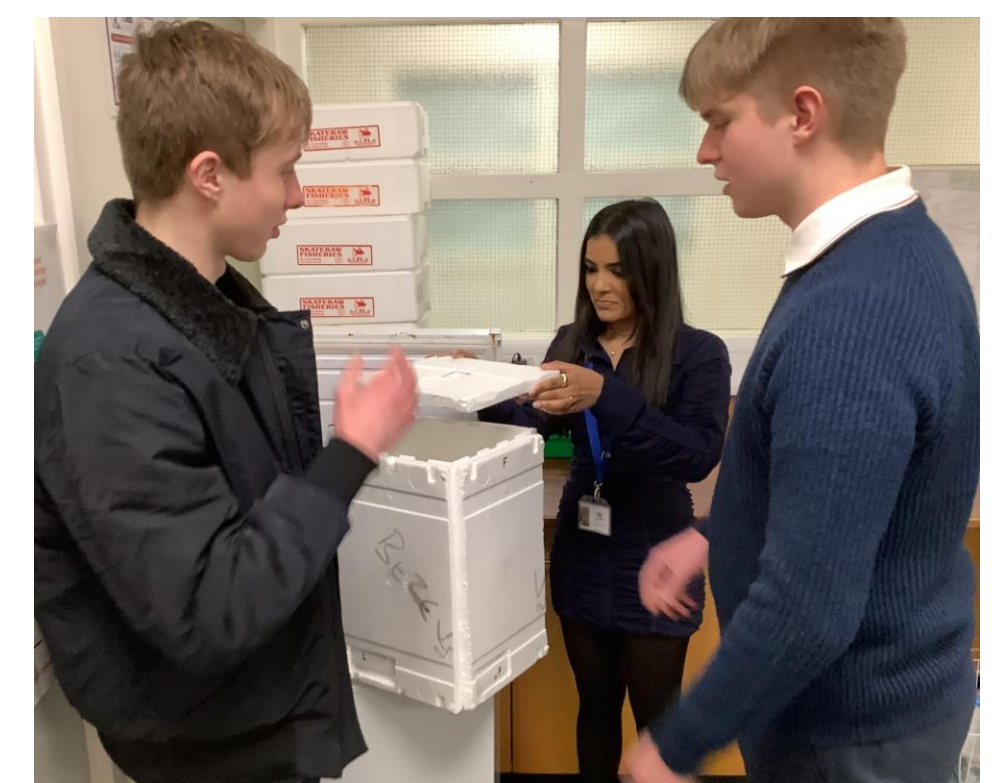
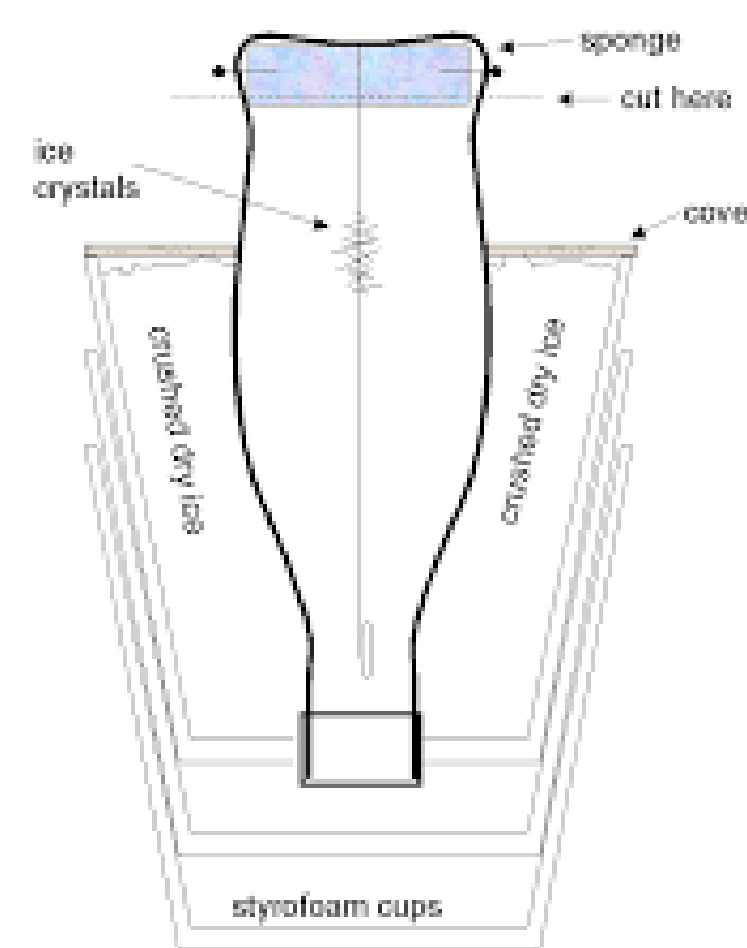
Snowflakes and Climate Change

The impact of climate change on our environment is becoming more evident in the increased number of events of extreme weather reported over the last decade. Snowfall is set to increase as the levels of humidity and carbon dioxide increase across the world. Using the concept of snowflake formation our project aimed to investigate the changes in climate indicators on snowfall.

Our project has developed a low-cost system for producing snowflake dendrites in the laboratory using everyday equipment.

The first part of the project involved creating a supersaturated humid environment, which can be cooled to between -5°C and -15°C using a salt/ice mix or dry ice.

Using a length of cotton as a nucleation site for the snowflakes to grow on. Over a period of 10-15 minutes crystals can be visualised by eye or with a microscope app on their mobile phones.



Increasing the carbon dioxide level increases the formation of prisms and columns.

The students have designed a growing chamber for investigating the differences in size and shape of the snowflakes with differing atmospheric conditions.

The students have designed the chamber using CAD software and 3D printing in DT. They have also designed, constructed and programmed sensors for carbon dioxide, humidity and temperature to monitor the conditions within the chamber. The formations were then visualised using a USB digital microscope linked to a laptop.

Snowflake formation can be used to investigate climate change in the laboratory.