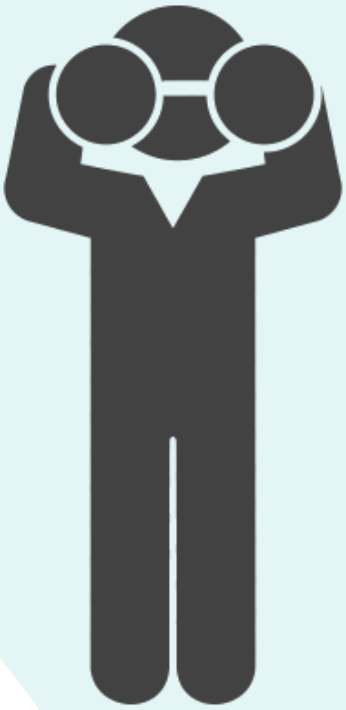

BRITEC

Case studies and
researchers science pills

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Design/DTP: Karolina Chodzińska

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CONTENTS

1. Introduction

The BRITEC project was conceived to study the impact that the use of Citizen Science (CS) projects may have on School Education. The project began in October 2018 and will end by September 2021, as scheduled, despite the remarkable impact that COVID-19 has had on all the participating countries and the significant delays that it has introduced in several parts of the original design.

The first task within BRITEC was to study and report the state-of-the-art of the use of Citizen Science in the classroom and to identify the most successful practices so far. The experience of some of the partners and an exhaustive research in different, national and European sources, allowed us to synthesize the main conclusions that several successful projects had reported on the use of CS project in the classroom. These conclusions, however, referred to each project separately, and a larger effort was required to oversee the topic from a general point of view.

Therefore, our next step was to design and implement several pilot projects of Citizen Science in the classroom of schools in four countries (Belgium, Greece, Poland and Spain) jointly drawing conclusions from the projects, analysing their conclusions together and comparing impressions and analyses of teachers and researchers in a unified way. This report describes the abovementioned section of the BRITEC project. By using our previous report, the consortium partners identified several research groups and schools that were interested in the BRITEC project and we convinced them to participate. The projects were supposed to be implemented for the duration of up to one school year. The age of the students and the topics to cover depended on the researchers and teachers of the schools.

As our goal was to obtain as much information as possible from the pilots, a protocol was designed to document the experiences in the most efficient way. Let us consider the most relevant aspects of this protocol:

- The project´s success depended on the joint efforts of researchers and teachers, so the implementation of each pilot was co-designed by both. Indeed, the researcher knew in detail the scientific problem to be studied, while the teachers knew their students and were the most adequate to design the most efficient framework to involve them into the topic and how to make them profit most of their involvement. The success of the implementations prove that this co-design mechanism was a major success.

- The researchers participating in the different pilots of each country as well as the corresponding teachers participated in two different discussion groups to analyse their impressions. They also answered several online surveys designed to evaluate their experiences of the co-creation phase.

- Teachers designed specific lesson plans to introduce the project to the students and to drive their efforts to optimize both the learning experience and the scientific output of the process. In order to provide a common framework for all of them, the group of the Faculty of Education of the Autonomous University of Madrid led a common effort by all the BRITEC partners which created a common scheme for the lesson plans to be used by the teachers of all the schools in the four countries. We have collected all these lesson plans which you can find further down this document. The template used to elaborate these lesson plans is also included in this report (Annex 1).

- On the other hand, the participating researchers have also prepared specific materials to describe the project to the students and to document their impressions and their experiences. They were asked to prepare 5 minutes *´Sience-pills videos´* to which we provided links further down this document. As you can see in those videos, the general impressions were very positive, despite major disruptions caused by Covid-19-related sanitary situations in some countries, with complete lockdowns or major changes in the school activities during 2020 and 2021.

- During the pilots, the researchers were asked to visit the schools at least once to directly speak to the students about their research and project. These proved to be one of the most appreciated parts of the process by the students. They reported enjoying the contact with the professional researchers and learning about the importance of their contribution to the scientific process. Again, the Covid-19 related sanitary situation introduced several limitations and some of the ´visits´ were done online, but the students still declared to enjoy the contact enormously.

- After the implementation, researchers, teachers and heads of schools involved were asked to fill in a final survey to share their impressions. Reports showed very positive impressions for all the actors involved.

Besides the present report, the information collected from our analysis has been included in different documents, which must also be considered as complements of the present one to compile the general conclusions of our project. In particular, since they contain conclusions of the different steps described above, we would like to mention:

1. The initial analysis we performed to identify the state-of-the-art at the beginning of our project was published as a Scientix Observatory publication '**Bringing Research into the Classroom – The Citizen Science approach in schools' report**', produced by Scientix, the Community for Science Education in Europe and BRITEC–Bringing Research into the Classroom projects. The purpose of this report was to provide a baseline for understanding the key conditions of successfully implementing citizen science activities in schools. Link: https://britec.igf.edu.pl/wp-content/uploads/2019/10/Scientix-BRITEC-Citizen-Science-in-Schools-WEB-final-2.pdf

2. We also listed a series of interesting technical tools that could be useful to implement a CS project in the classroom, and we reflected on the possible mechanisms to engage schools and researchers in co-designing citizen science projects that serve the needs of both parties. This reflection resulted from the analysis of the surveys created and answered by the different actors described above. Thus, after research done by the different partners, the BRITEC Citizen Science Toolkit was compiled and published. It contains examples of various IT-tools, which could be used during the whole cycle of the creation and implementation of Citizen Science initiatives. Moreover, reflections on how to address research ethics and what are the roles and responsibilities of the actors involved in these types of projects are also included as part of the report. Finally, some examples of useful sources and CS networking platforms developed under various Horizon 2020 projects relevant for this purpose are given. The toolkit is available in English and 5 national languages (French, Dutch, Greek, Polish and Spanish) on the project website: https://britec.igf.edu.pl/?page_id=407

3. The BRITEC-consortium used some of the project pilots as a basis to develop, an online course focused on integrating scientific activities in STEM teaching. The MOOC "A Roadmap to Citizen Science Education" provides materials and stories of implementation from innovative educational Citizen Science projects. Inspired by the co-creation spirit adopted during the design of the pilots, the course proposes a process of collaboration between teachers and researchers. It incorporates insights

from the perspective of researchers who have supported teachers developing STEM learning scenarios. With those, the main goal of this MOOC is to provide instructional design guidelines and the necessary resources so that teachers can develop a learning scenario of their own.

Link: https://www.europeanschoolnetacademy.eu/courses/course-v1:BRITEC+CitizenScience+2021/about

4. Finally, the BRITEC project has also prepared another document (O6-Bringing Research into the Classroom-Recommendations) with recommendations for the different stakeholders, aiming to offer advice to teachers, schools, scientific institutions, and policy makers, on how to bring research into the classrooms and how to ensure fruitful collaborations between all parties involved. The report describes the piloting activities from Belgium, Greece, Poland and Spain as mentioned above in this document in collaboration with and under mentorship of local scientific institutions. The pathways enabling successful CS uptake and the main challenges that emerged are highlighted as well.

As we mentioned above, despite the fantastic efforts of all teachers and researchers, the pandemic situation has affected some of the pilots and has introduced remarkable delays and forced several modifications of the original design. Thus, some projects which were designed to be implemented with in-the-classroom activities had to be re-created as pure online activities. These changes implied, in several cases, an extra workload for the teachers, that were already struggling to get regular school activities done within the context of Covid-19. Therefore, we would like to strongly acknowledge the fantastic work done by all the teachers to support our project in the difficult situation we are living in. Thank you!

2. List of projects

Below you can find a detailed list of the pilots created by the partners in different countries, containing the information about the researchers and the teachers implementing the projects. We also indicate the name of the schools involved. The name of each pilot project represents the respective topic pretty well, but further down the text you can also find the ´*Science-pills*´ created by the researcher of each project, introducing it and describing the pilot from his/her perspective. You can also find the learning scenarios (´lesson plans´) which were created to implement it.

Belgium

Image by TUBS, Wikimedia

Study of meteors using reflection of radio waves on ionised air.

Under the scientific guidance of Eng. Stijn Calders from Royal Belgian Institute for Space Aeronomy, four teachers of different schools, namely Margo Nys from OLVC Plus (Antwerp), Stijn De Vusser from Sint-Jan-Berchmanscollege (Brussels), Kjell Olieslagers from Sint-Claracollege (Arendonk) and Wim Van Buggenhout from GTIL (Londerzeel) have implemented this pilot project in their Geography classes for students aged 16-18, majoring in 'sciences-mathematics' (OLVC Plus, Sint-Jan-Berchmanscollege), and students aged 12-13 majoring in 'sciences' (Sint-Claracollege). This pilot was introduced in the Geography courses, focusing on the study of meteors and aiming at creating an independent computer system to scan data for meteors. During the implementation, students got background information about the solar system and its various elements, and about radio-observations. Finally, they were asked to

identify meteor signals in radio data (visualised in spectrograms made available online), in order to improve a computer algorithm that learns to identify meteor signals from the spectrograms.

Monitoring of sound levels and analysis of traffic related annoyance in residential areas: "Build your own disruption function".

Dr. Luc Dekoninck from the University of Ghent was the researcher in charge of this pilot project, implemented by three teachers, namely Wim van Buggenhout from GTIL (Londerzeel) and Luigi Vallozzi and Tine Festjens from Edugo Campus Glorieux (Oostakker) with students aged 16-18 majoring in 'industrial sciences' (Edugo school) and 'sciences-mathematics' (GTILonderzeel). The project can fit in courses of Physics, Biology, Geography and Mathematics in an interdisciplinary approach. The goal of the project was to analyze the impact of traffic noise on humans and to monitor noise in areas where it is seldom monitored. Teacher Wim Van Buggenhout also extended the research into analysing how building types affect the transmission of noise in the classrooms. In this project, students made a full environmental impact study and went through the full DPSIR scheme ('driving forces', 'pressure', 'state', 'impact', 'response'). Their measurements and countings will ultimately help to improve mathematical models that are used to make Flanders 'noise map'with a high spatial resolution.

Air Quality

Dr. Geert Bauwens from KU-Leuven was the researcher in charge of this pilot project implemented by the teachers Lore Jespers fromEdugo Campus Glorieux (Oostakker), Eef Delfosse from KAMSA Atheneum (Aarschot), Carine Vallons from Sint-Janscollege (Meldert) and Wim Van Buggenhout from GTIL (Londerzeel), with students aged 17-18 majoring in 'science-mathematics'. This pilot can fit in courses of Physics, Biology, Geography and Mathematics in an interdisciplinary approach. The goal of the project is to study the indoor air quality in relation to the building characteristics. Students were asked to measure the amount of CO_2 in the classroom during 14 consecutive days, as to assess the current state of the air quality in Belgian schools.

Greece

Image by TUBS, Wikimedia

Urban Climate and Human Bioclimate

Dr. Chris Giannaros from the National Athens Observatory was the researcher in charge of this pilot project, implemented by the teachers Flora Paparou, Science teacher, and Marina Korasoidi, Economics teacher at the 1st Upper High School of Vrilissia with students aged 15-16. The program was intended in the context of the subject of 'Creative research activities', a 2 hours weekly subject included in the Upper High School Curriculum. The project focused on Environmental protection issues. The main points of the research process were students to be informed about concepts like (a) Climate change, (b) Urban climate, (c) Urban Heat Islet (UHI), (d) Urban population, and (e) Human biometeorology and then to focus on the School research work including scientific measurements, research on the topic, presentation and documentation of the results.

Analysis of students' dietary habits

The researcher Riviou Katerina from the R&D Department of Ellinigermaniki Agogi coordinated this pilot project implemented by the teachers Konstantinos Soutos, Head of the Department of Physical Education at Ellinogermaniki Agogi and Panousis Clearchos, Physical education teacher at Ellinogermaniki Agogi, with primary school students aged 9-12. The goal of the project was to study childhood obesity and public health. School aged children become citizen scientists by collecting data about their behavioural patterns and local environment, with the myBigOapp. This data is anonymized and used to create complex statistical models to analyse how behaviour and the environment influence obesity prevalence.

Poland

Image by TUBS, Wikimedia

Observing of seasonal change of river riparian vegetation and microclimate of river valleys

The researcher Prof. Monika Kalinowska from the Institute of Geophysics, Polish Academy of Sciences (IG PAS) directed this project which was implemented by 15 teachers from 9 schools from Poland, namely: Małgorzata Popławska, Joanna Grecka-Otremba, Katarzyna Wolska, Daniela Dębska, Anna Prokop, Małgorzata Pietrusik, Kinga Budzik, Aneta Teodorczyk, Grażyna Kosmala, Małgorzata Florczak, Agnieszka Marciniak, Joanna Gadomska, Joanna Ropka, Sylwia Serafin, Aneta Przeklasa-Korgul. Among them, three active teachers: Joanna Ropka from Primary School in Celiny and Agnieszka Marciniak and Joanna Gadomska from the Frederic Chopin Complex of Economic and Service Schools in Żychlin contributed to preparation of the teacher video and the lesson plan. Students who participated in this project were 15-20 and attended the courses of Geography, Biology, Photography and Informatics. Students were involved in the monitoring of riverbank vegetation and meteorological conditions in different specific locations by taking photographs as well as simple meteorological measurements conducted near rivers closed to their schools.

UV radiation and Vitamin D3

Dr. Agnieszka Czerwińska from the Institute of Geophysics PAS was the researcher in charge of this project implemented by 26teachers from 15 schools in Poland, namely: Romana Danak, Agata Twardowska, Małgorzata Trejtowicz, Elżbieta Zielińska, Małgorzata Popławska, Damian Makowski, Agnieszka Marciniak, Joanna Gadomska, Joanna Wilmańska, Andrzej Sip, Piotr Siłka, Magdalena Zawada, Julita Majewska, Anna Prokop, Małgorzata Pietrusik, Katarzyna Wolska, Daniela Dębska, Anna Koc, Paulina Garbolińska, Agnieszka Sobczak, Jacek Pawłowski,

Grażyna Kosmala, Małgorzata Florczak, Joanna Ropka, Sylwia Serafin, Aneta Przeklasa-Korgul. One of the teachers - Piotr Siłka from Pryzmat Academic High School prepared the lesson plan. He was working with students aged 15-19 in the context of Geography and Physics courses. The goal of the project was to gather information on students' habits regarding outdoors activities in terms of UV radiation and let them calculate vitamin D3 doses gain, calculate the risk of sunburn and determine 'safe' duration of sun-tanning, taking into account their individual skin phototype.

Spain

Image by TUBS, Wikimedia

Flebocollect: Are hand-made traps to trap sand flies so effective as commercial ones?

Dr. Rosa Gálvez and Dr. María Clemente from the UAM in Madrid directed the research of this project, implemented by the teachers Rosa Martín and Noelia Sánchez at the IES San Agustín de Guadalix (Madrid), with students aged 12-13 in the context of courses in Natural Science, Environmental health, Arts and Mathematics. The goal of the project was to involve students in Citizen Science in and around the classroom to study efectiveness of phlebotomine sandflies light traps. During the implementation, students got information about flying insects which transmit leishmaniosis, as well as the effectiveness of hand-made and commercial light traps based on real data collected by researchers. Finally, students had to draw appropriate conclusions to explain the results obtained.

Cellspotting: How can we teach a computer to classify microscopy images of tumoral cells?

The researchers Dr. José Alberto Carrodeguas and Dr. Jesús Clemente-Gallardo from the University of Zaragoza were in charge of this project implemented by teachers Noelia Sánchez (Biology) at IES San Agustín de Guadalix (Madrid) and Marta Balbás and Adrián Gollerizo (Technology) at Escuela IDEO (Madrid), with students aged 14-18 in the context of courses in Biology and Technology. The goal of the project is to involve students in Citizen Science in and around the classroom to study effectiveness of using analysis of microscopy images of tumoral cell done by students, to train a machine leaning platform to do the analysis autonomously.

Hence, students got information about cell structure and the different mechanisms of cellular death and performed the analysis of a set of microscopy images in the platform cellspotting (http://pybossa.socientize.eu/pybossa/app/cellspotting/)

3. List of Science Pills (videos)

Belgium

Study of meteors using reflection of radio waves on ionised air.
Engineer Stijn Calders from the Belgian Royal Institute for Space Aeronomy discusses the challenges and benefits of bringing an online citizen science project to schools in order to study meteors by use of radio techniques
LINK to Science Pill: https://www.youtube.com/watch?v=ScYueVsxWT4

Margo Nys, geography teacher at onze-Lieve-Vrouwecollege Plus, at Anwerpen describes the implementation of the project at her School and talks about the impact it had on the students.
LINK to Teacher Video: https://youtu.be/bKPqHECYdws

Monitoring of sound levels and analysis of traffic related annoyance in residential areas: "Build your own disruption function".
Dr Luc Dekoninck, researcher in Enviromental Acoustics at the Faculty of Engineering and Architecture of the University of Gent presents the project and describes how was the collaboration with the teachers in the implementation at Schools.
LINK to Science Pill: https://youtu.be/Nz7Mkkw3z0I

Teacher Wim Van Buggenhout from the GTILonderzeel school in Belgium presents the noise exposure pilot study in which he and his students had participated along with the two other Belgian pilots.
LINK to Teacher Video: https://youtu.be/n9pFX83O1ps

Air Quality
Lore Jespers, teacher from the Edugo school in Oostakker, Belgium, explains about the air quality pilot study she had been participating in with her class, and how she approached and appreciated it. She thoroughly explains the aspects that were challenging and/or rewarding.
The video is supplemented by a video of teacher Wim Van Buggenhout (GTILonderzeel, Belgium) who also participated in, and even extended the Britec pilot on air quality.
LINK to Teacher Video: https://www.youtube.com/watch?v=_KzKPzRhyb4

Greece

Urban Climate and Human Bioclimate
Christos Giannaros, Associate Researcher in Athens Observatory, responsible for pilot dedicated to monitoring of Urban Climate and Human Bioclimate, describes the involvement of schools, the results and his experience from the participation in a citizen science project involving students from Greece
LINK to Science Pill: https://www.youtube.com/watch?v=YpVqRFbmxwo

Dr. Flora Paparou, Science teacher in the 1st Vrilissia Upper High School in Athens, presents the methodology of the implementation of BRITEC project at her school, after participating in the pilot dedicated to monitoring of Urban Climate and Human Bioclimate in Greece
LINK to Teacher Video: https://www.youtube.com/watch?v=GRe4f0ClGlM

Analysis of students' dietary habits
LINK to Teacher Video: https://www.youtube.com/watch?v=wC4KhrWHYLY

Poland

Observing of seasonal change of river riparian vegetation and microclimate of river valleys
Assoc. Prof. Monika Kalinowska, Researcher in the IG PAS, explains what the project was about and presents what kind of measurements were taken by the students. Dr. Joanna Ropka, Teacher from Poland, talks about the benefits of implementing Citizen Science projects.
LINK to Science Pill: https://youtu.be/Z8sK3wXN6iQ
Assoc. Prof. Monika Kalinowska, Researcher in the IG PAS, responsible for pilot dedicated to monitoring of seasonal changes in river vegetation, describes the involvement of schools and the results; and Dr. Joanna Ropka, Teacher from Poland talks about difficulties while implementing the pilot:
LINK to Science Pill: https://youtu.be/uJMjsAhyDpc
Dr. Joanna Ropka, Teacher from Poland, shares her thoughts on what to look for in Citizen Science projects. Dr. Agata Goździk, BRITEC Project Coordinator shares feedback gathered during Focused Group Interview with Teachers.
LINK to Teacher Video: https://www.youtube.com/watch?v=-oyJOZC68dg

UV radiation and Vitamin D3
Dr. Ing. Agnieszka Czerwińska, Researcher in the IG PAS, responsible for UV radiation and vitamin D3 pilot, describes the measurements taken by students and shares her thoughts on collaborating with students and teachers.
LINK to Science Pill: https://youtu.be/V5Rx1M2_X0w
Karolina Chodzińska, Specialist in the Science Communication and Education Unit, IG PAS, shares the experience from implementing UV radiation and vitamin D3 pilot in Poland:
LINK to Science Pill: https://www.youtube.com/watch?v=G3EZvvOGzrw
Piotr Stankiewicz, Geography and Science Teacher from Poland, talks about his students' attitude towards activities dedicated to UV radiation measurements and calculations of 'safe' sunbathing time.
LINK to Teacher Video: https://www.youtube.com/watch?v=Y9bEcmSIIeU

Spain

Flebocollect: Are hand-made traps to trap sand flies so effective as commercial ones?
Rosa Gálvez Esteban, Assistant Professor at Universidad Autónoma in Madrid (UAM), talks about her experience as main researcher in the pilot project: "Are hand-made traps to trap sand flies so effective as commercial ones?"
LINK to Science Pill: https://www.youtube.com/watch?v=fq8Li5dtB7A

Adrián Gollerizo, a technology teacher at Escuela Ideo in Madrid describes for us the details of the implementation of Flebocollect project.
LINK to Teacher Video: https://youtu.be/DTcYY9anM3o

Cellspotting: How can we teach a computer to classify microscopy images of tumoral cells?
Dr. Jesús Clemente-Gallardo, Associate Professor at Universidad de Zaragoza talks about the Cellspotting project and summarizes it for us. He also describes his experience as researcher in this Citizen Science project.
LINK to Science Pill: https://youtu.be/3lKARkrqnJ8

Noelia Sánchez Sánchez, Biology teacher at IES San Agustín de Guadalix, shares with us how she implemented Cellspotting pilot project in class, as well as her students' opinions after the implementation
LINK to Teacher Video: https://www.youtube.com/watch?v=5TrtTtiSUyI

4. Learning Scenarios ("lesson plans")

BELGIUM

BRITEC – Bringing Research Into the Classroom

Learning Scenario 1

1. Title:

Radio Meteor Zoo

Author(s)

Margo Nys (teacher), Stijn Calders (researcher)

Area of research

Study of meteors using reflection of radio waves on ionised air.

Subject(s)

Geography

Topic

Structure of the solar system – different objects in the solar system and their properties

Age of students

16-17

2. Introduction

Contribution of the CS project to Science in general

The Radio Meteor Zoo project, which is the name of the online citizen science activity for this educational pilot, aims to further study meteors. The goal is to create an independent computer system to scan data for meteors. The Royal Belgian Institute for Space Aeronomy (BIRA-IASB) has built a network of one transmitter (in the south of Belgium) and several receivers (scattered around the country). The transmitter sends out a steady radiosignal. This signal gets reflected by de ionised air that forms when a meteor passes through the high atmosphere. The receivers then record the reflected signal. This system makes it possible to 'see' the meteors even during the day or when there is a heavy cloud cover. The problem is that, for now, the data has to be processed by people. The goal is to feed correct data (tracing of meteors on a sort of screensho called a spectrogram) to a computer algorithm so it can

Aim of the activities plan and learning objectives

Structure of the solar system is part of the geography curriculum. The researcher covered a lot of the subjects (different objects in the solar system and their properties, position, …) during his lesson.

Due to a lack of time and lack of enthusiasm (from colleagues, e.g. physics teachers) I don't think the students acquired any specific newskills. The lack of time was partially caused by the corona-breakout though.

Summary of activities

Number of activity	Name of activity
1	Introduction to the project by S. Calders (researcher) (40 min.)
2	Identifying meteors in radio data during 1 geography lesson (45 min) (https://www.zooniverse.org/projects/zooniverse/radio-meteor-zoo)

3. Detailed description of each activity

First Part: Aim of the activity

- S. Calders introduced the project. The students got background information about the solar system and the various objects in the solar system. They learned about the difference between comets and meteors, and how the two are also linked. They needed to understand how the meteors can be spotted using radio data and why using radio data gives us an advantage (you can spot meteors during the day or when there are lots of clouds). S. Calders also explained the importance of classifying as many meteors as possible by volunteers: the more correct data, the more the algorithm for autonomicallyidentifying meteors improves.
- Students identify meteors in radio data using a computer. The website offers enough explanation for the students to get started

- (https://www.zooniverse.org/projects/zooniverse/radio-meteor-zoo)
-

Second Part: Suggested procedure

Preparation time	Very little
Teaching time	40 min. / 50 min.
Online teaching material	https://www.zooniverse.org/projects/zooniverse/radio-meteor-zoo Teacher Wim Van Buggenhout (GTILonderzeel) created an educational package for his students, which is available online: https://bit.ly/3ia3TkU
Offline teaching material	None, it can all be done online.
Citizen science purpose of the activity (if any) *	Collecting data (identifying meteors from radio data) to improve the computer algorithm that learns to identify meteor signals from the spectrograms.

*** Guidance for teachers**	Most of the meteors that end up in the atmosphere are not visible to the eye because they are either too small or they are occurring during the day or when the sky is cloudy. For this reason, scientists have developed a system with radio signals, that bounce back on the meteors (or rather: on the ionisation trail they leave in the high atmosphere). These signals are plotted in spectrograms, yet not every signal on those spectrograms represents a meteor. Sometimes there are signals from planes for example. Scientists want to analyse large datasets of meteor signals, to learn more about the outer space (e.g. when do most meteorites occur during the year? Are they different when a comet is nearby?). Because the datasets are so large, it is difficult for scientists to manually identify each and every meteor signal from the spectrograms, so they want to develop a computer algorithm. In order to increase the performance ('correctness') of the computer algorithm, it needs to be trained by us. Hence the need for people to manually indicate which signals are most probably meteor signals, and which are not. This is what we do with our students! In terms of education, this project is great because it helps to hook the interest of the students and I can easily relate it to the content I have to give in my geography classes anyway (e.g. about the difference between meteorites, meteors and meteoroids, or about the solar system, comets, as well as observation techniques to study space.

Third Part: Advice on methodology

If I had more time, I would like to try and collaborate with other teachers (physics, math, chemistry) to make an integrated STEM-project. I would have liked to explore the background of the system more (Why do meteors ionize the air? Can we figure out the trajectory of the meteors from this data? …)

Another option (again with more time) would be to let the students themselves ask the

questions and search for the answers, guided by the scientist and the various teachers.

Fourth Part: Educational analysis

Lifelong learning

STEM learning

Student based learning

Snack learning

4. Assessment after implementation of the activities plan

Student´s learning

Due to the restricted time, I didn't really asses the students. However, I evaluated the process: I wandered through the classroom, checking in with the students as they identified meteors, helping them if needed.

Another teacher, Wim Van Buggenhout, assessed the students in a more formal way, by giving them fill-in sheets, asking them to analyse at least 8 spectrograms per day during one week, and to go and search for information about comets, meteors, meteorites on the internet, in order to answer specific questions he asked them in his teaching materials.

License

About the BRITEC project

BRITEC – Bringing Research into the Classroom project (https://britec.igf.edu.pl/) aims to introduce the Citizen Science (CS) approach in schools as a way of engaging pupils in research practices. This project has been funded with support from the European Commission within ERASMUS+ Programme and is coordinated by the Institute of Geophysics, Polish Academy of Sciences.

BELGIUM

BRITEC – Bringing Research Into the Classroom

Learning Scenario 2

1. Title

In Dutch: Impact van verkeersgeluid op de mens "Bouw een eigen hinderfunctie"

In English: Impact of traffic noise on people "Build your own disruption function"

Author(s)

Wim Van Buggenhout (teacher), Luc Dekoninck (researcher), Mieke Sterken (facilitator, translator)

Area of research

The impact of traffic noise on humans, noise mapping

Building physics: impact of building type (classical building versus 'passive building') on noise transmission in our classrooms.

Subject(s)

Industrial Science, Physics, Biology, Geography and Mathematics in an interdisciplinary approach.

Topic

The impact of traffic noise on humans

Building physics: impact of building type (classical building versus 'passive building') on noise transmission in our classrooms

Age of students

16 to 18 years
Students of the field of study IW, classes 5IW and 6IW (IW = Industrial Science)

2. Introduction

Contribution of the CS project to Science in general

Traffic doesn't only impact our health through air pollution, but also through ambient noise. Globally, more attention is given to air pollution, but with the Belgian BRITEC-topic of „Sound measurements in relation to mobility" our students are helping the researcher to measure noise pollution in locations where our country has no monitoring yet, which is mainly on local roads.

In this project the students make a full environmental impact study and go through the full DPSIR scheme ('driving forces', 'pressure', 'state', 'impact', 'response'). Their measurements and counting will ultimately help to improve the mathematical models that are used to make Flanders 'noise map' on with a high spatial resolution.

Note: What is described above is carried out by our students of 5IW and 6IW (IW- Industrial Sciences).
There is also one student of 6IW who will carry out research on the transmission of sound within the building. This was not proposed by the scientist, but he did agree for us to use the sensors and to help us in case we have questions. As part of the individual research the student has to do for his '*integrated task*' (an assessment/thesis each student has to make in their final year at school), he is using the BRITEC sensors to measure noise levels in four classrooms at school. During one full week, he will measure noise levels in two classrooms on the ground floor, of which one is in the old building (traditionally built, without isolation) and one in the school's newest building (passive building). During the second week, he will repeat these measurements in classrooms on the first floor of these two buildings. For the practical part of his integrated task, the student will program two new sensors in Arduino and construct a suitable housing for them. He will then conduct measurements and analyse the results by comparing them with the results from the sensors provided by BRITEC.

Aim of the activities plan and learning objectives

Prerequired knowledge: for the correct interpretation of all the noise measurements the students must construct a ´disruption function´. Therefore, the students need to **program in Excel** and need **logarithms** to come to decibels.

Students specifically learn about all the steps in an Environmental Impact Study, using the DPSIR-scheme (('driving forces', 'pressure', 'state', 'impact', 'response'). They acquire the general 'research investigation skills' they need to get by our Government.

Detailed learning outcomes:

Driving forces: Students learn about 'noise': what is it? (physics: waves) how is it measured? What is a decibel?

Pressure: Students learn where to find official surveys and information from the government and from scientists. They check for coordinates of their homes and learn to convert them from GPS to local coordinates (and the other way around). They fill in the survey and get more aware of the relationship between noise and their own feeling of wellbeing, and about the difference in experienced arousal depending on the source or type of the sound.

They do countings of traffic in front of their houses and learn how to transfer and integrate their answers into excel.

State: students learn about sensor measurements and they learn to read values from maps (noise maps). They compare their traffic countings with the noise levels deduced from noise maps, and make graphs in Excel. They learn to apply trend analyses and try to explain the difference between the countings and the noise levels as deduced from the noise maps. They learn to calculate 'weighted averages' as they summarize their countings into one single number as a proxy for the countings (called 'weighted traffic', in which a bycicle counts for less than a truck for example).

Impact: students learn what a disruption function is and how it is constructed. They learn to analyse the data from the sensors, in Excel (e.g., min, max, count, log) and learn different functions and cell formats in Excel.

Response: students learn to think about possible measures one can take to reduce not only the noise levels but more importantly the disturbance by noise. They learn that measures can be taken at a remediating (often local) level, or can be taken at the root or cause of the

problem. They get to know the complexity of environmental problems.

Summary of activities

Number of activity	Name of activity
1	Survey
2	Traffic counts
3	Measurement of noise exposure at student's homes
4	Interpretation of noise measurements
5	Finding additional information from noise maps
6	Constructing a disruption function
7	Formulating possible measures to reduce exposure

3. Detailed description of each activity

First Part: Aim of the activity

In this project the students make a full environmental impact study and go through the full DPSIR scheme ('driving forces', 'pressure', 'state', 'impact', 'response'). Their measurements and countings will ultimately help to improve the mathematical models that are used to make Flanders 'noise map' on a high spatial resolution.

***Driving forces*:** the need of transport and displacements for our humans in the context of social activities is the main driving force of the noise pollution.

***Pressure*:**

- [activity 1] Start completing a survey: the scientist (Dr. Luc Dekoninck) extracted relevant noise-related questions from the Standard Environmental Survey ('Standaard LeefomgevingsOnderzoek') that the Flemish Government applies once every five years among its citizens. You can find the questions in the Annex of this report (p. 159-166). The

document is in Flemish.
- [activity 2] Carrying out traffic counts: in front of student's home, in an industrial area and in front of our school. This happens twice a day during rush hour, for the duration of one hour each.

***State*:**
- [activity 3] Measurement of noise exposure by use of a noise sensor placed at student's homes, in the industrial area of Londerzeel and at our school. We are placing four noise sensors at varying distances (1m, 100m, 200m, 300m) from a busy highway near the industrial zone of Londerzeel.
- [activity 4] Interpretation of the noise measurements (both the measurements we obtained from the sensors, as well as the measurements or noise levels we deduced from existing noise maps of Flanders).
- [activity 5] Finding additional information from noise maps.

Impact:
- [activity 6] In order to assess the impact of the noise on us as humans, we construct a 'disruption function' (based on the noise map, the traffic counts and the survey). A disruption function is a graph of the percentage of people indicating they are hindered by a certain degree of noise. This graph will look different for different types of noise (e.g. the sound of a train may cause more/less arousal in people than the sound of a car with the same level of decibels). The disruption function will thus show the amount of people indicating they are strongly disturbed by the noise, at each dB-level.

Response:
- [activity 7] List of possible measures to reduce exposure in/around the home, in the industrial area at Londerzeel and at our school.
- Discussion and awareness rising.

Second Part: Suggested procedure

Survey (1) + traffic counts (2)

Preparation time	1 h
Teaching time	1/2 h
Online teaching	None

material	Some extra background information added by the scientist for the purpose of the European MOOC: Fields et al. 2001: Standardizd general-purpose noise reaction questions for community noise surveys: research and recommendations. DOI: 10.1006/jsvi.2000.3384 Jeon et al. 2008. Community annoyance from road traffic noise and construction noise in urban spaces. http://www.icben.org/2008/PDFs/Jeon_et_al.pdf Interesting extra information for The Netherlands: Onderzoek Beleving Woonomgeving (OBW) 2019 (cbs.nl)
Offline teaching material	All the documents are made by the very enthusiastic researcher (Dr. Luc Dekoninck) and adapted to our school by teacher Wim Van Buggenhout.
Citizen science purpose of the activity (if any) *	I only mention the purpose of the citizen science project. The survey and traffic counts are meant as a preparation for constructing the disruption function. Traffic counts: during the morning- and evening rush hour students count every person, biker, car or truck or other device that passes their home. They do this in a simple excel spreadsheet.
*** Guidance for teachers**	The spreadsheet for counting traffic contains a column for each type of traffic (e.g. walker, biker, car, truck, bus) that passes by. In each row you can fill in the date and hour during which the respective counting was done. From there, you can calculated a weighted average of the countings (with walkers and bikes having a 'lower weight' [or importance] than trucks and busses).

Measurement of noise exposure at students' homes (3)

Preparation time	1 h
Teaching time	1/2 h
Online teaching	The measurements made by the sensors are made available to

material	us by the scientists at http://ssmdb.intec.ugent.be:8080/node/status
Offline teaching material	All the documents are made by the very enthusiastic researcher (Dr. Luc Dekoninck) and adapted to our school by teacher Wim Van Buggenhout. Noise sensor
Citizen science purpose of the activity (if any) *	This activity is also a preparatory activity in order to construct the disruption function. For the researcher it is also important to have more data on noise measurements at location where our country is not measuring at the moment. Procedure Activity 3: students only have to install the noise-sensor at their home. The data are transmitted automatically and we get them in Excel, provided by the researcher.

Interpretation of noise measurements (4) + Finding additional information from noise maps (5) + Constructing a disruption function (6) + Formulating possible measures to reduce exposure (7)

Preparation time	4 h
Teaching time	16 h
Online teaching material	Different kinds of websites regarding the subject.
Offline teaching material	All the documents are made by the very enthusiastic researcher and adapted to our school by teacher Wim Van Buggenhout.
Citizen science purpose of the activity (if any) *	I mentioned the citizen science purpose: for the researcher is important to have more data on noise measurements at location where our country is not measuring at the moment.

	Procedure Activity 5: Finding additional information from noise maps: we can find this on the internet or get it from the researcher. For Belgium: https://omgeving.vlaanderen.be/geluidsbelastingkaarten and http://www.geopunt.be/search?facet=all&q=geluid For European noise related information you can check https://noise.eea.europa.eu/ or https://www.eea.europa.eu/themes/human/noise/browse-products/data-and-maps and https://www.eea.europa.eu/data-and-maps/data/data-on-noise-exposure-7 The Netherlands: Onderzoek Beleving Woonomgeving (OBW) 2019 (cbs.nl) Procedure Activity 6: For the correct interpretation of all the noise measurements the students must draw a disruption function.
*** Guidance for teachers**	For Activity 6: For the correct interpretation of all the noise measurements the students must draw a disruption function. For this, the students need to program in Excel and need logarithms to come to decibels. They need knowledge of mathematics and physices to realise this.

Third Part: Advice on methodology

Every document, photo, information in the Excel-files must have a specific filename or system of filenames that you use consistently. That is very important. E.g. for pictures of the installed sensors: Photo_NodeID_4_p1.jpg (= picture 1 of sensor 4). For the traffic countings you can ask every student to name their files Trafficcounting_Schoolname_Studentname.xlsx.

Fourth Part: Educational analysis

Project-Based Learning
Collaborative Learning
Flipped Classroom (see https://facultyinnovate.utexas.edu/sites/default/files/utflipquickstartguide120516-2.pdf)
Student Centred Learning
STEM Learning
Outdoor Education
Peer Learning
Personal Learning Environment
Cloud Based Learning
Visual Search & Learning
Mobile Learning
Augmented Reality
Learning materials

4. Assessment after implementation of the activities plan

Student´s learning

The students had to write a report (in MS Word) of the online lesson which was evaluated.

For the activities undertaken at home we evaluate the document that is sent via the school platform our school uses (called Smartschool).

The construction of the disruption function and its interpretation must be done at school, so that the teacher operates as coach/mediator. We evaluate the students permanently during this work at school.

Students do also peer- and self-evaluation.

Citizen Science experience

My apologies for not naming them, because there were too many (small) problems to mention, however they all got solved though. One part of the problems was related to technical issues, because I was the very first teacher to test the education and measurement activities and hence some small bugs needed to get worked out of the setup. We've provided feedback to the scientist and jointly worked our way around those bugs. The activities are now perfect for other teachers.

5. Bibliography

Own work.

License

About the BRITEC project

BRITEC – Bringing Research into the Classroom project (https://britec.igf.edu.pl/) aims to introduce the Citizen Science (CS) approach in schools as a way of engaging pupils in research practices. This project has been funded with support from the European Commission within ERASMUS+ Programme and is coordinated by the Institute of Geophysics, Polish Academy of Sciences.

BELGIUM

BRITEC – Bringing Research Into the Classroom

Learning Scenario 3

1. Title

Air Quality

Author(s)

Lore Jespers (teacher), Geert Bauwens (researcher)

Area of research

Indoor air quality and building physics

Subject(s)

This is being taught in the framework of the course called 'Applied Sciences'. The content of the course is meant to provide a basis of scientific knowledge (e.g. biology, physics, chemistry) in function of, and in the context of, the general study area the students are focused on (e.g. students who study 'wood and building' will have different content in their courses of Applied Sciences than students who study 'nursing' as a general study line. In the course 'Applied Sciences' that we are teaching, they have a module called 'building physics in function of the indoor environment and sustainability', which focuses on the science (e.g. physics) behind architecture. I (Lore Jespers) have made an agreement with my colleague of mathematics that he will take up this project, or refer to it (as for the mathematical part of it) when he will teach about mathematical concepts that the students needed for this project but aren't getting until later this year. That will obviously be during within the course "mathematics".

Part of the module also teaches about our breathing metabolism, in which students assess the amount of CO2 they breathe out, so it could perfectly fit into biology classes too if you want.

In terms of the corona pandemic it is very relevant too: the amount of CO2 in the classroom can be used to assess the level of aerosols in the air and hence the risk of spreading any virus.

Age of students

6th grade, which means approximately 17-18 years (or older).

2. Introduction

Contribution of the CS project to Science in general

The building sector represents 40% of the end use of energy in Europe, being the largest energy consuming sector. This means that making buildings more energy efficient has a huge potential to reduce overall energy consumption in Europe and help battle climate change.

In terms of energy efficiency, however, school buildings are far behind the current trend of making buildings more efficient. Yet, they are being used all the time and by many people at once. At the same time, heating up a classroom and not opening te windows (to keep warmth inside the building) results in the fast accumulation of CO2 (and VOC's: volatile organic compounds) in the indoor air, impacting the health and concentration of both students and teachers. Especially in the context of COVID-19, measuring CO2-levels in the classroom is important, as it gives a signal of when the air needs to be refreshed to avoid spreading of the disease through aerosols.

School buildings and classrooms are often not accessible for scientists, so combining the educational materials provided by the scientist (Geert Bauwens, KULeuven, Belgium) with the measurements of the air quality (during a minimum of two weeks) creates a win-win situation for both parties. The researcher is investigating the current state (in terms of classroom indoor air quality) of schools in Belgium, in order to be able to give policy advice and provide efficient strategies to improve the air quality in schools.

Aim of the activities plan and learning objectives

Applying mathematical, scientific and technical-technological knowledge;

Collaborative learning,

Learning to collaborate.

Summary of activities

Number of activity	Name of activity
1	Introduction by the teacher, with information about our lungs function.
2	Experiment by the students: qualitative assessment of the amount of CO2 in the classroom air as well as the air people breathe out (test with lime water).
3	Experiment by the students: quantitative assessment of the amount of CO2 in the classroom air as well as the air people breathe out (using a tube, plexiglass box and CO2-sensor).
4	Data processing by calculating the volume balance & mass balance.
5	Monitoring C02 in the classroom during 2 weeks (by use of sensors).
6	Link the method of the volume balance to the values measured by the sensors in class.
7	Analyse the monitored CO2-curve in function of the IDA classes.
8	Check the ventilation flow by iteration (in Excel).
9	Calculate the ventilation rate.

3. Detailed description of each activity

First Part: Aim of the activity

Students learn to understand where CO2 originates from. Not just “from the lungs” but through specific processes in the cells (mitochondria).

Students get more aware of the fact that there is a lot of CO2 in the air they breathe out.

Students start working on hands-on tasks. They have to collaborate, and they witness the differences between different measurements.

Students need mathematical and scientific knowledge they acquired in the past school years, in order to get to a sound conclusion/result for the project.

The monitoring increases the level of engagement of both the students and other teachers

in the school. What happens when I open or close the door? What is the impact of opening less or more windows?

In this task we estimate the levels of CO2 in the classroom in a theoretical manner. We subsequently compare these values with the real measurements. Students can reflect on the reasons why there's differences between those values.

By studying the graphs we can estimate the level at which we surpass the treshold of "good air quality". By recording our actions in the class (like opening doors, windows, estimating the amount of students that are present in class, etc.) we can assess the different potential actions to take (at minimum) when CO2 levels are rising and air quality needs to be improved.

Mathematics is being applied here. Students try to derive the ventilation flow from calculations they make by iteration.

Once the ventilation flow is known, students can calculate the value of the ventilation rate (a factor often used in building works) (this links with the course "building").

Second Part: Suggested procedure

Preparation time	Students don't need to prepare anything beforehand.
Teaching time	First half hour: explaining how the lungs work.
Online teaching material	I used MS OneDrive to share a Word-document with my students, which they could work on or fill in. It was a pity though that the figures which I had included in the Word-file did not show clearly when they wanted to work on the document. Possibly because I extracted them from the PDF provided by the scientist, and something may have gone wrong in the conversion process. Teaching materials were provided by the scientist, and are available in Dutch on https://bit.ly/3CNXYK7
Offline teaching material	Computers for editing their reports. A little pot with tubes and lime water (provided by the researcher) Cylinders and box with sensor (provided by the researcher)

	CO2- loggers (provided by the researcher) Folding rulers (to measure the dimensions of the classroom)
Citizen science purpose of the activity (if any) *	To measure the amount of CO2 in the classroom during 14 consecutive days, as to assess the current state of the air quality in Belgian schools. It is recommended to keep a diary of your activities in the class: when did you open the door and for how long? How many pupils were present in the class at any given time? When did you open the windows? This is good to compare with the CO2-measurements done by the sensors. .
*** Guidance for teachers**	See part 2: 'contribution of the CS project to Science in general'.

Third Part: Advice on methodology

The students were asked to do the reporting of the project in small groups, but the experiments were carried out with the whole group all together (it was a rather small class, though).

I spent four times two hours (in class) on this project (including introducing the students to the project, having an online lesson from the researcher, and filling in the online questionnaires for Britec, as well as carrying out the experiments).

If you have enough time, it could be interesting to spend more time on the experiments in class. We measured and calculated the amount of CO2 in the air breathed out by two students, but the results were very different. We did not have the time to repeat the experiment with more students though, so this impeded us to check why exactly the values of those two students were so different. I would advise to reserve more time for repetition of the experiment(s) so you can to a proper assessment of the situation together with your students.

Fourth Part: Educational analysis

Mainly: project-based learning (which is interdisciplinary), but also collaborative learning, and STEM of course.

4. Assessment after implementation of the activities plan

Student´s learning

The students have to write a report of the results and calculations. A template was foreseen for them, so they didn't have to start from scratch but rather had to fill in the prepared template.

It might perhaps be nicer to give the students a bit more freedom with regards to the reporting phase, only providing them with a few starting points in order to let them work on it more independently. (This could be done in a context where teachers have more available time together with their students). Nevertheless, I do consider the idea of letting the students write (or fill in) a report is an excellent way to evaluate them.

You could give them some basic questions which they need to answer (e.g. 'Introduction: what are the scientific questions we wanted to resolve with our experiments?', 'what is the relevance for society?', 'What is the relevance for science?') or a general structure for their report (consisting of: an introduction, a description of the methods, a description of the results of the experiments, and a discussion on what these results mean ('interpretation & discussion') followed by a final conclusion or recommendation and summary.

Citizen Science experience

The scientist has been teaching one hour to the students directly. He explained them about his research on air quality and building physics, and about the experiments they would be going to do. The teaching did not run super smooth, because of technical reasons: it was held online because of Covid-restrictions, and some of our pupils did not bring earphones, resulting in a one-directional conversation, so there was not a lot of interaction or Q&A. A live lesson would have been more interesting.

It is important to engage the students as much as possible:

- What helped was to share the link to the online platform where they could see the CO2 values/monitoring, not only with the students, but also with other teachers in school.
- Give the students some time in advance to prepare questions to ask the researcher, it helps to increase their level of involvement.

License

About the BRITEC project

BRITEC – Bringing Research into the Classroom project (https://britec.igf.edu.pl/) aims to introduce the Citizen Science (CS) approach in schools as a way of engaging pupils in research practices. This project has been funded with support from the European Commission within ERASMUS+ Programme and is coordinated by the Institute of Geophysics, Polish Academy of Sciences.

GREECE

BRITEC – Bringing Research Into the Classroom

Learning Scenario 1

1. Title

Urban Climate and Human Bioclimate activies and Lesson plan

Author(s)

Chris Giannaros, researcher, National Athens Observatory

Flora Paparou, Science teacher, 1st Upper High School of Vrilissia

Marina Korasoidi, Economics teacher, 1st Upper High School of Vrilissia

Area of research

Environmental protection issues

Subject(s)

Creative research activities

Physics: Introductory concepts for the study of physics, research and experimental methodology

Mathematics: Statistics and Probabilities, Graphs and Functions

Informatics: Use of office platforms, cloud computing and use of collaborative Open Source Platforms

Topic

The program was intended in the context of the subject of 'Creative research activities', a 2 hours weekly subject included in the Upper High School Curriculum

The "Research Creative Activities" foreseen in the current Upper High School Curriculum expand the content of the Research Works (Project), so that in addition to the scientific micro-researches they also include artistic, social character activities (volunteering,

solidarity, interpersonal, etc. .), environmental, cultural, activities related to modern and traditional media and information (print and digital media, creation of printed or electronic student magazine, actions related to internet student radio, etc.), as well as others, related to a variety of issues of school life and the environment.

Age of students

A' grade from 1st Vrilissia Upper High School, 23 students, 3 students in the management group, the rest separated in groups of 5. Age of students 16 years old

The same program was also run in the C grade from the 1st Vrilissia Junior High School, 21 students separated in groups of 5 or 6. Age of students 15 years old

2. Introduction

Contribution of the CS project to Science in general

The main points of the research process were students to be informed about concepts like (a) Climate change, (b) Urban climate, (c) Urban Heat Islet (UHI), (d) Urban population, and (e) Human biometeorology and then to focus on the School research work including scientific measurements, research on the topic, presentation and documentation of the results.

Aim of the activities plan and learning objectives

The aim of the Urban Climate and Human Bioclimate citizen Science project meet the targets of BRITEC program, namely:

Support the exchange between research institutions and schools. Both the Research center and the school gain experience in terms of working together for mutual benefits. Students develop skills, acquired knowledge and experience in the field of scientific research, while the NOA open new routes in involving citizens and raise awareness to pupils and the wider school community to become more active in supporting scientific research on global issues as the protection of the environment.

Co-create and pilot Citizen Science initiatives, skills and attitudes in schools, teachers and students.

Provide online training for teachers and recommendations for stakeholders, schools and local community into engaging schools and researchers into joint initiatives.

Beyond the above, the Urban Climate and Human Bioclimate program proposes to:

Facilitate learning and cultivate attitudes and approaches related to citizen science process that includes a number of characteristics present in Computational Thinking, such as logically ordering and analysing data and creating solutions using a series of ordered steps (or algorithms), and dispositions, such as the ability to confidently deal with complexity and open-ended problems. Students became researchers and producers by discovering information and by helping researchers to their research.

Support interdisciplinary teaching between STEM and research issues in the school. The project aims to create a community of practice for "citizen science" teachers inside the school, on how to teach their subjects supporting each other and provide input and methodologies to their subjects' activities and teaching.

Co-create and implement integrated models inspired by research disciplines, increasing relevance while supporting the development of Computational Thinking related skills like solving problems, designing systems, and understanding human behaviour and the 21st century skills in students and school progress.

Soft, hard and technical skills development was also a goal for implementing the project

Hard and Technical Skills

Computer Technology skills in terms of Cloud, Open Source and MS Office Suite, Digital communication, Data Analysis (Data mining, Data presentation, Resource management, Data engineering, Data management, Use of data to explore a problem or make a decision), Design, Cloud computing

Soft Skills:

Communication Skills in terms of Clarity, Confidence, Respect, Empathy, Listening, Verbal and non-verbal communication, Written communication, Constructive feedback, Friendliness etc

Team Work Skills in terms of Conflict management, Collaboration, Cooperation, Coordination, Idea exchange, Mediation, Negotiating

Adaptability Skills in terms of Curiosity, Self-management, Decision-making, Calmness, Optimism, Open-mindedness, Analysis, Self-confidence, Organization, Self-motivation.

Problem-Solving, analytical and creative thinking skills in terms of Analysis, Lateral thinking, Logical reasoning, Initiative, Persistence, Observation, Persuasion, Negotiation, Brainstorming, Decision making

Creativity in terms of developing innovative solutions by using Divergent thinking, Inspiration, Imagination, Reframing, Mind mapping, Insight, Innovation, Experimenting, Questioning, Design.

Work Ethic in terms of Integrity, Responsibility, Discipline, Initiative, Dependability, Commitment, Self-motivated, Professionalism, Teamwork, Time-management.

Time Management in terms of Goal setting, Prioritizing, Self-starter, Planning, Decision making, Focus, Delegation, Stress management, Organization.

Leadership especially for the group leaders that guided the other students to the goals and mission of the project, in terms of Project management, Empathy, Selflessness, Agility, Listening, Humility, Cultural intelligence, Authenticity, Versatility, Generosity, Trust and Attention to Detail allowing them and the group to be both, thorough and accurate in their work.

Summary of activities

Number of activity	Name of activity
1	Record the meteorological conditions
2	Record of the subjective thermal sensation
3	Edit the data obtained and answer the research questions
4	Present the results

3. Detailed description of each activity

Activity 1: Record the meteorological conditions

First Part: Aim of the activity

Students record the meteorological conditions in seven (7) selected areas of the school and surrounding areas namely:

- school class,
- school yard under Shadow
- school yard under Sun
- street under Shadow
- street under Sun
- local parκ under Shadow
- local parκ under Sun

The *Pocket Weather Meter* for the measurements was provided by the Research Center.

Initially the meteorological conditions were kept in worksheet, see Annex 1.

Second Part: Suggested procedure

Preparation time	1 hour
Teaching time	1 teaching hour
Online teaching material	All support documents have been uploaded to the Google Drive (Google sheets, google docs, google presentations)
Offline teaching material	See Methodology / Protocol "Urban Climate and Human Bioclimate" and Annex 1,
Citizen science purpose of the activity (if any) *	Give a brief description (1 paragraph) of the meteorological conditions prevailing at the measurement points, emphasizing the differences that occur between the points. What are the characteristics of the points that lead to these differences? Urban Thermal Island 1. Create the temperature graph in relation to the time for the day November 18, 2019 for the area of Ampelokipi, Vrilissia and Spata on the same graph, using the CHARTS tools (Note: Adjust the scale of the vertical axis of temperatures so that the differences are more obvious). 2. Calculate the temperature differences between Ampelokipi, Vrilissia and Spata and then find the maximum differences using the MAX function. What time of day does it appear? 3. Calculate the average temperature difference between Ampelokipi and Spata during: a) night (from 17:00 to 07:00) and b) day (from 08:00 to 16: 00) using the AVERAGE function. When is the phenomenon of the Urban Thermal Island more intense? Are there lower temperatures in the urban area during the day than in other areas? How would you characterize this phenomenon? 4. Search for information about areas (Google Search, Google Earth, etc.) to briefly describe (1 paragraph) the characteristics of the areas (buildings, green spaces, etc.). What are the characteristics of the areas that contribute to the Urban Thermal Island phenomenon at night and to the opposite phenomenon during the day?
*** Guidance for**	These are the main research questions that will promote the

teachers	study. It is suggested for teachers and students to have a clear understanding of the Urban Thermal island based on based on bibliographic references and recent research papers. the activities, the type and the time of the activities are decided after close cooperation with the responsible researcher The scientific research carried at a school level could consists of: • Define purpose. • Construct hypothesis. • Test the hypothesis • collect data. • Analyze data. • Draw conclusion. • Communicate results. (note: steps 2 and 3 is about a more statistically based study, outside the scope of students' abilities. However, the steps can be simplified after the collaboration of teaches – researchers, in order to meet student's abilities and knowledge)

Third Part: Advice on methodology

The program was intended in the context of the subject of 'Creative research activities', a 2 hours weekly subject included in the Upper High School Curriculum

The "Research Creative Activities" foreseen in the current Upper High School Curriculum expand the content of the Research Works (Project), so that in addition to the scientific micro-researches they also include artistic, social character activities (volunteering, solidarity, interpersonal, etc. .), environmental, cultural, activities related to modern and traditional media and information (print and digital media, creation of printed or electronic student magazine, actions related to internet student radio, etc.), as well as others, related to a variety of issues of school life and the environment.

Indoors activities took place during the subject's teaching hours.

To complete outdoors activities we took the permission to use other teaching subjects' hours (total 1 school day)

Use of computer lab after the school

Fourth Part: Educational analysis

Project-Based Learning: students get fact-based tasks, problems to solve and they work in

groups. This kind of learning usually transcends traditional subjects.

Collaborative Learning: a strong focus on group work.

Outdoor Education: learning outside of the school building in the “real” environment

STEM Learning: Increased focus on Science, Technology, Engineering, Mathematics subjects in the curriculum

Peer Learning: students learn from peers and give each other feedback.

Cloud Based Learning: data, tools, software is all online and can be reached and modified from different devices.

Snack Learning: small and attractive bits of learning rather than pro-longed forms of study

Activity 2: Record of the subjective thermal sensation

First Part: Aim of the activity

Students record the subjective thermal sensation by each student in seven (7) selected areas of the school and surrounding areas namely:

The seven (7) selected measurement points.

- school class,
- school yard under Shadow
- school yard under Sun
- street under Shadow
- street under Sun
- local parκ under Shadow
- local parκ under Sun

Initially the subjective thermal sensation by each student were kept in a worksheet, see Annex 2.

Second Part: Suggested procedure

Preparation time	2 hour
Teaching time	1 teaching hour
Online teaching material	All support documents have been uploaded to the Google Drive (Google sheets, google docs, google presentations)
Offline teaching material	See Methodology / Protocol "Urban Climate and Human Bioclimate" and Annex 2,
Citizen science purpose of the activity (if any) *	• Outline questions or guidelines required for collecting data • Complete the activity, subjective thermal sensation and characteristics (columns I to T) of Groups 2 and 3, as in the case of Group 1, based on the thermal sensation questionnaires (see attached excel file) • Calculate the average subjective thermal sensation of Groups 2 and 3 in column U, using the AVERAGE function, as in the case of Group 1 (see attached excel file) • Give a brief description (1 paragraph) of the meteorological conditions prevailing at the measurement points,

	emphasizing the differences that occur between the points. What are the characteristics of the points that lead to these differences? • Give a brief description (1 paragraph) of the average subjective thermal sensation of the participants at each measuring point, emphasizing the differences that appear between the points. To what environmental factors are these differences likely to be due? • Give a brief description (1 paragraph) of the subjective thermal sensations of the participants at each measurement point, emphasizing the differences that occur between the participants. To what personal factors are these differences likely to be due?
*** Guidance for teachers**	The selected measurement points are very important for the experiment's output and must be selected and decides according to the • the depth of research • mobility of students • measuring instruments and • expected results

Third Part: Advice on methodology

The program was intended in the context of the subject of 'Creative research activities', a 2 hours weekly subject included in the Upper High School Curriculum

The "Research Creative Activities" foreseen in the current Upper High School Curriculum expand the content of the Research Works (Project), so that in addition to the scientific micro-researches they also include artistic, social character activities (volunteering, solidarity, interpersonal, etc. .), environmental, cultural, activities related to modern and traditional media and information (print and digital media, creation of printed or electronic student magazine, actions related to internet student radio, etc.), as well as others, related to a variety of issues of school life and the environment.

Indoors activities took place during the subject's teaching hours.

To complete outdoors activities we took the permission to use other teaching subjects' hours (total 1 school day)

Use of computer lab after the school

Fourth Part: Educational analysis

Project-Based Learning: students get fact-based tasks, problems to solve and they work in groups. This kind of learning usually transcends traditional subjects.

Collaborative Learning: a strong focus on group work.

Outdoor Education: learning outside of the school building in the “real” environment

STEM Learning: Increased focus on Science, Technology, Engineering, Mathematics subjects in the curriculum

Peer Learning: students learn from peers and give each other feedback.

Cloud Based Learning: data, tools, software is all online and can be reached and modified from different devices.

Snack Learning: small and attractive bits of learning rather than pro-longed forms of study

Edutainment: playful learning. Learning while having fun.

Activity 3: Editing the data obtained and answer the research questions

First Part: Aim of the activity

Students in groups (every group is coordinated by one elected student)

Transfer the data obtained to a spreadsheet. Edit the data obtained using Data Sheets (Excel, Google Sheet, Libre office Calc). Analysis and discussion of results. Drawing conclusions.

The attached excel file (1st High School of Vrilissia - Biometeo Metrics - 18th November 2019.xls) was used to carry out the activity. The file was also transferred to a google sheet to facilitate collaboration between students and introduce them to the use of cloud computing.

Second Part: Suggested procedure

Preparation time	3 hours
Teaching time	2 teaching hours
Online teaching material	All support documents have been uploaded to the Google Drive (Google sheets, google docs, google presentations)
Offline teaching material	See attached excel file
Citizen science purpose of the activity (if any) *	Outline questions or guidelines required for collecting data Why use digital technologies to edit, store, process, transmit data and information How digital technologies contribute to the development of sciences How digital technologies are used by sciences and scientists

*** Guidance for teachers**	In a citigen science program teachers must be ready to explain the questions above and be fully informed of the physical object of the program. The simplest way to edit the data is to use free Open Source Collaborative tools and/or scientific applications offered by the research Institution.

Third Part: Advice on methodology

The program was intended in the context of the subject of 'Creative research activities', a 2 hours weekly subject included in the Upper High School Curriculum

The "Research Creative Activities" foreseen in the current Upper High School Curriculum expand the content of the Research Works (Project), so that in addition to the scientific micro-researches they also include artistic, social character activities (volunteering, solidarity, interpersonal, etc. .), environmental, cultural, activities related to modern and traditional media and information (print and digital media, creation of printed or electronic student magazine, actions related to internet student radio, etc.), as well as others, related to a variety of issues of school life and the environment.

Indoors activities took place during the subject's teaching hours.

To complete outdoors activities we took the permission to use other teaching subjects' hours (total 1 school day)

Use of computer lab after the school

Students have used cloud technologies to collaborate, communicate and integrate the project.

Fourth Part: Educational analysis

Cloud Based Learning: data, tools, software is all online and can be reached and modified from different devices.

Collaborative Learning: a strong focus on group work.

Project-Based Learning: students get fact-based tasks, problems to solve and they work in groups. This kind of learning usually transcends traditional subjects.

Outdoor Education: learning outside of the school building in the "real" environment

STEM Learning: Increased focus on Science, Technology, Engineering, Mathematics subjects in the curriculum

Peer Learning: students learn from peers and give each other feedback.

Snack Learning: small and attractive bits of learning rather than pro-longed forms of study

Activity 4: Present the results

First Part: Aim of the activity

Students in groups (every group is coordinated by one elected student)

Presentation of the results (see attached files)

The attached excel file (data processing BRITEC 1st Vrilissia Upper High School.xls) and the attached word file (britec_analysis_conlusion 1st Vrilissia Upper High School.doc) were used to present the conclusion and the results of the research and the activities carried out by the students.

Second Part: Suggested procedure

Preparation time	No preparation time needed,
Teaching time	2 teaching hours
Online teaching material	All support documents have been uploaded to the Google Drive (Google sheets, google docs, google presentations)
Offline teaching material	See attached excel and word files
Citizen science purpose of the activity (if any) *	Outline questions or guidelines required for collecting data Why use digital technologies to edit, store, process, transmit data and information How digital technologies contribute to the development of sciences How digital technologies are used by sciences and scientists

*** Guidance for teachers**	In a citizen science program teachers must be ready to explain the questions above and be fully informed of the physical object of the program. Data interpretation refers to the implementation of processes through which data is reviewed for the purpose of arriving at an informed conclusion. The interpretation of data assigns a meaning to the information analyzed and determines its signification and implications. Data analysis tends to be extremely subjective. People often simply summarize their results because they do not know how to interpret their findings. Summary, however, is not interpretation. Interpreting your findings is about seeing whether what you found confirms or does not confirm the findings of previous studies in your literature review. The presentation of the results should include the findings of your study and ONLY the findings of your study. The findings include: • Data presented in tables, charts, graphs, and other figures (may be placed among research text or on a separate page) • A contextual analysis of this data explaining its meaning in sentence form • Report on data collection, recruitment, and/or participants • Data that corresponds to the central research question(s) • Secondary findings (secondary outcomes, subgroup analyses, etc.)

Third Part: Advice on methodology

The program was intended in the context of the subject of 'Creative research activities', a 2 hours weekly subject included in the Upper High School Curriculum

The "Research Creative Activities" foreseen in the current Upper High School Curriculum expand the content of the Research Works (Project), so that in addition to the scientific micro-researches they also include artistic, social character activities (volunteering, solidarity, interpersonal, etc. .), environmental, cultural, activities related to modern and traditional media and information (print and digital media, creation of printed or electronic student magazine, actions related to internet student radio, etc.), as well as others, related to a variety of issues of school life and the environment.

Indoors activities took place during the subject's teaching hours.

To complete outdoors activities we took the permission to use other teaching subjects' hours

(total 1 school day)

Use of computer lab after the school

Students have used cloud technologies to collaborate, communicate and integrate the project.

Fourth Part: Educational analysis

Cloud Based Learning: data, tools, software is all online and can be reached and modified from different devices.

Collaborative Learning: a strong focus on group work.

Project-Based Learning: students get fact-based tasks, problems to solve and they work in groups. This kind of learning usually transcends traditional subjects.

Outdoor Education: learning outside of the school building in the “real” environment

STEM Learning: Increased focus on Science, Technology, Engineering, Mathematics subjects in the curriculum

Peer Learning: students learn from peers and give each other feedback.

Digital Skills development (especially use of spreadsheets, text editors and presentations)

Snack Learning: small and attractive bits of learning rather than pro-longed forms of study

4. Assessment after implementation of the activities plan

Student´s learning

Discussion with students at the end of school year has shown that students believe that:

- The projects criteria were met successfully
- Acquired Proficiency in thinking like a researcher
- Understanding of the science, math and ICT tools needed to solve the problem
- Progress in working successfully in teams was achieved
- Development of student attitudes and confidence that lead to successful citizen science projects

Citizen Science experience

Lessons Learnt

The structure of the course has to be defined during the first meeting with teachers and researchers.
A presentation of the structured methodology has to be defined
The training of the teachers involved (by the researcher) is essential
The connection with the involved cognitive subjects, informatics, sciences must be clear
The experimental phase has to be conducted together with the researchers
Clear guidance and explanation of the scientific questions and research that students had to answer and accomplish.
It is expected that the students' outcome presentations will be exhibited to the school board and parents' associations, while local authorities will also be invited in the presentations. This is a strong motivation for students, as they have the chance to promote their research work and propose specific environmental measures that can potentially be applied in practice. In the same framework, the publication of the students' work in educational scientific conferences and journals will be considered.
In overall, the project is expected to increase the students' knowledge and awareness about urban climate and its importance in human bioclimatic conditions, especially under the climate change conditions that the planet is experiencing. The students will also practice in conducting research and in exploiting the resulting outcomes in the framework of serving society and their community.
Student's training involves:

1) One instructional lecture by the project's researchers, including the demonstration of the tools (weather meters, etc.) that will be used.
2) Practice in the methods and tools having the guidance of the teachers.
3) One demonstration on the daily operation of NOA/IERSD's ground-based weather stations, including the presentation of the different measure instruments.
We did not have high expectations after **the coronavirus crisis and the closure of schools** from March to June. Nevertheless, we believe that we have set goals that we have managed to achieve.
An effort has to be made before the start of the program to choose between students that are truly interested and motivated to participate and others that participate without any particular reason
The expectations were related to the development of knowledge and skills inextricably linked to the approach methodologies concerning the science of citizens such as:
Bring researchers and students together
The collection of data,
Sorting the data
Register the data
Processing and statistical analysis of data and
the recording of the results in a comprehensible form by non-experts
but also, with the development of similar knowledge and skills such as:
the use and utilization of CLMS systems like edmodo,
ways of remote communication,
utilization of cloud services
utilization of statistical analysis and processing analysis tools
use of office applications for data registration and presentation etc.
The citizen science initiatives/activities are suitable for cooperation between schools and scientists because it brought real researchers and students together under the same projects, sharing same questions, difficulties and expectations and because it was a great opportunity and experience for researchers to transmit knowledge at school level
Researchers offer motivation to the students
Teachers need support from the school environment, less bureaucratic conditions, team of teachers to support such programs, school must have a clear strategy to support such initiatives. Schools need support from the local and national educational authorities.
Clear institutional framework, flexibility in the curriculum to facilitate access to school hours.

Access to special equipment needed to implement science programs such as special sensors, special equipment, telescopes, access to original scientific data, electronic devices, science laboratories and last but not least, computer and network equipment and fast internet access. Teachers need training.
Bring research, researchers and universities and research centers closer to schools

5. Bibliography

- http://www.urban-climate.org/
- https://www.urbanclimate.net/
- https://uwm.edu/biometeorology/commissions-and-study-groups/isb-climate-and-health-commission/
- http://www.umr-cnrm.fr/spip.php?rubrique134&lang=en
- https://sustainability.asu.edu/urban-climate/research/
- https://ghhin.org/resource-library/
- https://workspace.google.com
- https://www.eea.europa.eu/el/themes/climate/intro
- https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/priority-themes-eu-cities/climate-adaptation-cities_el

6. Annexes

Methodology / Protocol "Urban Climate and Human Bioclimate"

Introduction (speech):

(a) Climate change: An introduction to the new terminology ("climate crisis"), which more accurately describes the catastrophe that the planet is experiencing and emphasizes the seriousness of the issue.

(b) Urban climate: Description of structural, environmental, etc. characteristics of an urban area. The problem of widespread urbanization.

(c) Urban Thermal Island (UTI): The UTI as the most representative environmental problem due to the climate crisis, which is due to abusive human interventions in the local climate.

(d) Urban population: The combined effects of UTI and the most frequent, intense and longer - due to the climate crisis - heatwaves on city residents.

(e) Human biometeorology: Thermal comfort as one of the basic conditions for a good quality of life. The factors of the urban climate and the ways in which they affect the thermal balance of the human body and consequently the thermal sensation of a human being.

(f) Research work at school: (i) What are the characteristics of the local climate and thermal sensation in the school and the surrounding areas? (ii) Are there differences in thermal sensation between two people? (iii) What are the most crucial factors in creating these potential differences? (iv) There are areas that could be described as "hot / cold spots" (areas of increased hot / cold stress). (v) What are the characteristics of these areas that make them "hot / cold spots"? (vi) What measures could lead to the alleviation of hot / cold stress in these areas?

Students' research work:

The above research questions will be answered by the students themselves through the execution of the following research work:

Recording of meteorological conditions in seven (7) selected points of the school and the surrounding areas (Annex 1).
Recording of the subjective thermal sensation by each student at each of the seven (7) selected measuring points (Appendix 2).

Calculation of the objective temperature index PET (physiologically equivalent temperature) at the seven (7) selected measurement points according to the meteorological records using specialized software (RayMan).
Processing the data that will be generated using Microsoft Excel. Analysis and discussion of results. Drawing final conclusions.

The recordings (data collection) will be done by students for at least one (1) day within three months (eg. November, January, April) during the school year, in order to take into account the seasonality during the analysis of the results. The students of the high school will be given additional meteorological data for the measurement periods, coming from three automatic meteorological stations of the National Observatory of Athens (EAA) / meteo.gr: (i) Athens center (Gazi) - urban station, (ii) Vrilissia - suburban station, (iii) Pallini (Schools of Greek-German Education) - rural station. The purpose is to study the differences between the meteorological conditions of the three areas and in particular to examine the phenomenon of UTI. The calculation of the PET index (c) for each measurement period will take place by the responsible researcher. The processing of the data (d) will take place by the students in groups of 5-7 people. At the end of the school year each group will present their research work. The presentation will include the group's conclusions on the thermal sensation conditions in the school environment, as well as proposals for adaptation measures of the local climate in the context of a sustainable development plan and response to the climate crisis.

Annex 1

Recording of meteorological conditions

Date:

Measuring Area	Description	Local Time	Air Temperature (°C)	Relative humidity (%)	Wind Speed (m/s)	Cloud cover [1]
1	School class					
2	School yard (in the shade)					
3	School yard (in the sun)					
4	Street (in the shade)					
5	Street (in the sun)					
6	Park (in the shade)					
7	Park (in the sun)					

[1]

Scale	Conditions
0	*Completely clear sky*
1	1/8 of the sky is clouded
2	2/8 of the sky is clouded
3	3/8 of the sky is clouded
4	*Half* of the sky is clouded
5	5/8 of the sky is clouded
6	6/8 of the sky is clouded
7	7/8 of the sky is clouded

8	*Completely cloudy sky*

Annex 2

Recording of the subjective thermal sensation

Personal Code:

Day of birth (e.g. 26)
First 2 letters of your favorite color (e.g. re)
Floor Number of the apartment you live in (e.g. 01)
} e.g. -> 26re01

Sex: M / F Age: Body Structure: Small / Medium / Big

Skin tone: Very light / light / dark / very dark

Date:

Measuring Area	Activity [1]	Conditions of location [2]	Clothing [3]	Hat [4]	Thermal sensation [5]
1					
2					
3					
4					
5					
6					
7					

[1] Sitting / Standing up / Walking [2] Sun / Shadow / Partial Shadow

[3]

Scale	Description	Colour
0.3	Very light summer clothes (shorts + short-sleeved blouse)	Bright / Dark
0.5	Light summer clothes (long light pants + short-sleeved blouse)	Bright / Dark
0.8	Light clothes (long light pants + long-sleeved blouse)	Bright / Dark
1.0	Average autumn clothes (long thick pants + long-sleeved blouse) or long-sleeved tracksuit	Bright / Dark

1.5	Average autumn clothes (long thick pants + long-sleeved blouse) with cardigan or long-sleeved tracksuit with sweatshirt	Bright / Dark
2.0	Average winter clothes (long thick pants + sweater)	Bright / Dark
2.5	Average winter clothes (long thick pants + sweater) + heavy jacket or coat	Bright / Dark
3.0	Average winter clothes (long thick pants + sweater) + heavy jacket or coat + gloves + hat + scarf	Bright / Dark

[4] Yes / No

[5]

Scale	Sensation
− 4	Extreme Cold
− 3	Very Cold
− 2	Cold
− 1	Chill
0	Comfortable
+ 1	Little Hot
+ 2	Hot
+ 3	Very Hot
+ 4	Extreme Hot

Example of Completion:

I am in the 1st measuring area (school class), standing up[1,] in the shadow [2], wearing light dark clothes [3], without a hat [4] and feeling chill [5]

Measuring Area	Activity [1]	Conditions of location [2]	Clothing [3]	Hat [4]	Thermal Sensation [5]
1	Standing Up	Shadow	0.8 dark	No	− 1

GREECE

BRITEC – Bringing Research Into the Classroom

Learning Scenario 2

1. Title

Analysis of students' dietary habits activities and Lesson plan

Author(s)

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Area of research

Childhood obesity and public health

Subject(s)

The project and research were applied in an interdisciplinary way involving subjects from the curriculum such as Science, ICT, Technology

Topic

The programme was developed in the context of the **BigO project (https://bigoprogram.eu/)** and of the "Flexible Zone" foreseen in the current Primary School Curriculum. The "Flexible Zone" expands the content of the Research Projects, so that in addition to the scientific micro-researches they also include artistic, social activities (volunteering, solidarity, interpersonal, etc.), environmental, cultural, activities related to modern and traditional media and information (print and digital media, creation of printed or electronic student magazine, actions related to internet student radio, etc.), as well as others, related to a variety of issues of school life and the environment.

Age of students

Primary School students (age 9 – 12, 3rd, 4th, 5th and 6th grades)

More focused on 9-10 years old students, 4th grade of Primary School in the specific context (due to the multidisciplinary project on Nutrition)

2. Introduction

Contribution of the CS project to Science in general

The purpose of the program is to evaluate a series of real-life Primary School students' meal pictures, physical activity, and geographic data (GPS) collection and analysis tools. Data collected is anonymous. With these tools we will analyze similar data from a large number of students in order to create community profiles (e.g. a neighborhood) on how and what students eat, how they move and how they sleep, in order to assess the relationship between these behaviours with the prevalence of overweight and obesity young people. The ultimate goal is to make these results available to the public health authorities to help them intervene and help communities in need. Individual behaviors, such as high and fast eating, when accompanied by little exercise and poor sleep, can be a reason why people become obese. In addition, the specific environmental conditions of a community, such as fewer exercise areas, many fast-food restaurants, or a greater number of food ads, etc., can contribute to the individual behaviors described above. Because of this, we are developing a system to measure these behaviors and relate them to specific environmental parameters of a community to see if they are related.

Aim of the activities plan and learning objectives

The number of children and adolescents with obesity is high and still increasing. These children have a higher risk of developing various diseases later on, compared to children without obesity. The reasons why some children become obese are complex. Behaviour is, amongst others, influenced by many factors in the living environment (such as transportation options, food advertisements, safety, food prices, et cetera). In turn, the living environment is affected by public health policies. Combined, these are components that determine obesity rates.

The program collects and analyses anonymous data on children's behavioural patterns and their living environment. By using advanced analytics and sophisticated visualizations it extracts data-driven evidence on which local factors are involved, and how these factors influence childhood obesity.

This is done in various steps. School aged children become citizen scientists by collecting data about their behavioural patterns and local environment, with the myBigOapp. This data is anonymized and used to create complex statistical models to analyse how behaviour and the environment influence obesity prevalence. This anonymous information can be used to predict how policy changes could influence obesity rates and can be used to compare different communities on group level. With this information it will be able to advice stakeholders and researchers on how to develop and plan effective programs and policies in an attempt to reduce childhood obesity.

The overall aim of the program is to collect and analyse big data on behavior and living environments related to childhood obesity in order for public health authorities to plan and execute effective programs to reduce childhood obesity prevalence. This is not because programs to reduce obesity do not exist, but because they are less effective than intended. In the EU, approximately 2.8 million deaths result from causes associated with overweight and obesity (easo.org).

Causes of obesity are complex, however evidence exist that interventions targeting multiple elements of children's behavioral patterns and living environment are needed.

Specific objectives

To accomplish the main goal of effectively advising public health and clinicians, specific objectives have been set. These objectives are divided into different domains.

Scientific objectives

The scientific objectives are all geared towards gathering the information needed to study the relationship between the various behavioural and environmental factors related to obesity and creating the analytical models to use this information. More specifically these objectives are:

- To extract what relationships between the external living environment and behavioural patterns increase behavioural risk factors for obesity. (Aetiology)
- To create models that show how changes in the external living environment can alter behavioural patterns, which in turn modify behavioural risk factors for obesity. (Prediction)
- To produce models that predict how changes in behavioural risk factors of obesity impact obesity prevalence. (Prediction)

- To define a behavioural model in such a way that it is useful for the above purposes, but does not store sensitive information or redundant personal information. (Privacy Preservation)

Technological objectives

The technological objectives are related to building the infrastructure to collect, store and analyse data. Moreover, they are focused on developing the technological programs, warrant privacy and develop the decision support tools for care facilities and public health authorities. More specifically these objectives are:

- Building an extensive network of information sources: namely sensors like smartphones and smartwatches which run mobile applications used to collect subjective data and objective data to get information on behaviour and the local environment.

- Moreover, server-based applications will be developed so that publicly available data (like maps, statistics and metadata) can be shown.

- To determine policies and the technical means to enforce these policies relating to big data governance, privacy and anonymization

- To provide 3 decision support functionalities:

    - the Policy Advisor that offers aetiology and data evaluation services. For example, visualizing aggregated evidence for public health authorities and schools to help them design and monitor programs.

    - the Policy Planner that offers simulation and prediction services. For example, extracting associations between environment and obesogenic behaviours to investigate causality and create prediction models and developing intelligent algorithms to recognize behavioural patterns.

    - the Clinical Advisor that offers evaluation and decision support for the individual at the point of care. For example: visualizing individual behavioural patterns for health professionals to help them follow-up obese children patients.

Validation objectives

The validation objectives are aimed at evaluating how the systems and platforms work. More specifically these objectives are:

- Evaluation of the system components
- Evaluation of the system in realistic usage environments
- Evaluation of the decision support platform.

Business objectives

The business objectives include:

- defining an effective, pragmatic and viable business plan and exploitation scheme in line with the use as a framework for supporting public health authorities on the one hand and as a tool that offers evidence to the health professionals on the other hand.
- Building the program around the “citizen-scientist” model, which relies on individuals sharing their behaviour data.

Summary of activities

Number of activity	Name of activity
1	Measuring students' weight and height.
2	Install the data collection app on the student’s mobile phone. Once students activate the app, they will be asked to complete a small number of questions about their most common eating, physical activity, and sleeping habits.
3	Students use the app to take meals pictures (see Appendix III). During the week students take pictures of meals, focusing mainly on breakfast and the main meal after school. Once such an image is captured, the application will ask the user to record their mood at this particular time, through a multiple-choice question.
4	Students use the app to take food and photos in their everyday environment (outside of school), regardless of the medium of advertisement (brochure,

	billboard, bus poster, digital, online or on television). Students are asked not to include faces of the people around them when taking photos.
5	Students use the smart watch to record GPS, physical activity and sleep data, self-assessment data (see Appendix I) and transfer it automatically to the phone. If students are comfortable, they are asked to wear the 'smart watch' for at least 2 weekends. They are also asked to wear it while sleeping for at least 3 nights during the week.
6	At the end of the week students will be asked to answer some questions (see Appendix II) about their experience using the application and the "smart" watch.

3. Detailed description of each activity

Activity 1: Measuring students' weight and height

First Part: Aim of the activity

Measuring students' weight and height by the school's physical education teachers.

Second Part: Suggested procedure

Preparation time	1h
Teaching time	1 teaching hour
Online teaching material	N/A
Offline teaching material	N/A
Citizen science purpose of the activity (if any) *	Outline questions or guidelines required for collecting data
*** Guidance for teachers**	Add some kind of guidance for teachers about why it is important to address those questions and collect those data.

Third Part: Advice on methodology

Use of Height and Weight Electronic Scales to measure weight and height of students

Fourth Part: Educational analysis

N/A

Activity 2: Install the data collection app on your personal mobile

Once students activate the app, they are asked to complete a small number of questions about their most common eating, physical activity, and sleeping habits.

First Part: Aim of the activity

The Aim of the activity is students to meet methodologies of recording initial data

Second Part: Suggested procedure

Preparation time	2h,
Teaching time	1 teaching hour
Online teaching material	See Appendix I
Offline teaching material	
Citizen science purpose of the activity (if any) *	• Record Initial data • Complete the activity.
***** Guidance for teachers**	Reliable and cleansed **data** supports effective decisions that help drive research

Third Part: Advice on methodology

Reliable and cleansed data supports effective decisions that help drive research. Web Applications can be used to collect and save data.

Fourth Part: Educational analysis

STEM Learning: Increased focus on Science, Technology, Engineering, Mathematics subjects in the curriculum
Peer Learning: students learn from peers and give each other feedback.
Cloud Based Learning: data, tools, software is all online and can be reached and modified from different devices.

Edutainment: playful learning. Learning while having fun.
Compare uploaded ideas with original ideas
Data collection allows students to stay on top of trends, provide answers to problems, and analyze new insights to great effect.
Through data collection a research project has the quality information it needs to make informed decisions from further analysis, study, and research.

Activity 3: Students use the app to take meals pictures.

First Part: Aim of the activity

Participating students will be asked to use the app outside of school hours for 4 weeks. During this time, participating students will be asked to take pictures of the foods they ate. Once such an image is received, the application will ask the user to record the mood at this particular time, through a multiple-choice question. Students are instructed not to include faces in the photos. It should be noted that the photos will only be used for analysis by researchers and will not be published on any website. They are used only to detect the type of food consumed, and only statistical (group and anonymous) results are published.

Second Part: Suggested procedure

Preparation time	1h,
Teaching time	1 teaching hour
Online teaching material	N/A
Offline teaching material	N/A
Citizen science purpose of the activity (if any) *	Outline questions or guidelines required for collecting data Why use digital technologies to edit, store, process, transmit data and information How digital technologies contribute to the development of sciences How digital technologies are used by sciences and scientists
*** Guidance for teachers**	In a citizen science program teachers must be ready to explain the questions above and be fully informed of the physical object of the program

Third Part: Advice on methodology

Give clear instructions on how students take pictures of the foods they ate.

Fourth Part: Educational analysis

Cloud Based Learning: data, tools, software is all online and can be reached and modified from different devices.

Project-Based Learning: students get fact-based tasks, problems to solve.

Outdoor Education: learning outside of the school building in the “real” environment

STEM Learning: Increased focus on Science, Technology, Engineering, Mathematics subjects in the curriculum

Peer Learning: students learn from peers and give each other feedback.

Snack Learning: small and attractive bits of learning rather than pro-longed forms of study

Activity 4: Students use the app to take food ads pictures in their everyday environment

First Part: Aim of the activity

Students will also be asked to take photos of food advertisements in their daily environment (inside or outside school), regardless of the medium of advertising (brochure, billboard, poster on bus, digital, online or on TV). In this case too, the same instruction will be given not to include persons. Also, these photos will only be used for analysis by the researchers, and will not be published on any website. They are used only to train algorithms that calculate children's exposure to advertisements and only statistical (group and anonymous) results will be published.

Second Part: Suggested procedure

Preparation time	1h
Teaching time	30 minutes
Online teaching material	N/A
Offline teaching material	N/A
Citizen science purpose of the activity (if any) *	Outline questions or guidelines required for collecting data Why use digital technologies to edit, store, process, transmit data and information How digital technologies contribute to the development of sciences How digital technologies are used by sciences and scientists
*** Guidance for teachers**	In a citizen science program teachers must be ready to explain the questions above and be fully informed of the physical object of the program

Third Part: Advice on methodology

Give clear instructions on how students take pictures of food advertisements in their daily environment (inside or outside school), regardless of the medium of advertising (brochure, billboard, poster on bus, digital, online or on TV).

Fourth Part: Educational analysis

Cloud Based Learning: data, tools, software is all online and can be reached and modified from different devices.

Project-Based Learning: students get fact-based tasks, problems to solve.

Outdoor Education: learning outside of the school building in the “real” environment

STEM Learning: Increased focus on Science, Technology, Engineering, Mathematics subjects in the curriculum

Peer Learning: students learn from peers and give each other feedback.

Snack Learning: small and attractive bits of learning rather than pro-longed forms of study

Game Based Learning & Gamification: learning is mixed with games or with game mechanisms; badges according with the data contributed by students

Activity 5: Students use the smart watch (provided by the project)

First Part: Aim of the activity

Students use the smart watch to record GPS, physical activity and sleep data (see Appendix) and transfer it automatically to the phone. If students are comfortable, they are asked to wear the 'smart watch' for at least 2 weekends. They are also asked to wear it while sleeping for at least 3 nights during the week.

The smartwatch is connected to the mobile application. Students will be asked to pair it with their mobile phone when they are out of school. They will be asked to wear it outside of school for as long as possible they feel comfortable during the study but with specific minimum periods of use per week: at least 2 daily when they are out of school, at least 1 day of the weekend and 3 any nights. The data will be automatically sent to the application's servers as soon as the mobile is on a Wi-Fi network (without the use of mobile data in order to avoid extra costs for the student).

Second Part: Suggested procedure

Preparation time	30 min
Teaching time	1 teaching hour
Online teaching material	N/A
Offline teaching material	N/A
Citizen science purpose of the activity (if any) *	Why use digital technologies to edit, store, process, transmit data and information How digital technologies contribute to the development of sciences How digital technologies are used by sciences and scientists

*** Guidance for teachers**	In a citizen science program teachers must be ready to explain the questions above and be fully informed of the physical object of the program

Third Part: Advice on methodology

Give clear instructions on how to pair the smart watch with their mobile phone and explain how the data will be automatically sent to the application's servers as soon as the mobile is on a Wi-Fi network (without the use of mobile data in order to avoid extra costs for the student).

Fourth Part: Educational analysis

Cloud Based Learning: data, tools, software is all online and can be reached and modified from different devices.

Project-Based Learning: students get fact-based tasks, problems to solve.

Outdoor Education: learning outside of the school building in the "real" environment

STEM Learning: Increased focus on Science, Technology, Engineering, Mathematics subjects in the curriculum

Peer Learning: students learn from peers and give each other feedback.

Snack Learning: small and attractive bits of learning rather than pro-longed forms of study

Activity 6: Students use the smart watch

First Part: Aim of the activity

At the end of the week students will be asked to answer some questions (see Appendix II) about their experience using our application and the "smart" watch

Second Part: Suggested procedure

Preparation time	30min
Teaching time	30 min
Online teaching material	See Appendix II
Offline teaching material	N/A
Citizen science purpose of the activity (if any) *	*Outline questions or guidelines required for collecting data* Why use digital technologies to edit, store, process, transmit data and information How digital technologies contribute to the development of sciences How digital technologies are used by sciences and scientists
*** Guidance for teachers**	In a citizen science program teachers must be ready to explain the questions above and and be fully informed of the physical object of the program

Third Part: Advice on methodology

Give clear instructions on how to complete the q/re

Fourth Part: Educational analysis

Cloud Based Learning: data, tools, software is all online and can be reached and modified

from different devices.

Project-Based Learning: students get fact-based tasks, problems to solve.

Outdoor Education: learning outside of the school building in the “real” environment

STEM Learning: Increased focus on Science, Technology, Engineering, Mathematics subjects in the curriculum

Peer Learning: students learn from peers and give each other feedback.

Snack Learning: small and attractive bits of learning rather than pro-longed forms of study

4. Assessment after implementation of the activities plan

Student´s learning

Discussion with students at the end of the school year has shown that students believe that:

- The projects criteria were met successfully
- Acquired Proficiency in thinking like a researcher
- Achieved understanding of the science, math and ICT tools needed to solve the problem
- Achieved progress in working successfully in teams was achieved
- Developed the attitude and gained confidence leading to successful citizen science projects

Citizen Science experience

Lessons Learnt

- The structure of the activities as well as objectives need to be defined during the first meeting among teachers and researchers
- A presentation of the structured methodology has to be defined
- The training of the teachers involved (by the researcher)
- The connection with the involved subjects, informatics, sciences must be clear
- The experimental phase together with the researchers
- Clear guidance and explanation of the scientific questions and research that students had to answer and accomplish.
- It is expected that the students' outcome presentations will be exhibited to the school board and parents' associations, while local authorities will also be invited in the presentations. This is a strong motivation for students, as they have the chance to promote their research work and propose specific environmental measures that can potentially be applied in practice. In the same framework, the publication of the students' work in educational scientific conferences and journals will be considered, such as the OSJ - Open Schools Journal for Open Science (https://ejournals.epublishing.ekt.gr/index.php/openschoolsjournal/index)
- In overall, the project is expected to increase the students' knowledge and awareness about dietary habits and healthy diet and its importance in human health. The students

will also practice in conducting research and in exploiting the resulting outcomes in the framework of serving society and their community.

- Student's training involves:
  - One instructional lecture by the project's researchers, including the demonstration of the tools (mobile app, smart watch, tablets use, etc.) that will be used.
  - Practice in the methods and tools having the guidance of the teachers.
- The expectations were related to the development of knowledge and skills inextricably linked to the approach methodologies concerning the science of citizens such as:
  - Bring researchers and students together
  - The collection of data,
  - Sorting the data
  - Register the data
  - Processing and statistical analysis of data and
  - the recording of the results in a comprehensible form by non-experts
- But also, with the development of similar knowledge and skills such as:
  - the use and utilization of collaborative tools,
  - ways of remote communication,
  - utilization of cloud services
  - Utilization of statistical analysis and processing analysis tools
  - Use of office applications for data registration and presentation etc.
- The citizen science initiatives/activities are suitable for cooperation between schools and scientists because it brings researchers and students together under the same projects, sharing same questions, difficulties and expectations and because it was a great opportunity and experience for researchers to transmit knowledge at school level
- Researchers offer motivation to the students
- Access to special equipment needed to implement science programs such as special sensors, special equipment, telescopes, access to original scientific data, electronic devices, science laboratories and last but not least, computer and network equipment and fast internet access.
- Teachers need training.
- Researchers, universities and research centers need to come closer and collaborate with schools, schools need to open up to the societal needs (Open schooling model,

5. Bibliography

Parallel activities in the context of the multidisciplinary project implemented in the 4th Grade of Primary School, https://portal.opendiscoveryspace.eu/en/osos_authoring_tool/view/849827

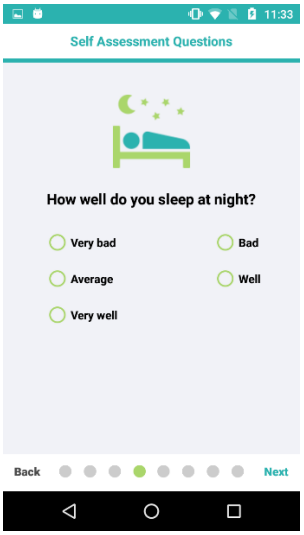
- http://ecoico2020.com/
- https://easo.org/
- https://www.worldobesity.org/
- https://asoi.info/
- https://www.obesityaction.org/
- https://stop.publichealth.gwu.edu/

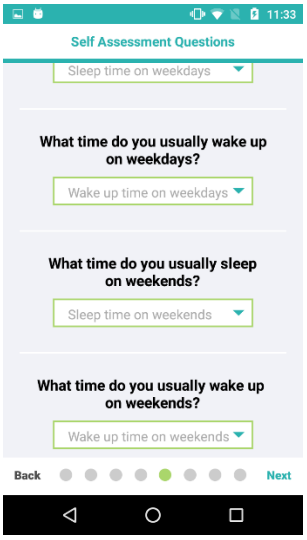
6. Annexes

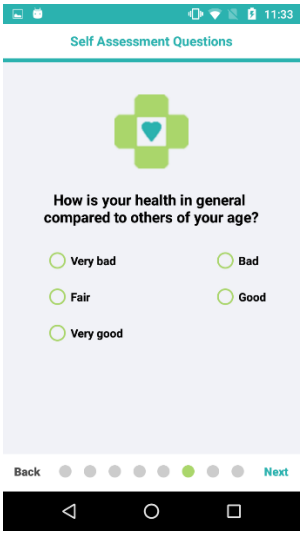
Any document needed for the development of the activity.

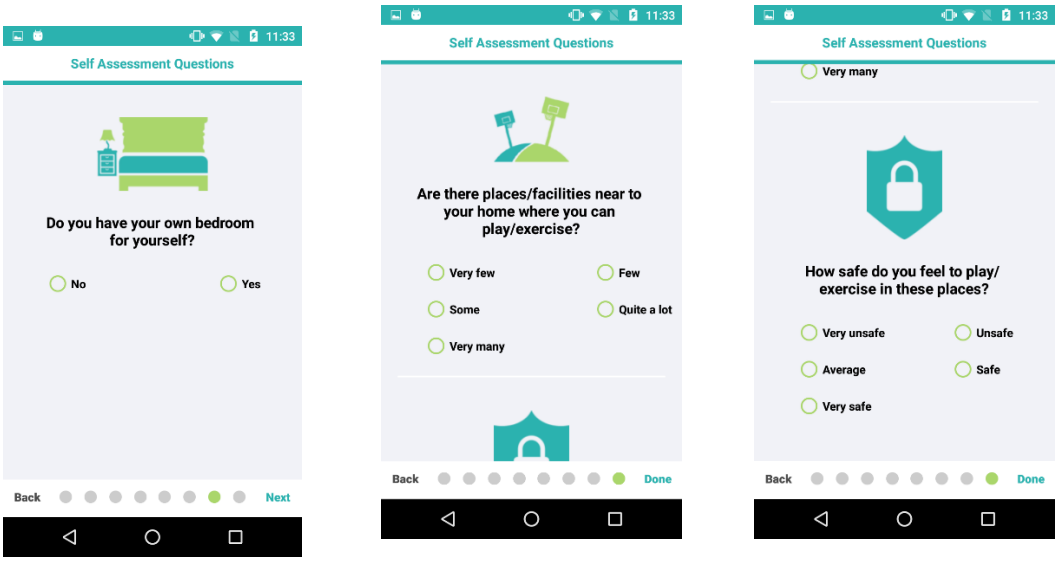
Appendix I.

Physical activity and sleep data

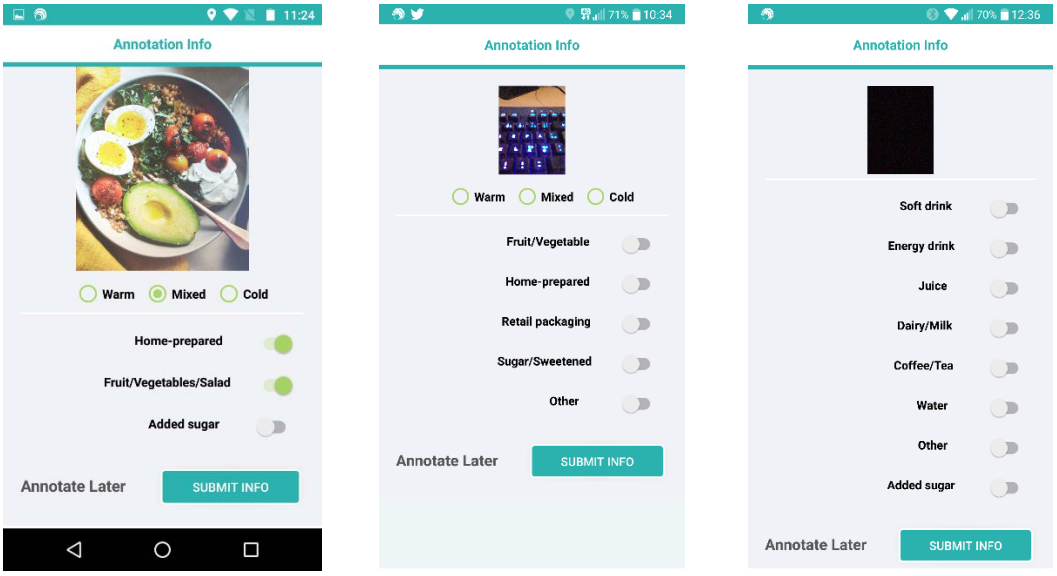


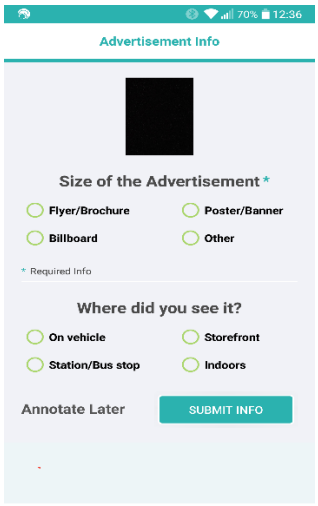


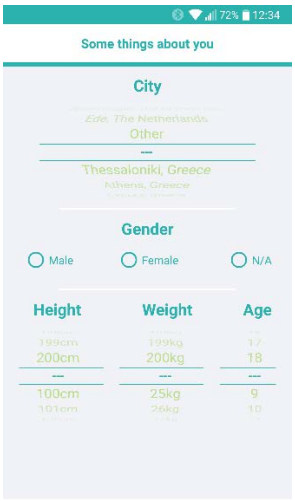


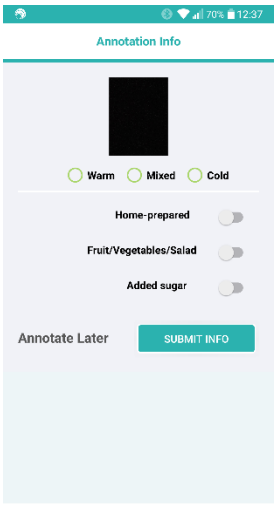


Self-Assessment Question screens




70% 12:36
Advertisement Info
Size of the Advertisement *
Flyer/Brochure
Poster/Banner
Billboard
Other
* Required Info
Where did you see it?
On vehicle
Storefront
Station/Bus stop
Indoors
Annotate Later
SUBMIT INFO


72% 12:34
Some things about you
City
Other
Thessaloniki, Greece
Gender
Male
Female
N/A
Height
Weight
Age
200cm
200kg
18
100cm
25kg
9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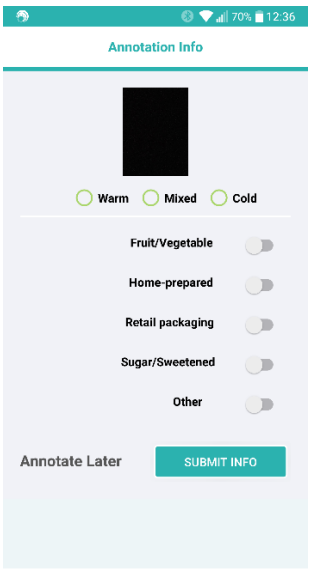
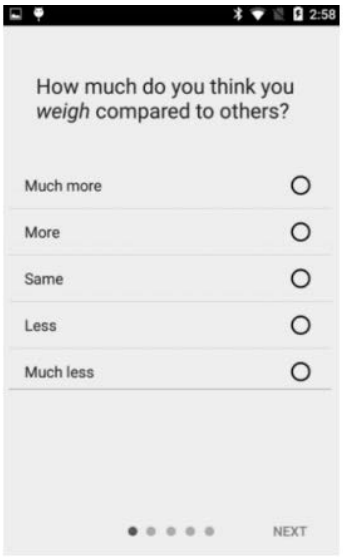
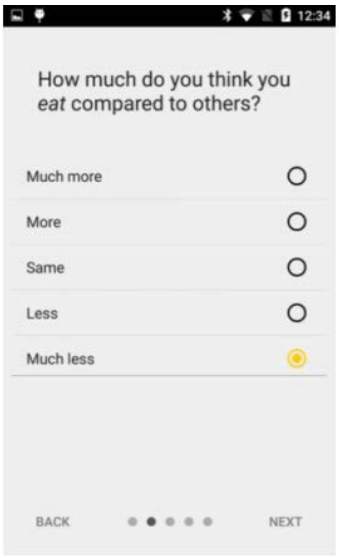
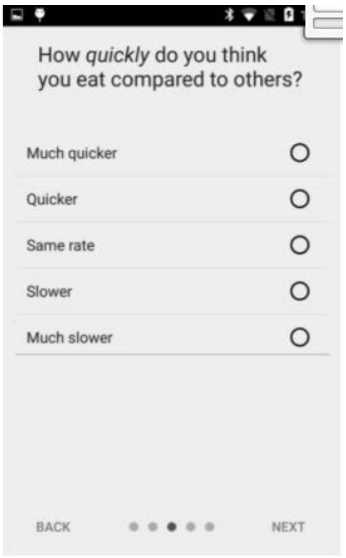
Annotation Info
Warm
Mixed
Cold
Home-prepared
Fruit/Vegetables/Salad
Added sugar
Annotate Later
SUBMIT INFO

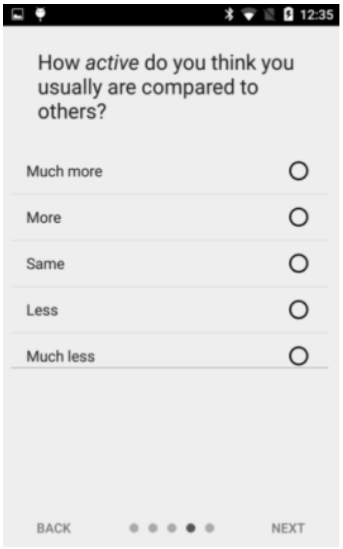

70% 12:36
Annotation Info
Warm
Mixed
Cold
Fruit/Vegetable
Home-prepared
Retail packaging
Sugar/Sweetened
Other
Annotate Later
SUBMIT INFO

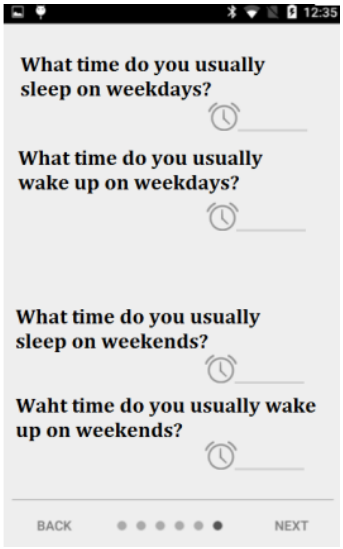
Evaluation questionnaires











A mood question that will be asked through the mobile application when the user has photographed a meal or some kind of food he ate. It concerns organized data collection action and spontaneous data collection action.

Appendix II

The following is a questionnaire of usefulness and expediency that students and / or their parents will be asked to answer at the end of the period of use of the system during both the organized and the spontaneous collection action data. Initially was administered in paper format but then came in the format of an online Google Form.

System Usability Scale (SUS)

Sensors and user-friendliness for the application will be measured using the System Usability Scale (SUS). This is a questionnaire where the people who used the system answer 10 questions. Each question follows a Likert scale with 5 answer options, where 0 represents "Strongly Disagree" and 4 represents "Strongly Agree".

Questions	0	1	2	3	4
1. I think I would like to use this system often.					
2. I found the system unnecessarily complicated					
3. I think the system was easy to use.					
4. I think I would need the support of a technician to be able to use this					
5. I found that the various functions in this system were well integrated					
6. I thought there was too much inconsistency in thi system.					
7. I imagine most people will learn to use this system very quickly.					
8. I found the system very difficult to use.					
9. I felt very confident when I used the system					
10. I had to learn a lot before I could proceed with this system often.					

Questionnaire of usability quality and user friendliness

1. How comfortable did you feel when participating in the study?

1	2	3	4	5	6	7	8	9
○	○	○	○	○	○	○	○	○

2. Would you recommend a friend to take part in a similar study?

1	2	3	4	5	6	7	8	9
○	○	○	○	○	○	○	○	○

3 To what extent did using the system affect your normal behavior?

1	2	3	4	5	6	7	8	9
○	○	○	○	○	○	○	○	○

4. Do you have any ideas about the system? What would you improve?;

_ _

_ _

_ _

5. Do you have any ideas about the study process? Any obvious problems? Any comments?

_ _

_ _

_ _

Smartwatch

6A. How comfortable do you feel using the supplied smartwatch?

1	2	3	4	5	6	7	8	9
○	○	○	○	○	○	○	○	○

6B. Would you recommend the use of Smartwatch, in a similar study, to a friend?

1	2	3	4	5	6	7	8	9
◯	◯	◯	◯	◯	◯	◯	◯	◯

6C. How many hours a day (on average) did you use your smartwatch? _ _ _ _

6D. How did the Smartwatch affect your behavior during the day?

_ _

_ _

_ _

6E. Indicate to what extent you agree with the Smartwatch statements below.

The Smartwatch was bothering me.

1	2	3	4	5	6	7	8	9
◯	◯	◯	◯	◯	◯	◯	◯	◯

My Smartwatch was easy / comfortable to use.

1	2	3	4	5	6	7	8	9
◯	◯	◯	◯	◯	◯	◯	◯	◯

I would use the Smartwatch at school

1	2	3	4	5	6	7	8	9
◯	◯	◯	◯	◯	◯	◯	◯	◯

You would use a Smartwatch while you are at home

1	2	3	4	5	6	7	8	9
◯	◯	◯	◯	◯	◯	◯	◯	◯

You would use a Smartwatch outside (eg in a restaurant).

1	2	3	4	5	6	7	8	9
◯	◯	◯	◯	◯	◯	◯	◯	◯

6F How many hours (per day) could / would you like to wear the Smartwatch in everyday life?

_ _

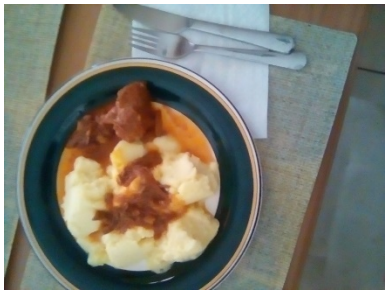
6G1. Any other ideas on using Smartwatch? Any suggested improvements?

_ _

_ _

_ _

Appendix III
Photos of meals















Appendix IV

Smart watches and mobile phones used

«Έξυπνα» κινητά & εφαρμογή BigO για κινητό

Η εφαρμογή **BigO**, την οποία θα κληθείτε να εγκαταστήσετε σε Android κινητό σας υποστηρίζει τις ακόλουθες λειτουργίες:

α) Λειτουργεί ως κεντρικό σημείο για τη σύνδεση του «έξυπνου» ρολογιού, συλλέγοντας τα παραγόμενα δεδομένα μέσω Bluetooth.

β) Θα σας επιτρέψει να πάρετε τις απαιτούμενες φωτογραφίες των διαφημίσεων τροφίμων που συναντάτε στην καθημερινότητά σας καθώς και φωτογραφίες γευμάτων του παιδιού σας.

γ) Θα μεταδίδει αυτόματα όλα τα δεδομένα που συλλέγονται στους διακομιστές BigO όταν είναι συνδεδεμένο σε Wi-Fi και θα είστε σε θέση να ελέγξετε πόσα δεδομένα έχετε φορτώσει στους διακομιστές μας.

«Έξυπνα» ρολόγια

Θα σας δώσουμε το TicWatch E. Παρακαλούμε να το φοράει το παιδί σας, αν αισθάνεται άνετα, τουλάχιστον 3 καθημερινές και 1 ημέρα το Σαββατοκύριακο ανά εβδομάδα. Η συσκευή θα χρησιμοποιηθεί για την παροχή δεδομένων επιτάχυνσης και GPS μέσω του αντίστοιχου 'έξυπνου' κινητού σας. Θα μπορείτε να ενεργοποιήσετε/απενεργοποιήσετε τη λειτουργία καταγραφής του ρολογιού κατά βούληση μέσω της εφαρμογής μας.

POLAND

BRITEC – Bringing Research Into the Classroom

Learning Scenario 1

1. Title

“Small retention - big deal. Plants store water and inhibit drought"
Field activities by the river.

Author(s)

Agnieszka Marciniak, Joanna Gadomska

Area of research

Activities should be conducted by the river, preferably in spring or summer. The research concerns water resources (in selected country), water retention, river regime, water velocity, observation of changes in riparian vegetation, river bathymetry, morphological activity of rivers, and meteorological parameters.

Subject(s)

Geography, Biology, Photography, Informatics

Topic

Selected country’s water balance. River network. Morphological activity of rivers. Biodiversity.

Age of students

15-20 years old

2. Introduction

Contribution of the CS project to Science in general

The main goal of this activity is to increase young people's awareness of water management and the impact of seasonal changes in riparian vegetation and microclimatic conditions on water retention.
By participating in the project, pupils acquire skills and apply the acquired knowledge into practice. Using various sources and methods, they develop creativity and independence, and develop skills such as: searching for and selecting information, measuring elements of the geographical environment, presenting research results. A very important aspect is shaping pupils' social competences such as: communication skills and teamwork.
As a result of participation in the project, pupils become more aware of the role of vegetation in the protection of the Earth's water resources.

Aim of the activities plan and learning objectives

Detailed objectives are divided into blocks of content and specific pupils' skills.

1. Water balance
Pupil can:
- characterize the components of country's water balance
- describe water resources in country and in given region
- indicate areas of risk of water deficit
- explain the causes of water scarcity in selected regions of the country
- explain the causes and effects of floods
- provide measures to prevent floods and water shortages

2. River network
Pupil can:
- provide the landscape and economic functions of rivers
- name the elements of the river valley
- read from the map basic data about the river: river source, estuary, river length, basin, catchment area, tributaries
- search for a hydrological station and get figures on the river's water status and flow rate
- provide the GPS coordinates of the measurement site on the river
- describe the structure of the river on the basis of hydrological data
- calculate the speed of the river
- plot the transverse profile of the river bed

3. Morphological activity of rivers
Pupil can:
- compare the features of the river in the upper, middle and lower reaches
- list examples of forms resulting from the erosion and accumulation of rivers
- indicate the possibilities of developing floodplains

4. Microclimate
Pupil can:
- perform simple meteorological measurements (air temperature, atmospheric pressure, air humidity, cloud cover) and hydrological measurements (water temperature)
- find the nearest weather station and read basic meteorological data (rainfall, wind speed and direction)

5. Riparian vegetation
Pupil can:
- identify plants by the river
- explain the impact of climate change on vegetation

Summary of activities

Number of activity	Name of activity
1.	The division of pupils into four task groups (3, 4 pupils per group)
2.	Remind the subject of classes and discussion on the safety rules during field campaign
3.	Assignment of tasks to each group, distribution of worksheets and measuring equipment
4.	Introduction to the topic of classes
5.	Working with the map - indicating the site of measurements, searching for the source of the river, estuary, basin, tributaries
6.	Determination of the geographical coordinates of the measurement site using GPS
7	Marking the elements of the river valley in the picture

8.	Performing the measurement of the water velocity in the river in accordance with given instructions
9.	Measurement of the river bed width and the river depth
10.	Search and analysis of the necessary figures from the nearest hydrological and meteorological station
11.	Perform simple meteorological measurements and hydrological surveys using given instruments
12.	Doing photographic documentation
13.	Filling out worksheets
14.	Observation and identification of riparian vegetation
15.	Observation and recognition processes and landforms resulting from the morphological activity of the river

3. Detailed description of each activity

First Part: Aim of the activity

Before going on field campaign, pupils are divided into four groups of 3 to 5 pupils. The teacher acquaints the pupils with the place and course of the lesson. Then she/he reminds pupils about the subject of the lesson and discusses the safety rules. Members of each group choose a leader who will be responsible for the work of the entire team. Leaders draw sets with tasks to be performed (work sheets) and receive equipment to perform measurements, e.g. compasses, thermometers, barometers, measuring tapes. The teacher presents the objectives of the lesson and introduces students to the topic of the lesson. Explains the basic concepts: source, estuary, main river, basin, river current, catchment, watershed. The teacher presents the Earth's water balance and its diversity in various climatic conditions. It describes the types and size of water resources in selected country and the region. Students describe the economic and landscape functions of rivers and the causes, effects and ways of preventing water shortages and floods. They indicate the importance of vegetation in counteracting the effects of drought and floods.

Each group receives a topographic map of the area and marks the place where measurements will be taken as well as the direction of the river flow. Then, each group uses GPS to determine the geographic coordinates of the measurement site. Based on the knowledge and observation of the river, pupils enter into the worksheet an information on the elements of the river valley (riverbed, river valley, floodplain). According to the instructions, pupils measure the time taken by the float to cover the designated part of the river. They repeat the measurement five times. Then they calculate the arithmetic mean of the obtained results. This is how they measure the speed of the river. The next task is to measure the wetted perimeter. For this purpose, pupils measure the width of the river (they attach a measuring tape to both sides of the river and measure the depth along it). Having the results of the measurements, pupils make a drawing of the river cross-section on a graph paper. The next activity is to describe the structure of the studied river (according to the instructions). The student finds the website of e.g. in Poland: the Institute of Meteorology and Water Management, and finds hydrological data on the monthly values of the flows of the selected river. Then, pupil presents obtained data in the form of a line chart. The pupil is able to analyze the changes in the volume of flow during the year and give reasons for the minimum and maximum values. The next task is to perform simple meteorological measurements (air temperature, atmospheric pressure, amount of cloud cover, wind

direction) and compare them with the data from the nearest weather station. By analyzing the data, pupils learn about the microclimate of the river. Using their own knowledge and the key to designate plant species, students write the names of plants growing on the river banks. They also make photographic documentation of plants. As a result of observations, they describe the course of the river (water velocity, transported material, size of the river bed, slope) and recognize morphological activity of rivers. They also present the morphological forms created as a result of the destructive or constructive activity of the river.

Pupils insert all measurements and collected data on their worksheets. During the next meeting, this time in the classroom, each group presents its topic. After the presentation of all groups, a discussion takes place and conclusions are drawn from the participation in the project.

By performing the described activities, students learn to independently take measurements, search for the necessary data and analyze it, and present the test results. They can formulate conclusions. They learn to use computer technology to acquire and process data. Moreover, work in groups has great shaping and educational values. Participation in the project teaches how to solve problems as well as take responsibility for the environment.

Second Part: Suggested procedure

Preparation time	1 Month
Teaching time	Field campaigns by the river - 3 hours (180 minutes) Preparation time - 2 weeks Activities in the classroom - Summary - 2 lesson hours
Online teaching material	List here all the links of online tools, applications and support documents that you will use during your activities such as: Padlet, Kahoot, etc. Here are examples of external sources in Polish. For each country, teacher needs to find national versions. https://meteo.imgw.pl/ website of the national meteorological survey. https://hydro.imgw.pl/ website of the national hydrological

	survey. https://atlas.roslin.pl/ website with guidelines for plants recognition. If no national services are available, students may use global services, e.g.: Climatic data, climate graphs: https://en.climate-data.org/ Actual weather conditions: https://www.yr.no/en/ Website with guidelines for plants recognition: http://www.worldfloraonline.org/
Offline teaching material	List here all the offline tools, such as: paper, glue, etc. Topographic map of the area, thermometer, barometer, compass, measuring tape, stopwatch, geodesic pole, graph paper, pencil, camera or smartphone with a camera and GPS, worksheets (one per group), atlases and keys for marking plants, laptop with Microsoft Excel and internet access.
Citizen science purpose of the activity (if any) *	Outline questions or guidelines required for collecting data 1. What will our project be about? 2. What will our tasks concern? 3. What are we going to achieve in the project?
*** Guidance for teachers**	Add some kind of guidance for teachers about why it is important to address those questions and collect those data.

Third Part: Advice on methodology

It is the best to carry out chosen project topic in the field, by the river. However, if this is not possible, then classes can be conducted in a classroom with Internet access. Using Google Maps and Google Street View, we can virtually move to the selected river. All planned activities can be performed in the classroom, except for measuring water speed and depth.

Fourth Part: Educational analysis

1. Investigative fieldwork where answers are definite and experimentally determined.
2. Collaborative learning, strong emphasis on group work.
3. Outdoor education. Learning outside the school building in a 'real' environment
4. Mobile learning. We gain access to knowledge via smartphones
5. The transition from books to online resources
6. The shift from "what you know" to "what you can do"

4. Assessment after implementation of the activities plan

Student´s learning

During field campaigns, pupils work in groups, carrying out tasks listed on worksheets. Each group has different tasks. The teacher observes the work flow and helps if necessary. Summary of field activities takes place in the classroom during a scheduled class. Then the groups present their research. They do it in whichever form they wish, e.g. description, presentation, film, portfolio. Each student is assessed. The final grade depends on the involvement of pupils in the field campaigns and the quality and presentation of the results of the work.

Citizen Science experience

Problems that may arise during the project:

- lack of motivation of students to participate in the project

- problems accessing river, if it is too far (this activity is recommended for schools located in the vicinity of a river)

- no internet access

- no access to required data (meteorological, climatic data, hydrological data or plant key) in national languages

- student's outfit not adjusted to weather conditions

- group conflicts

5. Bibliography

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3 Obserwacja zmian sezonowych roślinności nadbrzeżnej i warunków mikroklimatycznych rzeki Prezentacja. Monika B. Kalinowska Instytut Geofizyki PAN

4. A. Woś ABC meteorologii. Wydawnictwo naukowe UAM 1995r.

5. https://meteo.imgw.pl/

6. https://hydro.imgw.pl/

7. https://atlas.roslin.pl/

8. http://www.allourideas.org/trendiez/results

9. http://www.up.poznan.pl/

External sources available in English:

Plant key: http://www.worldfloraonline.org/

The current weather may be checked on the website https://www.yr.no/en/ - available in English and for whole world.

Climatic data, climate graphs: https://en.climate-data.org/

6. Annexes

Any document needed for the development of the activity.

Four worksheets

WORKSHEET 1

PROJECT: Small retention - big deal. Plants store water and inhibit drought

SUBJECT: River network

Date of observation and measurement: ……..
Group number 1

Composition of the group	Name and surname
Leader	
Members	• …… • …… • …… • ……

MIND THE SAFETY RULES!

- be careful when carrying out measurements and observations
- stay close to your group
- do not go into the river

Task 1 Enter the geographic coordinates of the measurement site using the Google Maps application.

……
……

Task 2 Using your own knowledge and available teaching materials, explain the concepts:

a) main river

……

b) first-order tributary

……

c) river basin

……

d) current

……

e) catchment area

……

f) watershed

……

g) river regime

……

h) flood

……

i) low flows

……

j) retention

……

Task 3 Complete the table (data from the topographic map)

The source of the river and the height above sea level	
Estuary of river and the height above sea level	
The length of the river	
Main river basin	
Cities through which it flows	

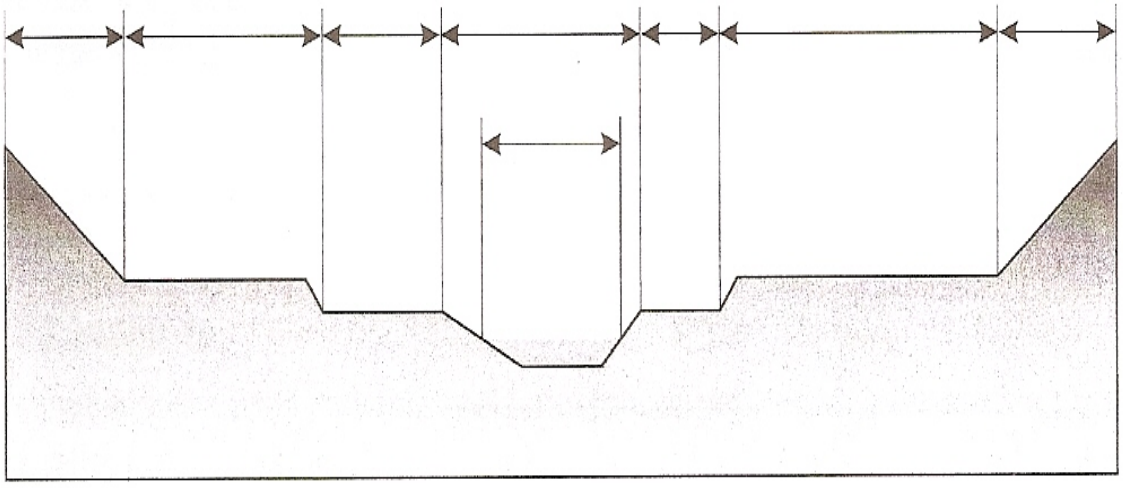
Tributaries	
Reservoirs on the river (if they are any)	

Task 4 Locate a river on the map and follow these instructions:

a) Mark with X the site of measurements on the map
b) Define the direction in which it flows and mark with an arrow on the obtained fragment of the topographic map
c) Mark the source of the river on the map (S) and the estuary (E)
d) Identify to which main river, the river basin belongs (use the tourist map)
e) Determine the order of the tributary of the studied river

Task 5 Based on your own knowledge and observations, enter the elements of the river valley on the transverse profile using the following abbreviations:

R- River bed
FT- floodplain terraces
OT - overwater terraces
RC- river corridor



Schematic profile of the river valley

Task 6 Measure the flow of the watercourse and formulate a conclusion for an average velocity of flow of the river on the tested section.

INSTRUCTION

- Choose as straight section of the river as possible.
- Measure a distance of 10 m with a measuring tape along the river bank.
- A person standing 1 meter in front of the starting line throws a stick at a predetermined distance from the river bank.
- At the moment the stick passes through the starting line, pupils start the stopwatches and measure the time (t) for the stick to reach the finish line (10 meters - S).
- When the stick (float) passes the finish line, the person standing there shouts STOP and stops the stopwatch.
- Read the flow time of the stick directly from the stopwatch.
- Repeat the measurement five times and calculate the average flow velocity.

Calculate the velocity using the formula: **V= S/t**
S - length of the section t - time

Measurement results:

The flow velocity

Measurement I: .....[m/s]

Measurement II:.....[m/s]

Measurement III: .....[m/s]

Measurement IV: .....[m/s]

Measurement V: .....[m/s]

Average velocity:..... [m/s]

Task 7 Take measurements of wetted perimeter and then draw the cross-section on a graph paper.

a. the width of the river bed - stretch the measuring tape perpendicular to the direction of water flow so that the beginning of the tape (0.00m) is on the left bank of the river. The tape is to be unrolled until the right edge begins. Read the measured value.

b. depth of the river bed - set several measuring points at equal distances (e.g. 0.5 m or 1 m) on an unfolded fixed measuring tape. Using a survey pole or a string with a weight, measure the depth of the river bed trough at the established points. If there are irregularities, compact the depth measurement points to capture the characteristic bends of the bed bottom.

Distance from the left bank (cm)	Depth (cm)
0	
50	
100	
150	
200	

Task 8 Following the instructions, describe the structure of the river and answer the following questions:

8.1 Characterize the hydrological regime of the studied river.

8.2 What are the minimum and maximum flow rates?

8.3 In which months (seasons) were the highest and lowest flows observed?

8.4 What kind of feed is indicated by the distribution of flows?

INSTRUCTION – River system

a) Find the hydrological station closest to the river under study

In Poland, use, for example, the map on the website http://monitor.pogodynka.pl

b) find hydrological data from that station

In Poland, go e.g. to the website of the Institute of Meteorology and Water Management https://dane.imgw.pl and open the measurement and observation data tab. On the next screens download in order: hydrological data> monthly> 2016. Use the data for 2016 as those for the following years may be incomplete.

c) Prepare the data for elaboration and analysis

Download the file Mies_2016.zip. Unpack it. Open the file in a spreadsheet. Note that the downloaded data is not separated - they are all in the first column of the following rows. Select the first column and then split the data using the Text As Columns tool in the Data menu.

There is text data in all cells of the table. Format the table so that they become numeric data. Select all cells with numeric data. Right-click and select Format Cells. Then, from the Numbers menu, choose the Numeric category. Numbers with decimals replace periods with commas. Filter the data in the following columns: C (select the river you are interested in), B (select the measurement post you are interested in), F (select the value 3, which is the maximum flow value). To filter the data, select the first row of the table and then use the Filter Tool from the menu. There will be twelve rows left in the table - one for each month. note that the downloaded data is for the hydrological year, so the first row in the table contains data from last November.

d) Develop hydrological data

Analyzing the obtained data on the volume of flow will be easier if you present it in a graphic form, e.g. on a chart. Make a line graph using the data in column H. They represent the maximum monthly flow rate in m3/s.

e) Describe changes in the flow rate in the selected river during the year

Analyze the amount of flow. Write down the answers to the questions given above (8.1-8.4).

8.1 The hydrological regime of the studied river:

_____

_____

8.2 The minimum flow rate: _____

the maximum flow rate: _____

8.3 The highest flows observed in _____

and the lowest flows observed in _____

8.4 Kind of feed: _____

WORKSHEET 2

PROJECT: Small retention - big deal. Plants store water and inhibit drought

SUBJECT: RIVER MICROCLIMATE

Date of observation and measurement: …….

Group number 2

Composition of the group	Name and surname
Leader	
Members	• …… • …… • …… • ……

MIND THE SAFETY RULES!

- be careful when carrying out measurements and observations
- stay close to your group
- do not go into the river

Task 1 Enter the geographic coordinates of the measurement site using the Google Maps application.

……
……..

Task 2 Using your own knowledge and available teaching materials, explain the concepts:

a) main river

……

b) climate

……

c) weather

……

d) microclimate

……

e) current air temperature

……

f) average air temperature

……

g) air amplitude

……

h) atmospheric pressure

……

Task 3. Complete the table (data from the topographic map)

The source of the river and the height above sea level	
Estuary of river and the height above sea level	
The length of the river	
Main river basin	
Cities through which it flows	
Tributaries	
Reservoirs on the river	

Task 4 List the economic and landscape functions of rivers

a)……
b)……
c)……
d)……

Task 5 Locate a river on the map and follow these instructions:

a) mark with X the site of measurements on the map
b) define the direction in which it flows and mark with an arrow on the obtained fragment of the topographic map
c) mark the source of the river (S) and the estuary (E) on the map
d) identify to which main river, the river basin belongs (use the tourist map)
e) determine the order of the tributary of the studied river

Task 6 Using meteorological instruments or observations, measure the following parameters:

a) air temperature in °C
……..
b) water temperature
……..
c) atmospheric pressure
……..
d) cloud cover
……
e) air humidity
……
f) wind direction and speed
……
g) precipitation
……..
h) other weather phenomena
……

Task 7
Using data from the nearest weather station enter: (e.g. in Poland, use the map on the website http://monitor.pogodynka.pl)

a) air temperature
……..
b) water temperature
……..
c) atmospheric pressure
……

d) wind speed

……..

e) the amount of precipitation

……..

Task 8 Describe the course of air temperature throughout the year and answer the questions. Follow the instructions.

8.1 In which months is the average monthly air temperature above and below 0°C?
8.2 In which months is the air temperature the highest and the lowest?
8.3 What are the values of the annual mean air temperature and the mean annual air temperature amplitude?

Instruction
a) Find the weather station closest to the measurement site.
E.g. in Poland, use the map on the website http://monitor.pogodynka.pl
The current weather may be checked on the website https://www.yr.no/en/ - available in English and for whole world.

b) Find meteorological data
You need to find them on the websites of institutions that collect, compare and analyze climate data, e.g. in Poland:
http://www.wordclimate.com, https://dane.imgw.pl//
http://www.pogodynka.pl/polska/daneklimatyczne/
For global locations you may search on the portal: https://en.climate-data.org/

c) Develop meteorological data
Analyzing the data on the course of air temperature throughout the year will be easier if you present them graphically, e.g. on a chart.

d) Describe the course of air temperature in a selected place during the year
Analyze the course of air temperature. Write down the answers to questions given above (8.1-8.3).

8.1 The average monthly air temperature is above 0°C in:

_____

and below 0°C in:

_____

8.2 The air temperature is the highest in:

_____

and the lowest in:

_____

8.3 The annual mean air temperature is: _____°C

The mean annual air temperature amplitude is _____°C

Your calculations:

_____

_____

WORKSHEET 3

PROJECT: Small retention - big deal. Plants store water and inhibit drought

SUBJECT: Sculptural activity of rivers

Date of observation and measurement: …….

Group number 2

Composition of the group	Name and surname
Leader	
Members	• …… • …… • …… • ……

MIND THE SAFETY RULES!

- be careful when carrying out measurements and observations
- stay close to your group
- do not go into the river

Task 1 Enter the geographic coordinates of the measurement site using the Google Maps application.

……

Task 2 Using your own knowledge and available teaching materials, explain the concepts:

- main river

……

- erosion

……

- estuary

……

- the source of the river

……

- upper, middle and lower course

……

- meanders

……

- oxbow lakes

……

- pebbles

……

Task 3 Complete the table (data from the topographic map)

The source of the river and the height above sea level	
Estuary of river and the height above sea level	
The length of the river	
Main river basin	
Cities through which it flows	
Tributaries	
Reservoirs on the river	

Task 4 List the economic and landscape functions of rivers

a) ……
b) ……
c) ……
d) ……

Task 5 Locate a river on the map and follow these instructions:

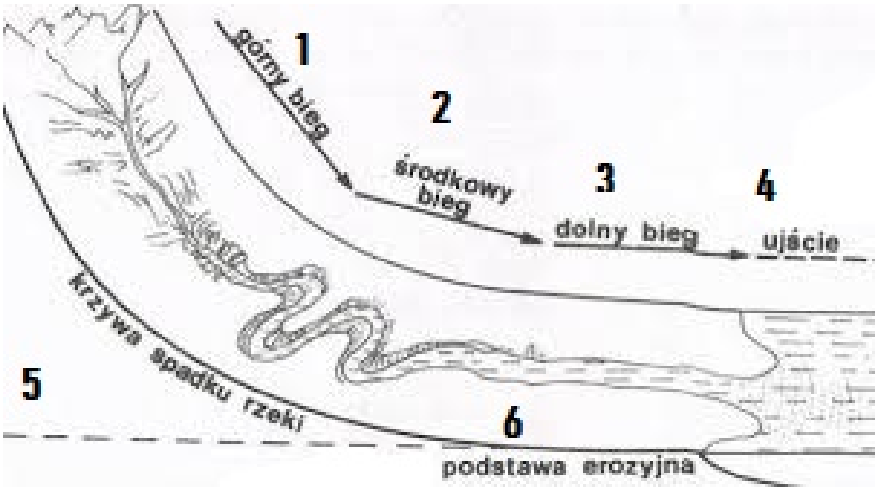
a) mark (X) the place of measurements on the map
b) define the direction in which it flows and mark with an arrow on the obtained fragment of the topographic map
c) mark the source of the river on the map (S) and the estuary (E)
d) identify to which main river, the river basin belongs (use the tourist map)
e) determine the order of the tributary of the studied river under

Task 6 Using the knowledge or the available teaching materials, provide the course of the river and its characteristics in the place where you are taking measurements.

COURSE OF THE RIVER -

CHARACTERISTICS -

Task 7 The figure shows the longitudinal profile of a river. Analyze the longitudinal profile of the river and give answers:



Legend:
1 upper course
2 middle course
3 lower course
4 estuary
5 river slope curve
6 erosion base

- List three factors that determine the intensity of river activity

1.- ……
2.- ……
3.- ……

- What is the erosion base of the river?

……
……

- Which river course is dominated by the submerged erosion process?

……

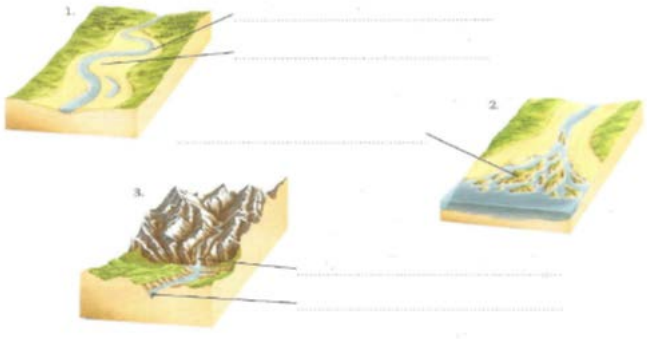
- Which the river course is dominated by lateral erosion?

……

- In which stretch of the river the accumulation process dominates?

……

Task 8 Complete the drawings by entering the names of sculptural processes listed below in the appropriate places. Processes: submerged erosion, back erosion, lateral erosion.



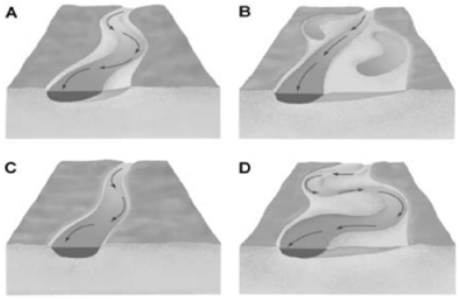
Task 9 In the appropriate places in the table enter the letters corresponding to the mentioned processes and phenomena characteristic for particular river courses.

A - the predominance of lateral erosion
B - transport of boulders and rock crumbs
C - a very wide river valley
D - predominance of accumulation over erosion
E - V-shaped valleys

F - predominance of depth erosion
G - silt and clay accumulation
H - meanders

Upper course	Middle course	Lower course

Task 10
Arrange the illustrations below so that they show the successive stages of the formation of oxbow lakes. To do this, enter the letters in the appropriate places in the diagram.



□→□→□→□

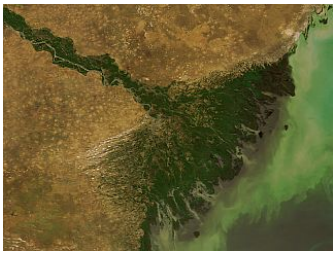
Task 11.

Add to the drawings the forms of sculpture resulting from the activity of rivers, the process and the section of the river.

Form of sculpture: _____

Process: _____

Course of the river: _____



Form of sculpture: _____

Process: _____

Course of the river: _____

Form of sculpture: _____

Process: _____

Course of the river: _____

Form of sculpture: _____

Process: _____

Course of the river: _____

Form of sculpture: _____

Process: _____

Course of the river: _____

Form of sculpture: _____

Process: _____

Course of the river: _____

Form of sculpture: _____

Process: _____

Course of the river: _____

Form of sculpture: _____

Process: _____

Course of the river: _____

WORKSHEET 4

PROJECT: Small retention - big deal. Plants store water and inhibit drought.

SUBJECT: Riparian vegetation

Date of observation and measurement: ……

Group number 2

Composition of the group	Name and surname
Leader	
Members	• …… • …… • …… • ……

MIND THE SAFETY RULES!

- be careful when carrying out measurements and observations
- stay close to your group
- do not go into the river

Task 1. Enter the geographic coordinates of the measurement site using the Google Maps application.

……

Task 2 . Using your own knowledge and available teaching materials, explain the concepts:

a) main river - ……
b) retention - ……
c) low flow - ……

d) flood - ……
e) water balance - ……

Task 3. Complete the table (data from the topographic map)

The source of the river and the height above sea level	
Estuary of river and the height above sea level	
The length of the river	
Main river basin	
Cities through which it flows	
Tributaries	
Reservoirs on the river	

Task 4 List the economic and landscape functions of rivers

a) ……
b) ……
c) ……
d) ……

Task 5 Locate a river on the map and follow these instructions:

a) mark with X the site of measurements on the map
b) define the direction in which it flows and mark with an arrow on the obtained fragment of the topographic map
c) mark the source of the river (S) and the estuary (E) on the map
d) identify to which main river, the river basin belongs (use the tourist map)
e) determine the order of the tributary of the studied river

Task 6 What are the functions of riparian vegetation?

a) ……

b) .....

c) .....

d) .....

Task 7 Based on your observations and atlases or plant identification keys, complete the list. You may use national plant identification key or English one available at: http://www.worldfloraonline.org/

LIST OF IDENTIFIED PLANTS

a) .....

b) .....

c) .....

d) .....

e) .....

f) .....

Task 8 Make photographic documentation of the riparian vegetation.

Task 9 List the causes and effects of floods.

The causes of the flood	The effects of the flood

Task 10 List flood prevention measures.

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POLAND

BRITEC – Bringing Research Into the Classroom

Learning Scenario 2

1. Title

UV index – a closer look from Earth

Author(s)

Piotr Siłka

Area of research

Earth science

Subject(s)

Geography, Physics

Topic

Geographical factors affecting the UV Index

Age of students

15-19 years

2. Introduction

Contribution of the CS project to Science in general

The project introduces the concept of citizen science and basing on real scientific examples, shows how people can contribute to data collection. This case study focuses on the issues related to UV index as an element of solar energy reaching the Earth. Various geographical

factors affecting the size of the index are presented. Students will also gain knowledge on how to protect themselves against the negative effects of UV radiation and will learn how to read the UV index and refer to their own needs.

The main goals of the project are:

making students aware of the possibility to take part in scientific projects without any professional scientific background;
acquiring basic knowledge in the field of UV radiation;
acquiring skills how to correctly collect data in the field of UV radiation.

Aim of the activities plan and learning objectives

The main goals of the activity plan are:

- Explain what UV radiation is and where it comes from.
- Presentation of main three types of UV radiation.
- Describe different geographical factors affect the UV radiation.
- Explain what UV index is and how it can be understood.
- Present a list of useful websites which can be used by a student.

The main learning objectives:

- Students can indicate the source of UV radiation.
- Students can list the types of UV radiation.
- Students can describe how different factors affect the UV radiation.
- Students understand UV index and how it relates to human health.

Skills acquire during activity:

- Critical thinking
- Communication and collaboration
- Information, Media and Technology Skills

Summary of activities

Number of activity	Name of activity
1.	From Sun to UV
2.	UVI factors over the world
3.	UV index and You

3. Detailed description of each activity

Activity 1: From Sun to UV

First Part: Aim of the activity

At the beginning of this activity, students become acquainted with the concept of civic learning. The Zooniverse.org website will be presented, where examples of such projects are shown.

Then the issue of UV radiation will be discussed, starting from the question of where solar energy comes from. Students will receive information on how the chemical reaction is responsible for producing solar energy, what the basic proportions of the solar system are, how powerful sun is, and finally the concept of UV will be presented. The division into three main types of UV radiation will be introduced, as well as the new UV index created in 2004. The last part of this activity is a quick brainstorming about the positive and negative effects of UV radiation.

Second Part: Suggested procedure

Preparation time	5’
Teaching time	15’
Online teaching	Power Point or PDF reader application for

material	Appendix_1_Presentation https://www.zooniverse.org/ Yt: Where Does the Sun's Energy Come From? https://www.youtube.com/watch?v=GAGFC8-wn1g
Offline teaching material	Equipment necessary for the presentation, i.e. a computer with internet access and a multimedia projector. Brainstorming can be carried out using a blackboard on which ideas will be written by the teacher, or by distributing markers and post-it notes to students to use them to write down their ideas.
Citizen science purpose of the activity (if any) *	A presentation of the basic concepts to better understand the collected data. The teacher's knowledge of the topic is necessary.
*** Guidance for teachers**	If the topic is not well understood, then this part should be well prepared by giving a closer look at the bibliography and online materials presented in the script.

Third Part: Advice on methodology

For this activity you should have a room with the necessary computer equipment. In addition to the last part, it has the character of a lecture, during which it is suggested to ask questions stimulating students' curiosity. If you have time, you can also present the proposed YouTube video. The last part of this activity, which is brainstorming, can be carried out in two ways. The first way is less physically engaging and less time-consuming. Teacher writes down the students' ideas on the board. The second way is to give out sticky notes on which students will write their ideas. It is necessary to determine in advance where they will be placed by students in the room.

Fourth Part: Educational analysis

- Critical thinking and problem solving.
- Lifelong learning: learning does not stop after leaving school.
- Open source learning: teachers copy, share, adapt, and reuse free educational materials.
- Learning with the use of visual media: images and multimedia are more powerful than verbal stimuli.

Activity 2: UVI factors over the world

First Part: Aim of the activity

At the beginning of this activity, the most important factors affecting UV radiation reaching the Earth's surface will be presented. Then, in order to check how these individual factors change in different places on the globe, we suggest working in groups on the joint filling of previously prepared worksheet.

Each group selects the country and city (it does not have to be the capital), which they enter in the upper part of the survey. The pre-selected countries are presented for selection. Then, step by step, six issues are presented in which students, on their own, must obtain data from public sources and enter them in the appropriate place on the form.

The following six issues will be investigated: longitude and latitude, solar noon, sun's angle, altitude, amount of ozone, UV Index.

Second Part: Suggested procedure

Preparation time	5’
Teaching time	30’
Online teaching material	PDF Reader Appendix_2_Worksheet https://www.google.com/maps/ https://www.latlong.net/ https://www.gps-coordinates.net/ https://www.geoplaner.com/ https://gps-coordinates.org/ https://www.timeanddate.com https://www.suncalc.org https://astro.unl.edu/naap/motion1/motion1.html https://www.mapcoordinates.net/en https://www.freemaptools.com/elevation-finder.htm http://temis.nl/uvradiation/nrt/uvindex.php https://www.mapcoordinates.net/en

	http://www.weatherlink.com/user/igfpan/ Apps for phone: LunaSolCal Mobile, Sun Locator Lite, Google Earth, My elevation, GlobalUV
Offline teaching material	Equipment necessary for the presentation, i.e. a computer with internet access and a multimedia projector. Paper to print worksheets, pens
Citizen science purpose of the activity (if any) *	The purpose of this activity is to gain experience in the understanding of acquiring sample data from publicly available sources on the Internet.
***** Guidance for teachers**	It is worth looking through the activities on each website presented in this part and practice obtaining this data yourself, based on different geographical coordinates.

Third Part: Advice on methodology

To perform this activity, students must have access to either computers connected to the internet or be able to use their own cell phones with internet access. The maximum number of people in a group should not exceed 4. If there are more people in the class, increase the number of teams.

Fourth Part: Educational analysis

- Critical thinking and problem solving.
- Lifelong learning: learning does not stop after leaving school.
- Open source learning: teachers copy, share, adapt, and reuse free educational materials.
- STEM learning and getting familiar with STEM-related careers: increasing focus on Science, Technology, Engineering and Mathematics. Through this Learning Scenario students will be introduced to various STEM-related careers.
- Cloud Based Learning: data, tools and software are available online and can be reached and modified from different devices.
- Mobile learning and ICT literacy: we get access to knowledge through smartphones and tablets. It is learning anytime, anywhere.
- Learning with the use of visual media: images and multimedia are more powerful than verbal stimuli.
- BYOD (Bring your own device): students bring their own mobile devices to the classroom.

Activity 3: UV index and You

First Part: Aim of the activity

At the beginning of this activity, two factors are presented that should be taken into account when reading the UV indicator in the context of one's health, i.e. skin type and type of sunscreen and its sun protection factor.

Then, based on the indicated websites or applications, students are asked to check how much time they can spend in the sun without exposing themselves to sunburn. Awareness of the dangers arising from excessive exposure to the sun is to provide data on skin cancer incidence. Students have the opportunity to check which countries in the world have a particularly high number of cases of skin cancer.

The last element of this activity is evaluation. It can be done using an online quiz or more traditional forms, i.e. on paper.

Second Part: Suggested procedure

Preparation time	5’
Teaching time	15’
Online teaching material	PDF Reader Appendix_3_Quiz https://www.omnicalculator.com/other/sunscreen http://www.anycalculator.com/tanningcalculator.html https://canceratlas.cancer.org/risk-factors/ultraviolet-radiation Apps for phone: UVIower, UVImate Yt clips: What does SPF mean and do UV filters damage coral reefs? https://www.youtube.com/watch?v=KPqocgI1-kc (remember about English subtitles) Sunburn and skin cancer, the burning issue https://www.youtube.com/watch?v=kmqhzG8QamU This tiny UV camera will show if you've missed any areas with sunscreen https://www.youtube.com/watch?v=-z4xQdQiZ18 Quiz:

	https://quizizz.com/admin/quiz/5edb82b6c3676f001ba1e974
Offline teaching material	Equipment necessary for the presentation, i.e. a computer with internet access and a multimedia projector. Paper to print quiz if needed, pens.
Citizen science purpose of the activity (if any) *	The purpose of this activity is to show how participation in a civic project can broaden knowledge and skills useful in everyday life.
***** Guidance for teachers**	It is worth checking your skin type before the activity, as there are often problems distinguishing them.

Third Part: Advice on methodology

This part has the character of a lecture interspersed with two activities actively involving students. As in the previous part, students must have access to either computers connected to the internet or be able to use their own cell phones with internet access. If the teacher has more time, then YouTube videos can be presented.

In this case, it is suggested that each student have their own access to such a device, so probably a cell phone will be more appropriate. If there is no time to complete the quiz, the page on which it was prepared gives the opportunity to do it later as homework. The quiz is available until the specific day and time.

The quiz can also be carried out in a traditional way using pre-printed questions on a piece of paper.

Fourth Part: Educational analysis

- Critical thinking and problem solving.
- Lifelong learning: learning does not stop after leaving school.
- Open source learning: teachers copy, share, adapt, and reuse free educational materials.
- STEM learning and familiarization with STEM-related careers: increased focus on Science, Technology, Engineering and Mathematics. Through this Learning Scenario students will be introduced to various STEM-related careers.
- Cloud Based Learning: data, tools and software are available online and can be reached and modified from different devices.

- Mobile learning and ICT literacy: we get access to knowledge through smartphones and tablets. It is learning anytime, anywhere.
- Learning with the use of visual media: images and multimedia are more powerful than verbal stimuli.
- BYOD (Bring your own device): students bring their own mobile devices to the classroom.

4. Assessment after implementation of the activities plan

Student´s learning

Assessment method of the lesson can be a quiz. It can be conducted as a final part of a lesson or assigned as homework. Quiz is prepared in traditional way (Appendix 3&4) and also available on a Quizizz platform:

https://quizizz.com/admin/quiz/5edb82b6c3676f001ba1e974

Here are the questions with answers.

- **How does the sun create energy?**

- **By nuclear fusion**
- Bu nuclear decay
- from stars
- from void

- **Which type of UV radiation almost entirely reach the Earth's surface?**

- UVC
- UVB
- **UVA**

- **What is the name of time when sun peak in the sky?**

- sunrise
- sunset
- **solar noon**
- solar max

- **What is crucial for sun's angle on Earth?**

- **latitude**
- longitude
- altitude

- **How does altitude change UV radiation?**

- **increase**
- decrease

- **How do we call unit that measures ozone concentration?**

- uvi
- **Dobson unit**
- Pascal unit
- SPF

- **What is the safe range of UV index?**

- 1
- **1-2**
- 1-3
- 1-4

- **How many types of skin were proposed by Thomas B. Fitzpatrick?**

- 4
- 5
- **6**
- 7

- **How many more minutes can you spend in sun with SPF 30 if your skin gets sunburn after 1 min without SPF?**

- 5
- 10
- 15
- **30**

- **Which of following countries has the highest rate of skin cancers cases per capita?**

- Egypt
- **New Zealand**
- Japan
- Kenya

Citizen Science experience

The main problem that students have is the correct reading of the individual indicators used in the lesson. Therefore, it is always recommended to provide an example of the form in which a given indicator should be written.

If students decide to read the data from applications installed on the phone, it is recommended to provide a list so that students before the lesson, so they can install the necessary apps on their phones.

5. Bibliography

https://eris-project.eu/index.php/en/packages/

https://www.who.int/uv/publications/en/

https://www.epa.gov/sites/production/files/documents/uviguide.pdf

https://ozonewatch.gsfc.nasa.gov/facts/dobson_SH.html

https://www.sunsmart.org.nz/resources

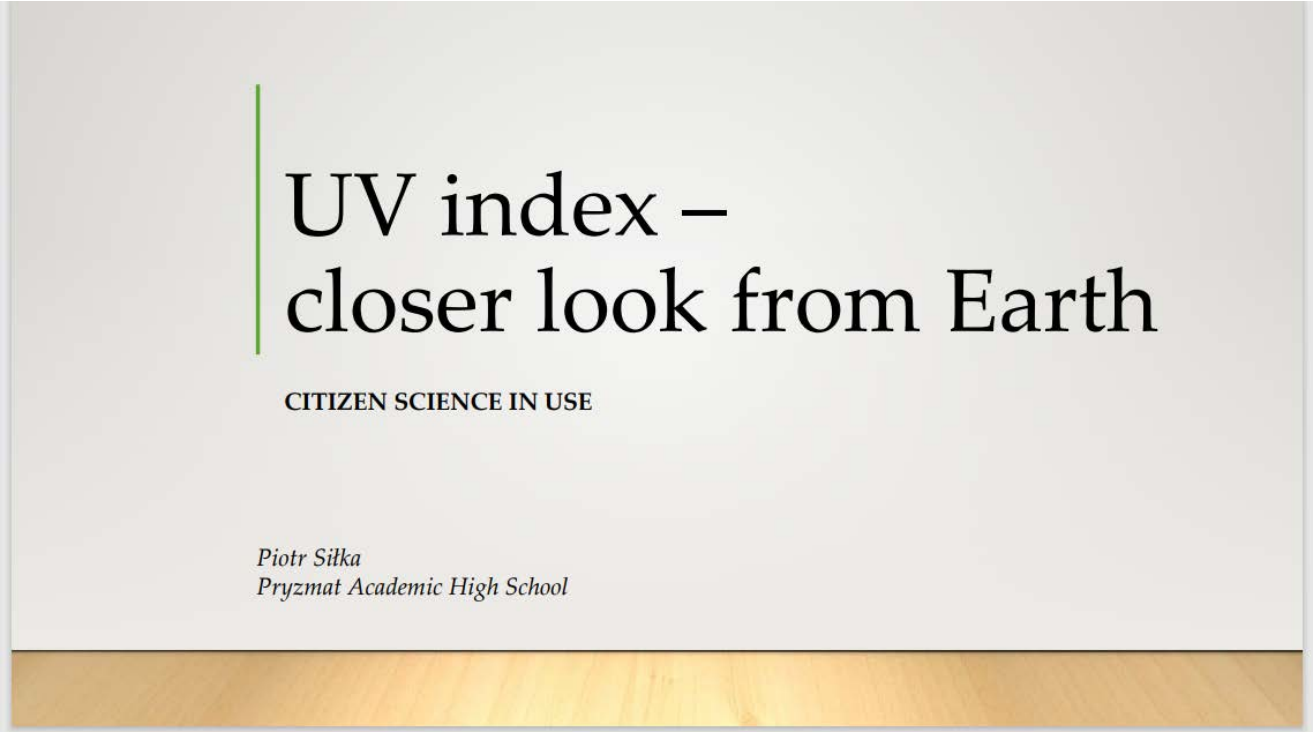
https://canceratlas.cancer.org/risk-factors/ultraviolet-radiation

https://www.sciencelearn.org.nz/resources/1304-positive-and-negative-effects-of-uv

https://www.zooniverse.org/

6. Annexes

Annex 1: Presentation



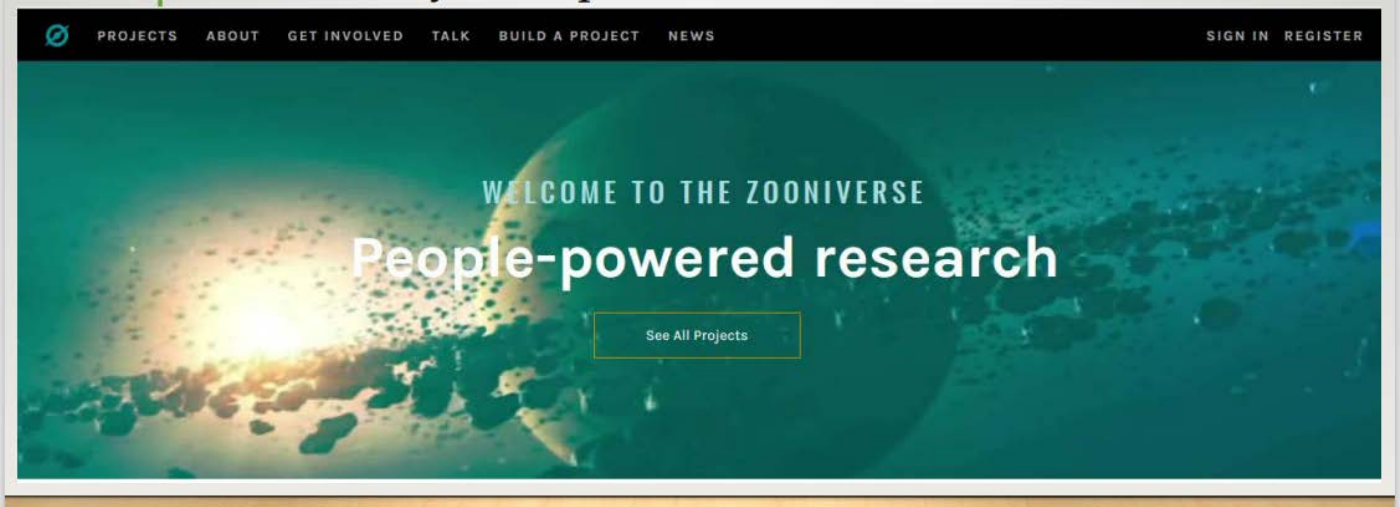
What is citizen science?

Citizen science is the practice of public participation and collaboration in **scientific** research to increase **scientific** knowledge. Through **citizen science**, people share and contribute to data monitoring and collection programs. Usually this participation is done as an unpaid volunteer.

What kind of topics???

https://www.citizenscience.org/out-of-school/

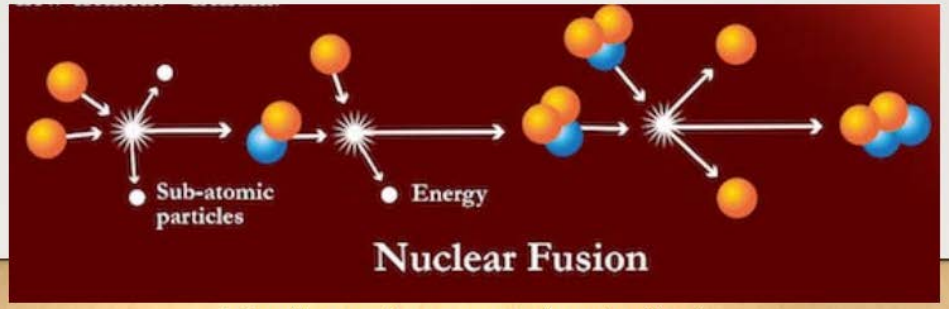
One of many examples…



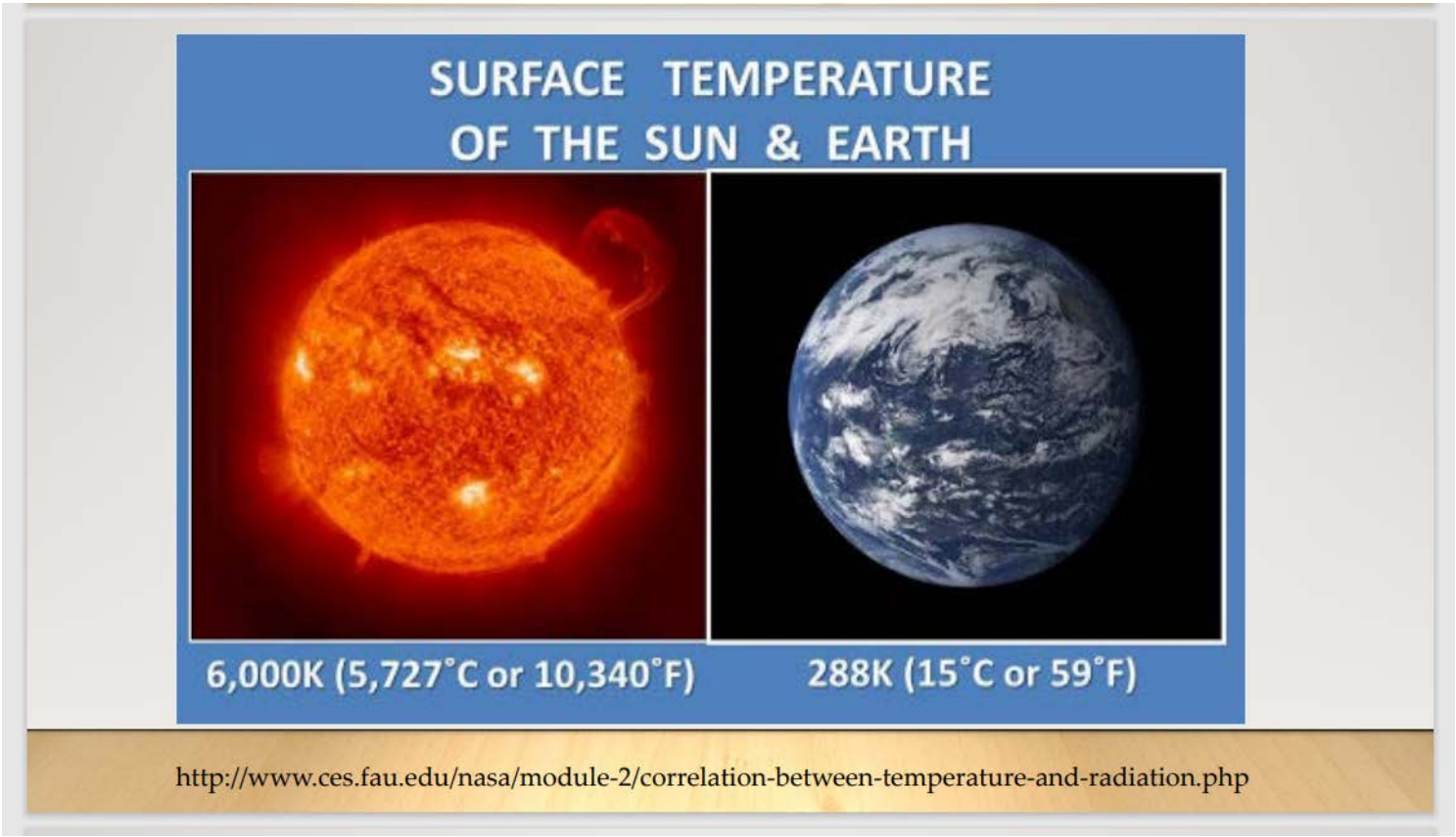
https://www.zooniverse.org/

Sun energy

- Sun, like all stars, is able to create energy because it is essentially a massive fusion reaction.
- Thanks to the extreme pressure and temperature that exists within the core sun, energy is produced by hydrogen atoms (H) being converted into nuclei of helium (He).

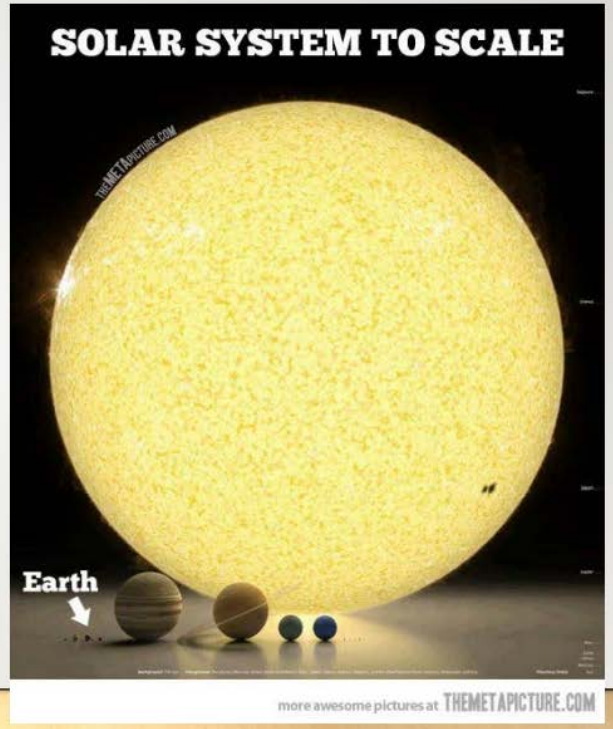


https://spaceplace.nasa.gov/sun-heat/en/


SURFACE TEMPERATURE
OF THE SUN & EARTH
6,000K (5,727˚C or 10,340˚F)
288K (15˚C or 59˚F)
http://www.ces.fau.edu/nasa/module-2/correlation-between-temperature-and-radiation.php

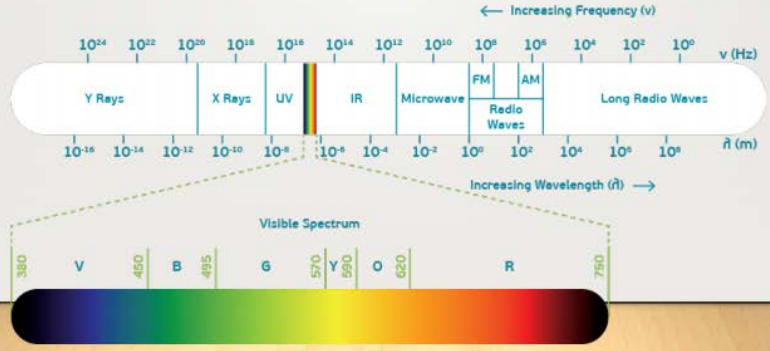
Distance is big, but sun is bigger

- Our solar system is so big it is almost impossible to imagine its size if you use ordinary units.
- The distance from Earth to the Sun is 149 million kilometers.
- 1.3 million Earths could fit insinde the sun
- That is why each plastic model you can see in classroom is not true.



Solar radiation

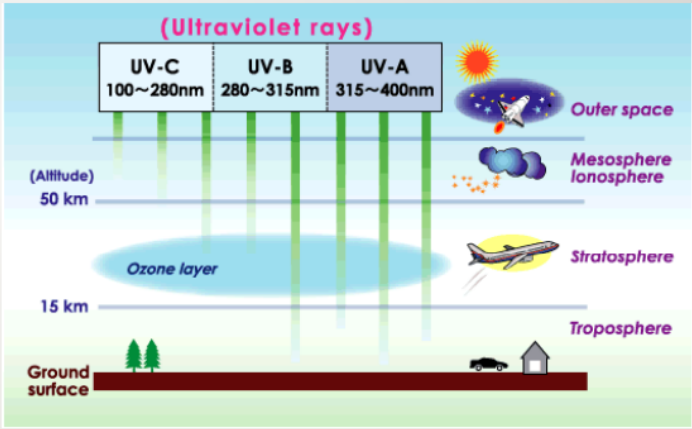
- All of the energy from the Sun that reaches the Earth arrives as solar radiation, part of a large collection of energy called the electromagnetic radiation spectrum.
- Solar radiation includes visible light, **ultraviolet**, infrared, radio waves, X-rays, and gamma rays.



http://obeikanglass.sa/quality/solar-spectrum/

UV radiation

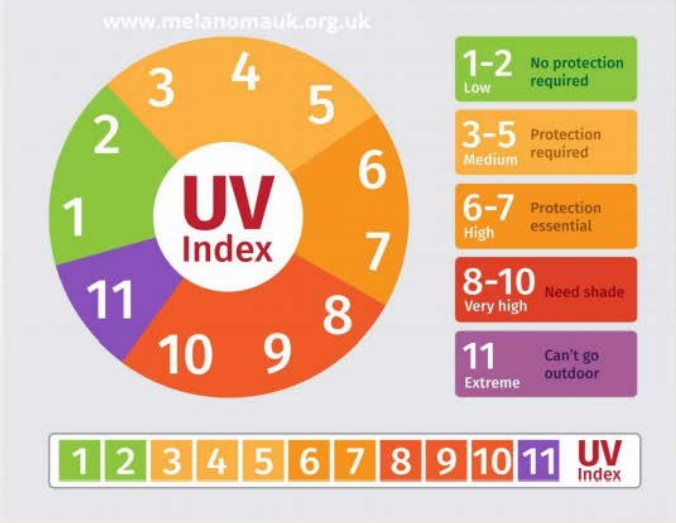
- UV radiation is classified into three types, according to the wavelength: UVA, UVB and UVC.
- UVC is completely absorbed by the atmospheric ozone, water vapour, and gases (O2,CO2).
- About 10% UVB and most UVA radiation radiation reaches the Earth's surface.
- Both UVA and UVB are of major importance to human health.



https://theozonehole.com/uvrays.htm

UV Index

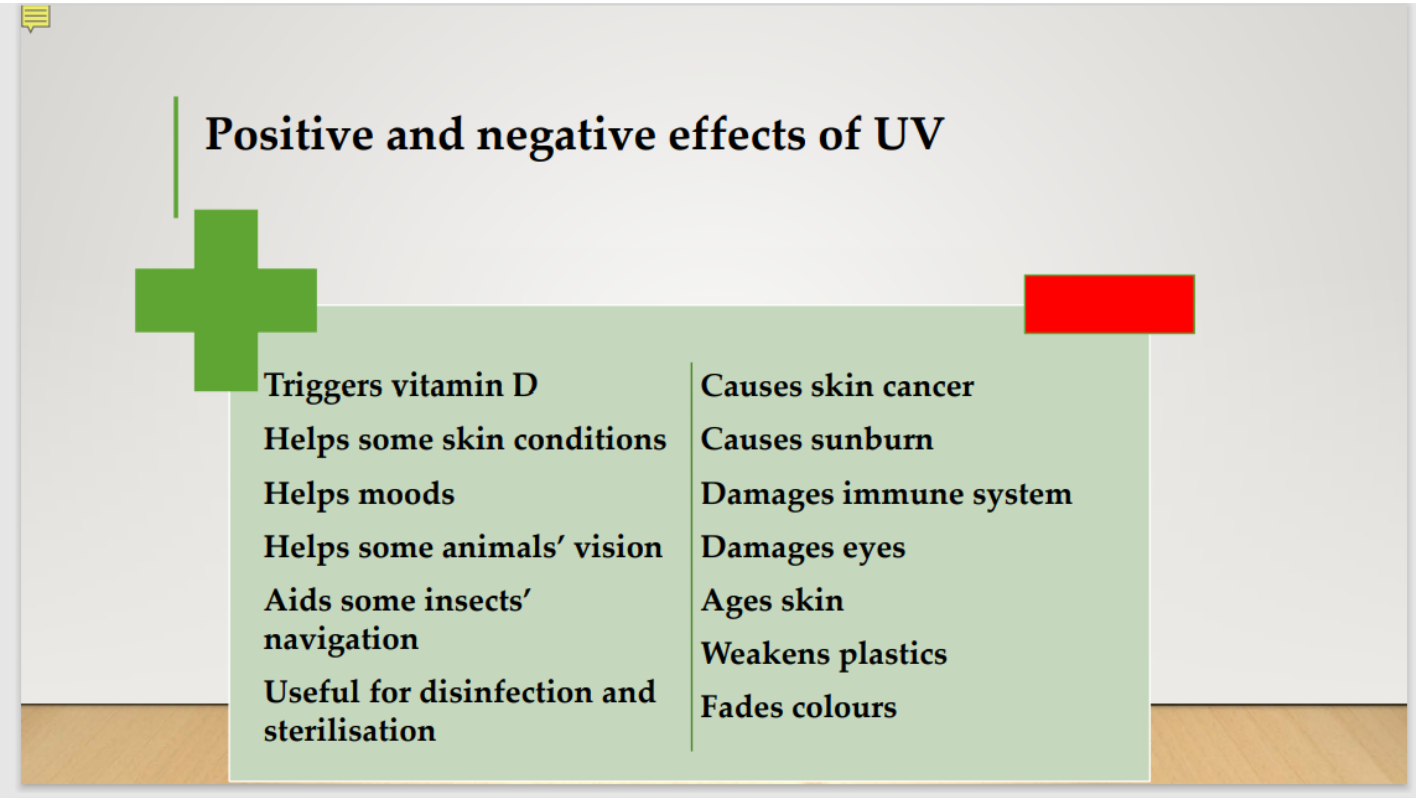
The Global Solar UV Index (UVI) described in this document is a simple measure of the UV radiation level at the Earth's surface and an indicator of the potential for skin damage.



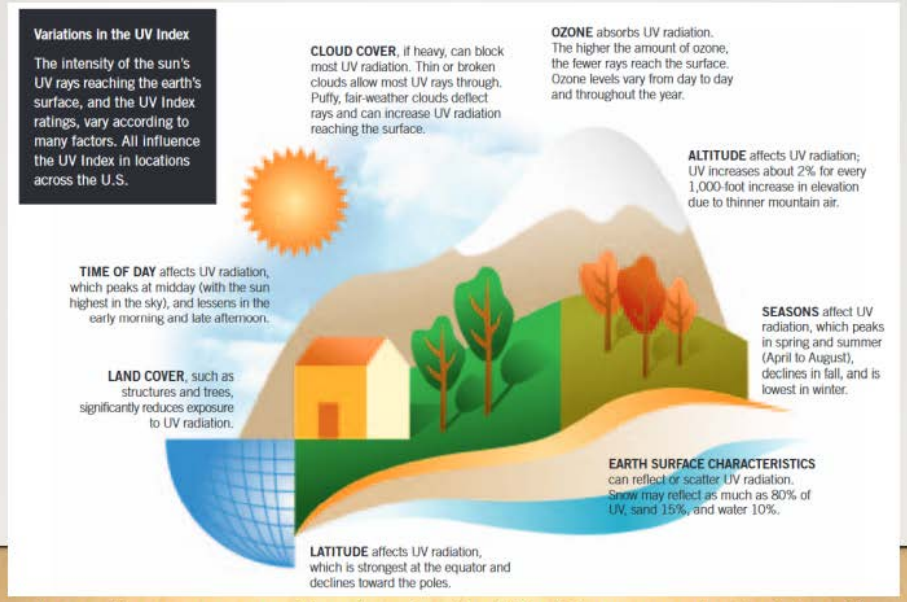
Positive and negative effects of UV

What are the benefits and disadvantages of UV???

https://www.everydayhealth.com/columns/therese-borchard-sanity-break/does-weather-affect-your-mood/


Positive and negative effects of UV
Triggers vitamin D
Helps some skin conditions
Helps moods
Helps some animals' vision
Aids some insects' navigation
Useful for disinfection and sterilisation
Causes skin cancer
Causes sunburn
Damages immune system
Damages eyes
Ages skin
Weakens plastics
Fades colours

Factors affecting the UV radiation



https://www.epa.gov/sites/production/files/documents/uviguide.pdf

UVI factors over to world

- Let's check how factors affecting the UV Index looks like in the different places in world.
- Please divide a class of students into 5 groups. Each group will investigate different country and city.
- You will find some examples on the next slide
- Each group will have a form to fill in (Annexes 2)

https://www.mapsofworld.com/map-of-countries.html

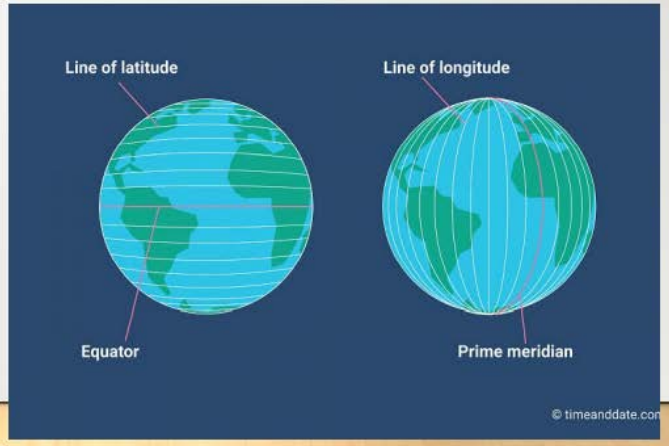
https://www.mapsofworld.com/map-of-countries.html

1. Longitude and Latitude

Write the geographical coordinates of your city.

You can use folowing sites:

- https://www.google.com/maps/
- https://www.latlong.net/
- https://www.gps-coordinates.net/
- https://www.geoplaner.com/
- https://gps-coordinates.org/



2. Time of the day

Write the time of solar noon in your city today.

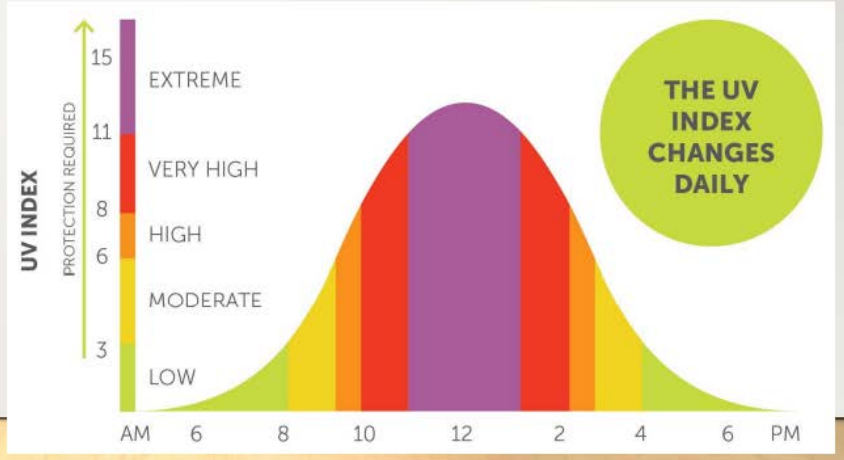
UV rays from the sun are strongest when the sun is at its peak in the sky, called **solar noon**, halfway between sunrise and sunset.

You can use following sites:

- https://www.timeanddate.com
- https://www.suncalc.org

Apps for phone:

- LunaSolCal Mobile
- Sun Locator Lite



http://melanomawa.org.au/awareness/how-to-prevent-melanoma/

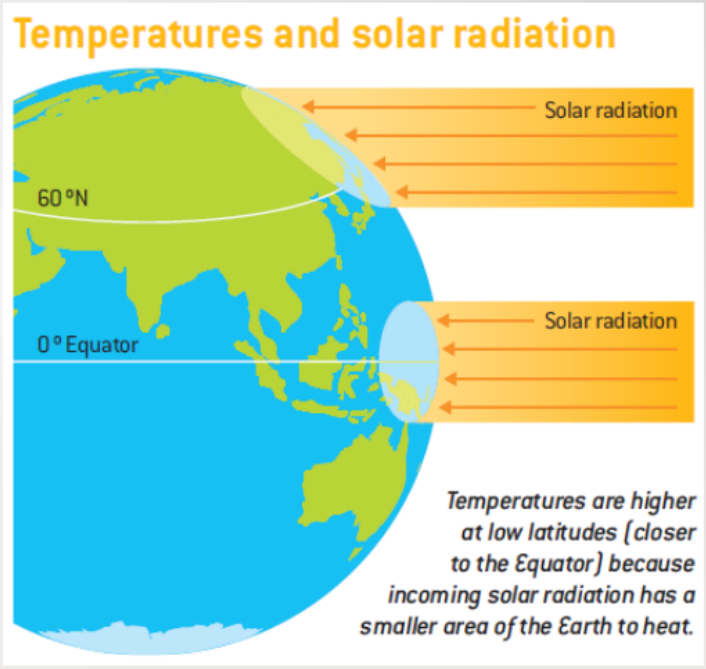
3. Latitude = sun's angle

Write the sun's angle during solar noon in your city today.

The most important determinant of the height of the sun and thus the amount of UV rays is latitude. The closer the equator, the higher the UV radiation levels. Of course, one should remember about the variability resulting from the time of day and season.

In addition to sites and apps mentioned before you can check also:

https://astro.unl.edu/naap/motion1/motion1.html



https://sites.google.com/a/syd.catholic.edu.au/boudica/year-7-geography/4g1-investigating-the-world/global-pattern-of-climate

4. Altitude

Write the altitude of your city.

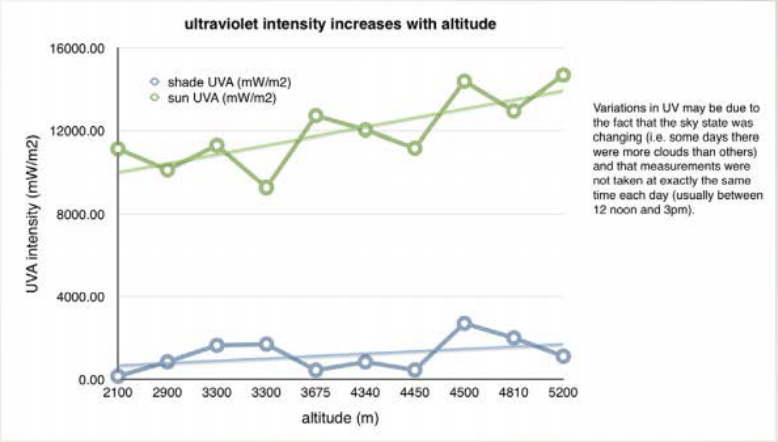
At higher altitudes, a thinner atmosphere filters less UV radiation. With every 1000 metres increase in altitude, UV levels increase by 10% to 12%

You can use folowing sites:

- https://www.mapcoordinates.net/en
- https://www.freemaptools.com/elevation-finder.htm

Apps for phone:

- Google Earth
- My elevation



https://melaniewindridge.co.uk/mountain-science/mountain-science-preliminary-results-3.html

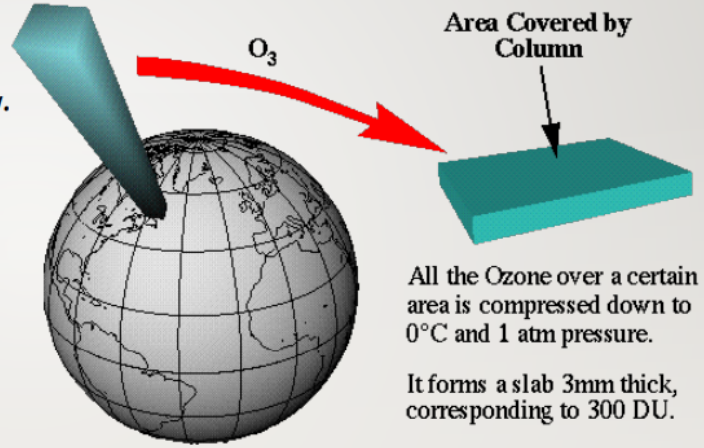
5. Ozone

Write the amount of ozone in you city for today.

Ozone absorbs some of the UV radiation that would otherwise reach the Earth's surface. Ozone levels vary over the year and even across the day. Dobson Unit (du) is the most common unit for measuring ozone concentration.

You can use following sites:

- http://temis.nl/uvradiation/nrt/uvindex.php



https://theozonehole.com/dobsonunit.htm

6. UV Index

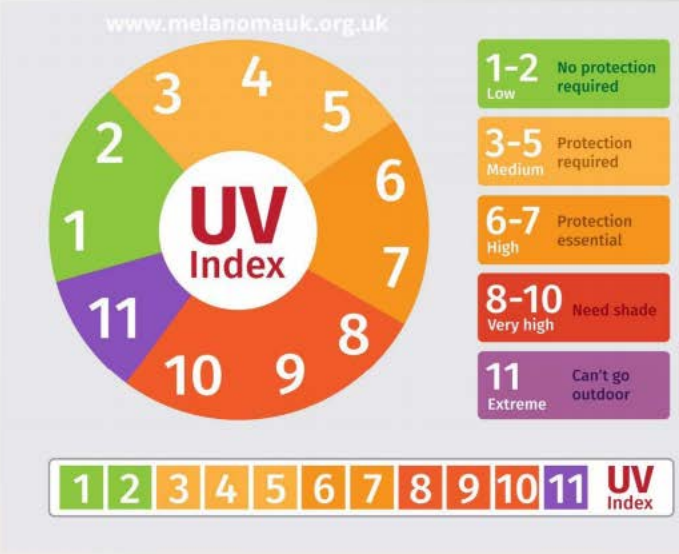
Write the highest UV index in your city for today.

You can use folowing sites:

- https://www.mapcoordinates.net/en
- http://www.weatherlink.com/user/igfpan/.

Apps for phone:

- GlobalUV



UV index and You

- Remember that the time you spend in the sun depends not only on UV index but also on your **skin type** and what kind of **sun protection** you use.
- Skin type - Thomas B. Fitzpatrick developed a way to classify the typical response of different types of skin to UV.
- Protection - sun protection factor (SPF) is a number, for example, SPF15. It indicates how much protection a product offers against UV light.

Skin Complexion	Sun's Effect on the Skin	Recommended SPF
Very Fair	Always burns easily; never tans	30-50+
Fair	Always burns easily; tans minimally	30-50+
Light	Burns moderately; tans eventually	15-30
Medium	Burns minimally; always tans well	6-15
Dark	Rarely burns; tans readily	2-10
Very Dark	Never burns; becomes deeply pigmented	2-10

http://www.hawaiiantropic.com/images/default-source/default-album/sunsafety_chart.gif?sfvrsn=2

UV index and You

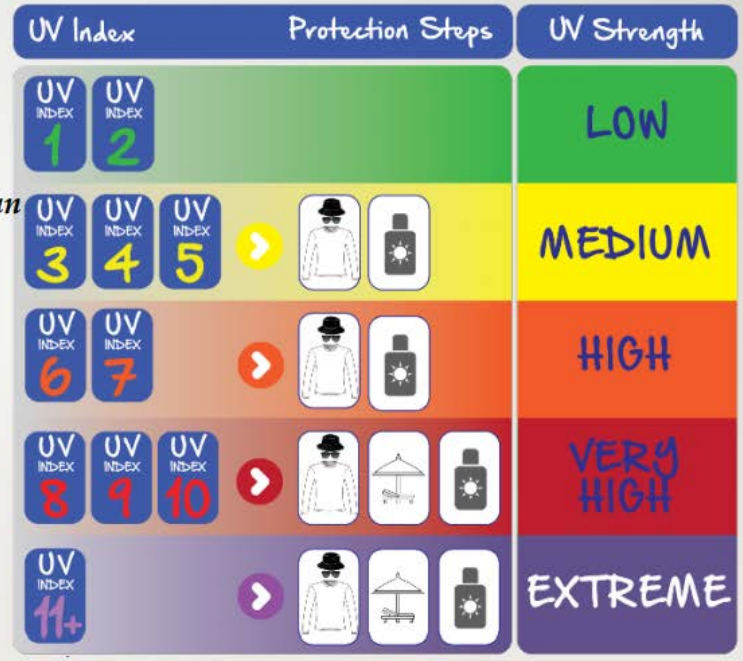
Check how many minutes you can spend safely in sun today.

You can use folowing sites:

- https://www.omnicalculator.com/other/sunscreen
- http://www.anycalculator.com/tanningcalculator.html

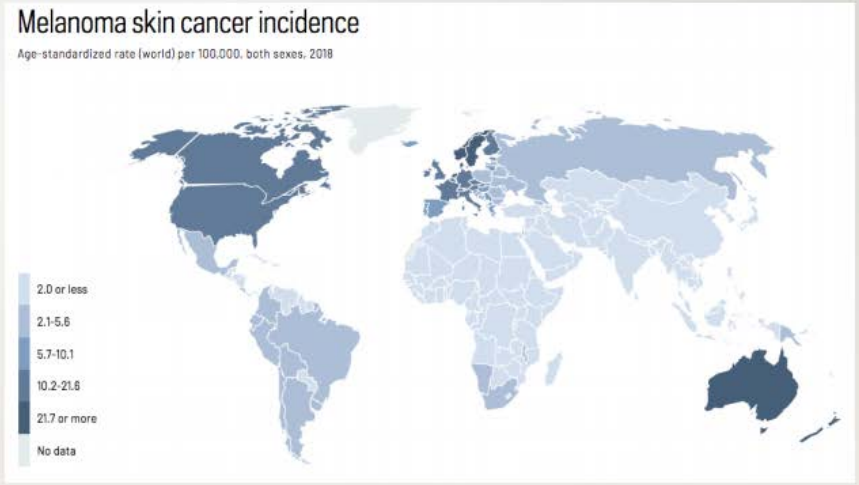
Apps for phone:

- UVIower
- UVImate



Skin cancer

A majority of skin cancers are caused by ultraviolet (UV) radiation. Keratinocyte skin cancers (basal cell and cutaneous squamous cell carcinomas) are the most common human cancers with over 13 million cases estimated each year worldwide.



https://canceratlas.cancer.org/risk-factors/ultraviolet-radiation


DARKER SKIN CAN'T SIDESTEP THE SUN
You can still get skin cancer, no matter what colour your skin
EVERYONE NEEDS TO COVER UP
SunSmart.org.nz
Skin Cancer in New Zealand
New Zealand currently has the world's highest rate of skin cancer, including melanoma.
EVEN THROUGH THE CLOUDS THE SUN CAN CATCH YOU
Whether it's hot or not, you can still get skin cancer
NO ONE'S TOO TOUGH TO COVER UP
SunSmart.org.nz
https://www.sunsmart.org.nz/resources

CHECK YOUR KNOWLEDGE BEFORE YOU GO ….

https://quizizz.com/admin/quiz/5edb82b6c3676f001ba1e974

Annex 2: Worksheet

UV in you country

Country:

City:

Date:

1. GEOGRAPHICAL COORDINATES

2.SOLAR NOON

3. SUN'S ANGLE DURING SOLAR NOON

4.ALTITUDE

5. AMOUNT OF OZONE

6. HIGHEST UV INDEX

Annex 3: Quiz

UV INDEX – CLOSER LOOK FROM EARTH

QUIZ

1. HOW DOES THE SUN CREATE ENERGY?

- by nuclear fusion
- by nuclear decay
- from stars
- from void

2. WHICH TYPE OF UV RADIATION ALMOST ENTIRELYREACHES THE EARTH'S SURFACE??

- UVC
- UVB
- UVA

3. WHAT IS THE NAME OF TIME WHEN SUN PEAK IN THE SKY?

- sunrise
- sunset
- solar noon
- solar max

4. WHAT IS CRUCIAL FOR SUN'S ANGLE ON EARTH?

- latitude
- longitude
- altitude

5. HOW DOES ALTITUDE CHANGE UV RADIATION?

- increase
- decrease

6. HOW DO WE CALL THE UNIT THAT MEASURES OZONECONCEN-TRATION?

- uvi
- Dobson unit
- Pascal uit
- SPF

7. WHAT IS THE SAFE RANGE OF UV INDEX?

- 1
- 1-2
- 1-3
- 1-4

8. HOW MANY TYPES OF SKIN WERE PROPOSED BY THOMAS B. FITZPATRICK?

- 4
- 5
- 6
- 7

9. HOW MANY MORE MINUTES CAN YOU SPEND IN SUN WITHSPF 30 IF YOUR SKIN GETS SUNBURN AFTER 1 MIN WITHOUT SPF?

- 5

- 10
- 15
- 30

10. WHICH OF FOLLOWING COUNTRIES HAS THE HIGHESTRATE OF SKIN CANCERS CASES PER CAPITA?

- Egypt
- New Zealand
- Japan
- Kenya

Annex 3. Quiz with answers

UV INDEX – CLOSER LOOK FROM EARTH

QUIZ

1. HOW DOES THE SUN CREATE ENERGY?

- **By nuclear fusion**
- By nuclear decay
- from stars
- from void

2. WHICH TYPEOF UV RADIATION ALMOST ENTIRELYREACHES THE EARTH'S SURFACE??

- UVC
- UVB
- **UVA**

3. WHAT IS THE NAME OF TIME WHEN SUN PEAK IN THE SKY?

- sunrise
- sunset
- **solar noon**
- solar max

4. WHAT IS CRUCIAL FOR SUN'S ANGLE ON EARTH?

- **latitude**
- longitude
- altitude

5. HOW DOES ALTITUDE CHANGE UV RADIATION?

- **increase**
- decrease

6. HOW DO WE CALL UNIT THAT MEASURES OZONECONCEN-TRATION?

- uvi
- **Dobson unit**
- Pascal uit
- SPF

7. WHAT IS THE SAFE RANGE OF UV?

- 1
- **1-2**
- 1-3
- 1-4

8. HOW MANY TYPES OF SKIN WERE PROPOSED BY THOMAS B. FITZPATRICK?

- 4
- 5
- **6**
- 7

9. HOW MANY MORE MINUTES CAN YOU SPEND IN SUN WITHSPF 30 IF YOUR SKIN GETS SUNBURN AFTER 1 MIN WITHOUT SPF?

- 5
- 10
- 15
- **30**

10. WHICH OF FOLLOWING COUNTRIES HAS THE HIGHESTRATE OF SKIN CANCERS CASES PER CAPITA?

- Egypt
- **New Zealand**
- Japan
- Kenya

License

About the BRITEC project

BRITEC – Bringing Research into the Classroom project (https://britec.igf.edu.pl/) aims to introduce the Citizen Science (CS) approach in schools as a way of engaging pupils in research practices. This project has been funded with support from the European Commission within ERASMUS+ Programme and is coordinated by the Institute of Geophysics, Polish Academy of Sciences.

SPAIN

BRITEC – Bringing Research Into the Classroom

Learning Scenario 1

1. Title

Are hand-made traps to trap sand flies so effective as commercial ones?

Author(s)

Rosa Gálvez (main researcher), Beatriz Bravo (researcher), Rosa Martín (teacher), Noelia Sánchez (teacher), Inés Rodríguez (research assistant) and María Clemente (supervisor of BRITEC in UAM)

Area of research

Entomology (Biology)

Subject(s)

Natural Science

Arts

Maths

Topic

Vector borne diseases related with environmental health

Age of students

12-13 years old

2. Introduction

Contribution of the CS project to Science in general

The aim of the present project is to involve students in Citizen Science in and around the classroom to study effectiveness of phlebotomine sandflies light traps. In order to achieve this goal, students are required to:

- Get information about flying insects which transmit leishmaniosis, a very important topic regarding canine and human health in Madrid region
- Analyse effectiveness of hand-made and commercial light traps based on real data collected by researchers
- Draw appropriate conclusions to explain the results obtained

Aim of the activities plan and learning objectives

The activities planned will include the following competences: Linguistic communication, Mathematical and basic competences in Science and Technology, Digital competence and Learning to learn. Moreover, the goals will be achieved through different subjects:

NATURAL SCIENCE:

- **Human being and health**
- **Living organisms**
    a. Classification of living organisms
        i. Know kingdom classification of plants and animals, identifying their general characteristics
    b. The animal kingdom
        i. Identify the characteristics by which animals are distinguish from other living organisms.
        ii. Identify the characteristics by which vertebrate animals are distinguished from invertebrate animals.
        iii. Know and distinguish different types of animals
    c. Scientific methodology. Skills, abilities and strategies.
- **Matter and energy. Technology, objects and machines**
    a. Use word processing to carry out written work
    b. Knows and applies access and work strategies on the Internet
    c. Do a responsible use of ICT information sources.
- **Biodiversity on the Earth**

- **The ecosystems**
- **Research project**

- **ARTS**:

- **Photograph, poster, comic and animated cinema**
  - Approach reading, analysis and interpretation of art, as well as, fix and in movement images, in their cultural and historical contexts, understanding critically their meaning and social purpose, being able to make new images from the knowledge acquired.
    - Make posters including information considering concepts such as size, harmony or colour, and using texts and the most convenient typography

- **MATHS**:

- **Statistics and probability**
  - Realization of tables and interpretation of simple graphs
    - Use templates to collect data and analyse them
    - Make and complete simple tables to collect data
    - Understand simple graphs (pictograms and bar graphs)

Summary of activities

Number of activity	Name of activity
1	Initial questionnaire
2	Watching of an explanatory video about the scientific topic
3	Discussion. Answer the questions of edpuzzle
4	Talk by Rosa Gálvez (researcher visit to school)
5	Make a Poster: What do you know about phlebotomine sand flies and how could we study them?
***6**	Construction of our own light trap
***7**	Capture phlebotomine sand flies in the playground of the school
8	Presentation of the researcher notebook
9	Answer the questions included in the researcher notebook
10	Final questionnaire

***Due to the COVID-19 restrictions these activities could not be implemented**

3. Detailed description of each activity

Activity 1 [1]: Initial questionnaire

First Part: Aim of the activity

Students will fill in an initial questionnaire to find out what do they know about the scientific topic which will be addressed.

Second Part: Suggested procedure

Preparation time	1 day
Teaching time	45 minutes
Offline teaching material	Copies of the initial questionnaire (go to annex 1)
*** Guidance for teachers**	Constructivism takes into account students´ prior conceptions to conduct a proper teaching process adapted to its initial assumptions.

Third Part: Advice on methodology

Individual activity, it could be done in class or at home.

[1] Osborne, R. J., Bell, B. F. i Gilbert, J. K. (1983). Science teaching and children's views of the world. *European Journal of Science Education, 5*(1), 1-14

Activity 2: Watching of an explanatory video about the scientific topic

First Part: Aim of the activity

Watch a video about Leishmaniosis outbreak in Madrid, so students will get a general understanding of the research problem that took place in Bosque Sur and the risk that it supposes in the Autonomous Community of Madrid.

Second Part: Suggested procedure

Preparation time	1 day
Teaching time	45 minutes
Online teaching material	Video about Bosque Sur and phlebotomine sandflies https://www.youtube.com/watch?v=zFNNAKtEPUU&t=2s
*** Guidance for teachers**	Leishmaniosis has been in the spotlight since 2009, when the largest human leishmaniosis outbreak in Europe affected the south-west area of the Madrid region. Moreover, Madrid region has been traditionally considered endemic for canine leishmaniosis. Hence, the control of leishmaniosis needs to be based on an in-depth knowledge and understanding of the biology of sandflies.

Third Part: Advice on methodology

Try to use a popular science video which does not include many technical concepts.

Fourth Part: Educational analysis

Visual Search & Learning: images and multimedia are more powerful than verbal stimuli.[2]

[2] Pintó, R., Couso, D.; Hernández, M. I. (2010). An Inquiry-oriented approach for making the best use of ICT in the classroom. *eLearning Papers, 20*.

Activity 3: Discussion. Answer the questions of edpuzzle

First Part: Aim of the activity

After the video, all the aspects shown will be discussed. Then, students will answer an edpuzzle survey.

Second Part: Suggested procedure

Preparation time	1 day
Teaching time	45 minutes
Online teaching material	Edpuzzle survey https://edpuzzle.com/media/5f947cc52fdaaf40ebdba830
*** Guidance for teachers**	Edpuzzle is an app which let you make interactive surveys for students. We will use it to know what students have understood after watching the previous video.

Third Part: Advice on methodology

It's convenient to guarantee that students have paid attention to the video information and have been able to understand it. Henceforth, that's why we will use Edpuzzle survey.

Fourth Part: Educational analysis

Visual Search & Learning**Błąd! Nie zdefiniowano zakładki.**

Activity 4: Talk by Rosa Gálvez (researcher visit to school)

First Part: Aim of the activity

A researcher specialised in this topic will come to class to give a lecture about the biology of phlebotomine sand flies and its relevance in animal and public health. The contents will be in accordance with the curriculum of the educational level considered. A powerpoint presentation would be convenient to be used for this lesson; the ppt file is below. Then, a commercial phlebotomine sand fly light trap could be shown to students and its functioning could be explained.

Second Part: Suggested procedure

Preparation time	1 day
Teaching time	45 minutes
Online teaching material	Powerpoint presentation https://dauam-my.sharepoint.com/:p:/g/personal/rosa_galvez_uam_es/ESYyFzA53y5AiNW8SKAV5g0BcGDXzfuhsoxhR34FflHOYA?e=v8x8Jj Video about the field work carried out by an entomologist using light traps https://youtu.be/PEXr2-o4t74 Video about adults phlebotomine sand flies in the lab https://www.youtube.com/watch?v=NoJ4m0SqP_c
Citizen science purpose of the activity (if any) *	Understand and recognize the morphology of phlebotomine sand flies and their impact to animal and public health[3]

Third Part: Advice on methodology

It should be great to encourage students to participate during the activity asking questions to the researcher

3 Killick-Kendrick, R. (1999). The biology and control of phlebotomine sand flies. *Clinics in Dermatology, 17*(3), 279-289.

Fourth Part: Educational analysis

Visual Search & Learning: images and multimedia are more powerful than verbal stimuli. **Błąd! Nie zdefiniowano zakładki.**

Activity 5: Make a Poster: What do you know about phlebotomine sand flies and how could we study them?

First Part: Aim of the activity

Students will make a poster (using a poster board or any computer program such as https://www.genial.ly/es or http://edu.glogster.com/) showing what do they know about phlebotomine sand flies.

Second Part: Suggested procedure

Preparation time	1 day
Teaching time	45 minutes
Online teaching material	https://www.genial.ly/es http://edu.glogster.com/
Offline teaching material	Paper, glue, poster boards, scissors, felt-tip pens, ruler, etc.
*** Guidance for teachers**	Additional material for teachers will be given so that they know which concepts should be included in the poster

Third Part: Advice on methodology

Try to motivate students. In our case, we will use a gamification technique. After making the poster, students were rewarded with an entomologist card (go to annex 2)

Fourth Part: Educational analysis

Vocational Education: An increased focus on vocational (not academic) skills in the curriculum.

Game Based Learning & Gamification: learning is mixed with games or with game

mechanisms[4]

Activity 6: Construction of our own light trap

First Part: Aim of the activity

Students will make their own trap with material we will provide them by using our own protocol.

Second Part: Suggested procedure

Preparation time	1 day
Teaching time	45 minutes
Offline teaching material	The materials needed to make the plastic trap are: a one liter plastic bottle, a piece of plastic net, recycled fan of a desktop computer, two nylon flanges, power supply of a small home appliance such as a handheld vacuum or a printer, a piece of perforated pcb board, 2 pin plug-in screw terminal block connector, a white LED lamp, hot melt glue and a rope. The materials needed to make the mesh collection bag are: a piece of wire, adhesive tape, hot melt glue, a sheet of wedding weil, a rubber band.
Citizen science purpose of the activity (if any) *	Making the apparatus needed to solve the scientific question
***Guidance for teachers**	Each teacher will have a ready-made trap to capture sandflies and show their operation to their students. The prototype has been already designed as a citizen science small project in Medialab Prado for BRITEC

Third Part: Advice on methodology

Due to COVID-19 restrictions this experimental activity could not be carried out.

Fourth Part: Educational analysis

Project-Based Learning
Collaborative Learning

[4]Khan, A. A., & Malik, M. (2017). Use of digital game based learning and gamification in secondary school science: The effect on student engagement, learning and gender difference. *Education and Information Technologies* , 2767-2804.

Activity 7: Capture phlebotomine sand flies in the playground of the school

First Part: Aim of the activity

Students will capture phlebotomine sand flies. Therefore, pupils will choose several places around the school to collect sandflies. Sand flies present nocturnal activity so traps will be placed late afternoon and recovered early morning next day.

Second Part: Suggested procedure

Preparation time	1 day
Teaching time	45 minutes
Offline teaching material	Hand-made light traps and commercial light traps to use them as control
Citizen science purpose of the activity (if any) *	Capture phlebotomine sand flies with our hand-made light trap in order to get results for further analysis
***Guidance for teachers**	Adequate location of light traps is important and best catches are made where cover is good and the humidity is relatively high. School garden surrounding area could be a good place.

Third Part: Advice on methodology

It is important not to put traps if there are signs of rain because adult sandflies will not leave their rest places to bite. Traps should be suspended 1 to 1.5 m above the ground and far away from other sources of artificial light or sites exposed to strong winds. A single trap usually reflects sandfly flight activity within a buffer of 250-500 meters of its location.

Fourth Part: Educational analysis

Project-Based Learning

[5] Freedman, M. P. (1997). Relationship among laboratory instruction, attitude toward science, and achievement in science knowledge. *Journal of Research on Science Teaching, 34*(4), 343-357

Activity 8: Presentation of the researcher notebook

First Part: Aim of the activity

Research was modified due to the COVID-19 restrictions, that's why students were provided with real data collected by researchers which was included in a ***Researcher Notebook***. In this activity, we will explain what is included in this notebook and how it is going to be used.

Second Part: Suggested procedure

Preparation time	1 day
Teaching time	45 minutes
Offline teaching material	***Researcher Notebook***
Citizen science purpose of the activity (if any) *	Non-analyzed data collected by researchers necessary to answer the scientific question

Third Part: Advice on methodology

Make sure that students know the importance of the data collected and how it has to be analysed in order to draw proper conclusions

Fourth Part: Educational analysis

Project-Based Learning[6]

STEM Learning**Błąd! Nie zdefiniowano zakładki.**

[6] Blumenfeld, P., Soloway, E., Marx, R., Krajcik, J., Guzdial, M. i Palincsar, A. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning. *Educational Psychologist, 26*(3&4), 369-398.

Activity 9: Answer the questions included in the researcher notebook

First Part: Aim of the activity

Students will answer the questions included in the ***Researcher Notebook***

Second Part: Suggested procedure

Preparation time	1 day
Teaching time	45 minutes
Offline teaching material	***Researcher Notebook***
Citizen science purpose of the activity (if any) *	Calculations and interpretation of results of the project
***Guidance for teachers**	This activity is more focused on maths than biology

Third Part: Advice on methodology

Students should do a statistical analysis in the most precise way

Fourth Part: Educational analysis

Project-Based Learning**Błąd! Nie zdefiniowano zakładki.**

Collaborative Learning

STEM Learning**Błąd! Nie zdefiniowano zakładki.**

Activity 10 [7]: Final questionnaire

First Part: Aim of the activity

Students will fill in a final questionnaire to know what they have learnt after doing the project. Moreover, students will draw their own conclusions after analysing real data.

Second Part: Suggested procedure

Preparation time	1 day
Teaching time	45 minutes
Offline teaching material	Final questionnaire
***Guidance for teachers**	Assist students if they get stuck at any step.

Third Part: Advice on methodology

Individual activity, it could be done in class or at home.

[7] Angelo, T. A., & Cross, K. P. (1993). *Classroom assessment techniques: A handbook for college teachers.* San Francisco: Jossey-Bass.

4. Assessment after implementation of the activities plan

Student´s learning

The Activity 10 is the method used to assess the learning process of students after the implementation of this Learning Scenario. Students must fill in a questionnaire (individually) about the contents addressed during the project in order to know what they have learnt.

Citizen Science experience

The main problem in FLEBOCOLLECT project was to implement it without any experimental activity. Henceforth, the implementation was not as enriching and interesting as it was planned to be, because all the field work had to be suppressed due to the COVID-19 pandemic. Furthermore, the contents addressed were not in accordance with the curriculum. Consequently, an activity plan could not be followed due to the incongruency with the curriculum and the restrictions of the COVID-19 pandemic. Apart from this, all the activities carried out made students being interested in a scientific problem close to their environment.

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Killick-Kendrick, R. (1999). The biology and control of phlebotomine sand flies. *Clinics in Dermatology, 17*(3), 279-289.

Osborne, R. J., Bell, B. F., & Gilbert, J. K. (1983). Science teaching and children's views of the world. *Journal of Science Education, 5*(1), 1-14.

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6. Annexes

Annex 1: Initial questionnaire

Flebocollect Project: SOS stop leishmaniasis **INITIAL QUESTIONNAIRE**

Name: **Class:**

Flebocollect Project: SOS stop leishmaniasis: INITIAL QUESTIONNAIRE

1.- Find in the following word search THREE alterations of the environment caused by human beings.

I	H	U	R	B	A	N	I	Z	A	C	I	Ó	N
B	J	N	H	O	X	F	U	X	G	P	K	O	P
W	O	I	H	A	J	B	W	F	T	H	C	M	Q
I	T	H	H	B	C	C	E	H	H	P	F	W	X
V	X	V	R	R	S	A	D	A	B	K	F	I	P
E	P	Y	S	S	F	I	N	L	K	W	J	P	T
F	Q	R	P	B	A	C	F	F	Z	X	D	R	M
Z	C	O	N	T	A	M	I	N	A	C	I	Ó	N
G	R	Z	V	O	N	U	W	I	H	S	J	M	Z
D	E	F	O	R	E	S	T	A	C	I	Ó	N	N
L	I	N	M	H	V	K	U	D	M	B	V	C	T
L	G	K	S	V	W	O	D	E	V	H	O	S	L
I	Y	G	T	L	S	E	E	U	D	M	B	A	T
C	P	Y	T	Z	X	U	P	B	D	J	V	J	X

Indicate if the next sentence is true or false:

2.- “The alteration of the environment due to human beings could cause the outbreak of new illnesses”

T / F

If you have said that the previous sentence is true, would you be able to give an example?

3.- Do you know that mosquitoes could transmit illnesses to us? (do a circle to indicate your answer) Yes / NO

If you have said yes, do you know any illness transmitted by mosquitoes?

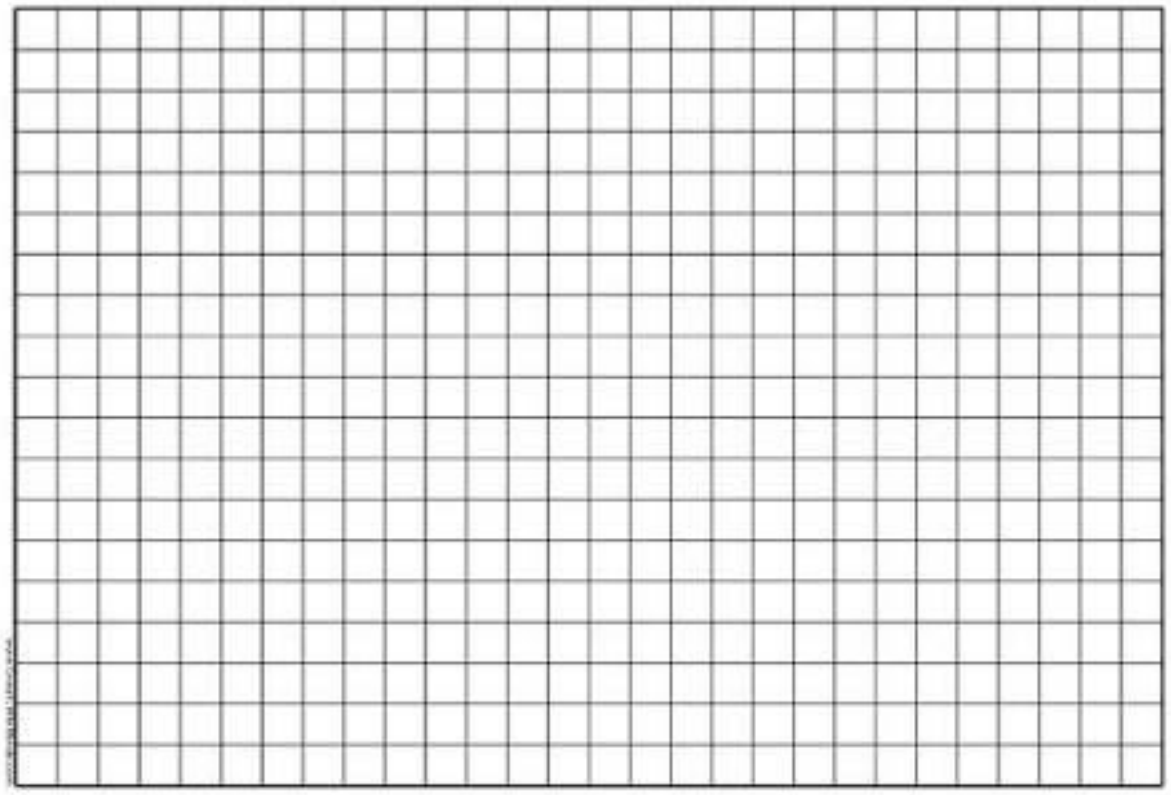
4.- Have you heard something about leishmaniasis before? (do a circle to indicate your answer)

Yes / No

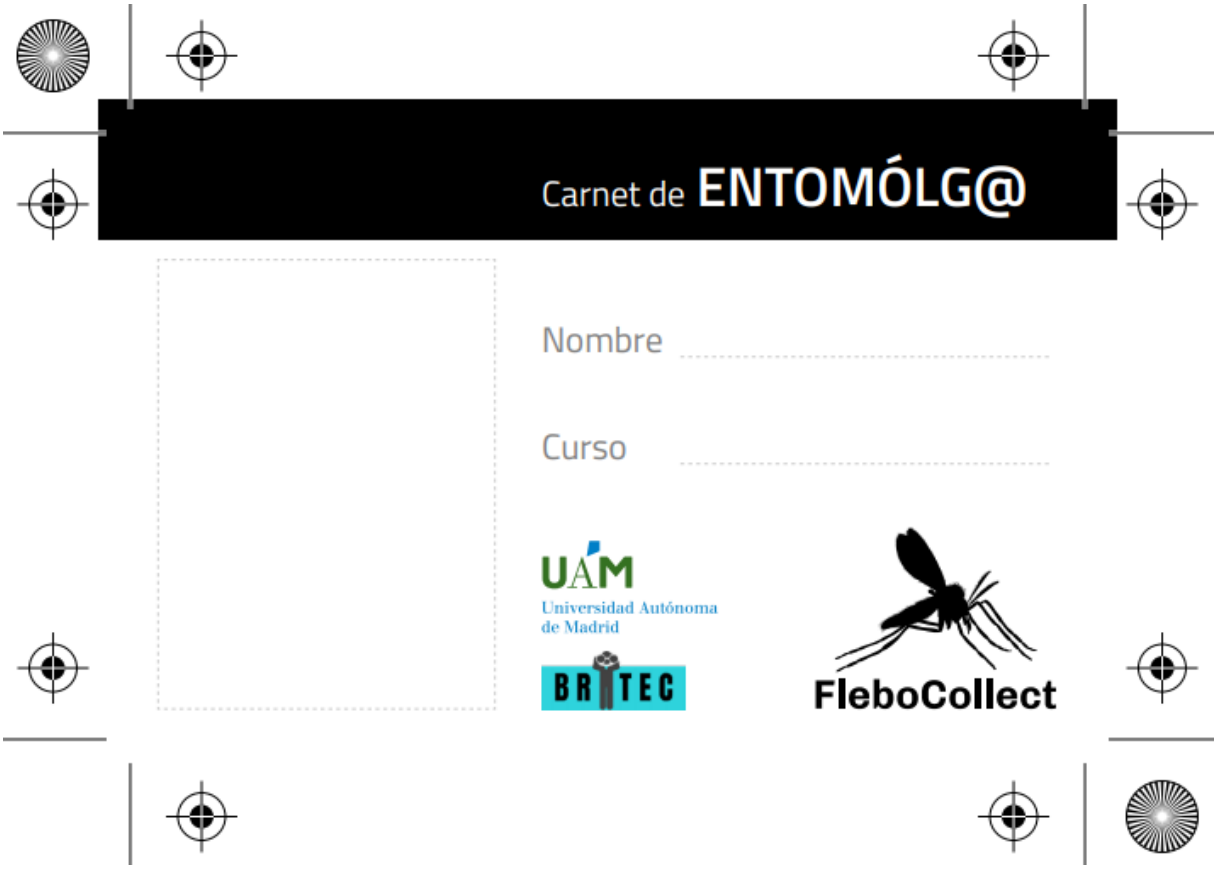
If you have said yes, could you describe to what does it sounds to you?

5.- Some researchers are capturing mosquitoes in three different towns of the Autonomous Community of Madrid. Represent, doing a bar graph, the number of mosquitoes captured in each town based on the data showed in the following chart (there's a graph paper which you can use to help you):

Town	Number of mosquitoes
Fuenlabrada	**14**
San Agustín de Guadalix	**4**
Majadahonda	**9**

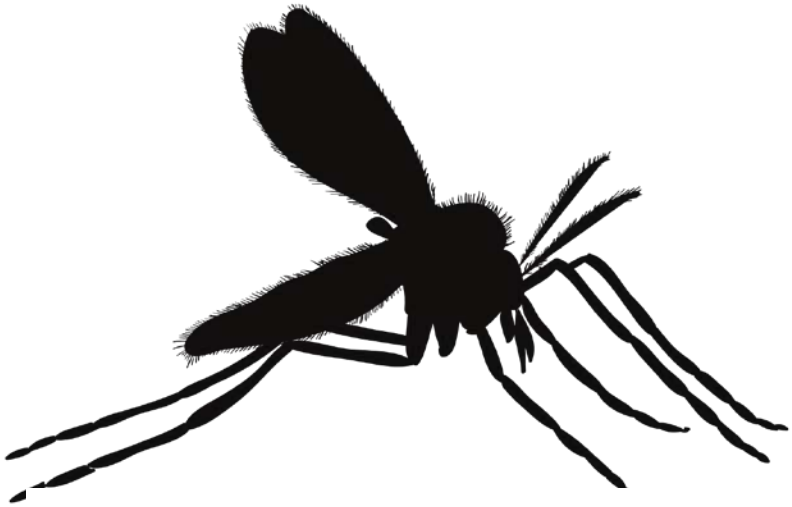


Annex 2: Entomologist card



Annex 3: Researcher Notebook

FleboCollect



RESEARCHER NOTEBOOK

2020/2021

BRITEC

LET'S DO SOME RESEARCH…

INTRODUCTION TO SCIENTIFIC ACTIVITY

Congratulations! You have achieved your entomologist card and you already are recognised entomologists.

The Autonomous Community of Madrid needs light traps to capture phlebotomine sand flies but they are too expensive, so it was decided to design new ones with recycled materials… but researchers do not have enough time to test them.

Can you help us? How can we prove the effectiveness of these hand-made traps?

What is the difference between the number of phlebotomine sand flies captured by the hand-made light trap and the commercial one?

Data:

Researchers went sample the 29th of July 2020. They putt raps at 8.00 pm and were collected the next day at 8.00 am. They put 3 commercial traps and 4 hand-made traps.

	COMMERCIAL TRAP	HAND-MADE TRAP
IMAGE		
CODES	C1 C2	H1 H2

	C3 …	H3 …
COLOUR OF THE LIGHT	Yellow	White
POWER OF THE FAN	1x	2x

We provide you with the images that researchers have observed through the microscope.

Identify the phlebotomine sand flies which have been captured in each trap and if they are male or female. Fill in the following charts.

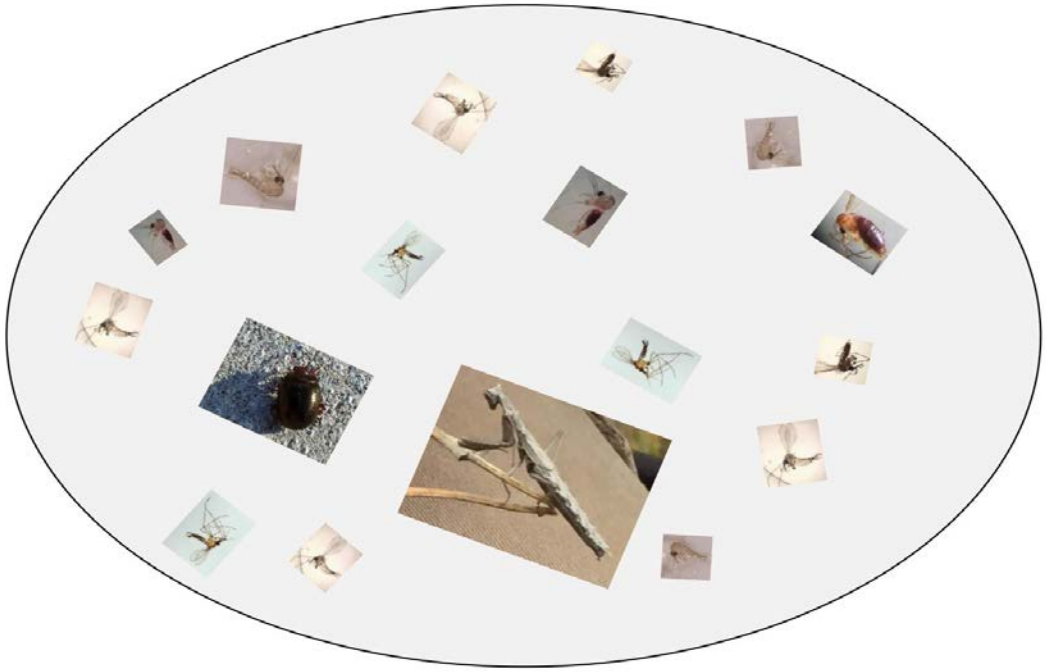


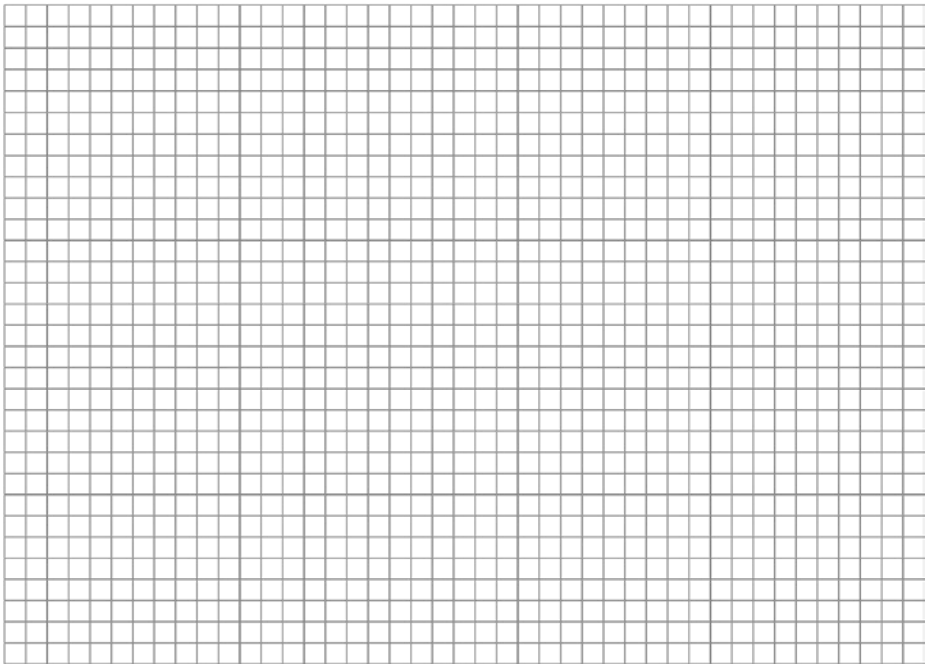
Figure 1. Examples of captures made by a sand fly phlebotomine light trap

Make your own charts to show the number of male and female phlebotomine sandflies captured by each trap:

Commercial trap code	Number of male phlebotomine sandflies	Number of female phlebotomine sandflies	Total phlebotomine sandflies
C1			
C2			
C3			
…			
Total			

Hand-made trap code	Number of male phlebotomine sandflies	Number of female phlebotomine sandflies	Total phlebotomine sandflies
H1			
H2			
H3			
…			
Total			

Make a graph which helps you to know which light trap is more effective.



Conclude based on the results obtained:

Annex 4: Final questionnaire

Name: **Class:**

Proyecto Flebocollect: SOS stop leishmaniosis: FINAL QUESTIONNAIRE

Once you have participated in this project, you are ready to answer the following questions:

1.- What is leishmaniasis and who it affects?

2.- How is leishmaniasis transmitted?

3.- When is produced an outbreak of an illness?

- ☐ when the cases of an illness suddenly grow in a certain place
- ☐ when an illness is characteristic of a certain place

4.- Where was there an outbreak of leishmaniasis in late 2009?

5.- What human modification of the environment caused an increase in human cases of leishmaniasis?

6.- Which reservoir played a key role in this outbreak of human leishmaniasis?

- ☐ the rabbit
- ☐ the dog

7.- What is a phlebotomine sandfly?

8.- When a phlebotomine sandfly can bite me and transmit leishmaniasis?

- ☐ at any time of the year
- ☐ only when adult phlebotomine sandflies are present, from May to October

9.- Did you enjoy participating in this project? How would you rate the project from 1 to 10?

10.- Point out what you have learned by participating in this project that you did not know before.

´

11.- Draw an adult female phlebotomine sandfly highlighting its characteristics and pointing out the parts that you remember.

License

About the BRITEC project

BRITEC – Bringing Research into the Classroom project (https://britec.igf.edu.pl/) aims to introduce the Citizen Science (CS) approach in schools as a way of engaging pupils in research practices. This project has been funded with support from the European Commission within ERASMUS+ Programme and is coordinated by the Institute of Geophysics, Polish Academy of Sciences.

SPAIN

BRITEC – Bringing Research Into the Classroom

Learning Scenario 2

1. Title

How can we teach a computer to classify microscopy images of tumoral cells?

Author(s)

Noelia Sánchez (teacher), Adrián Gollerizo (teacher), Marta Balbás (teacher), Roger Pou (researcher), José Manuel Pérez (researcher), and Jesús Clemente-Gallardo (main researcher, University of Zaragoza and Ibercivis)

Area of research

Cellular Biology and Computer Science

Subject(s)

Biology

ICT

Maths

Physics

Topic

Cellular structure, Cellular death mechanisms, Machine learning

Age of students

14-18 years old

2. Introduction

Contribution of the CS project to Science in general

The aim of the present project is to involve students in Citizen Science in and around the classroom to study effectiveness of using analysis of microscopy images of tumoral cells done by students, to train a machine learning platform to do the analysis autonomously.

In order to achieve this goal, students will do the following:

- Get information about cell structure and the different mechanisms of cellular death.

- Perform the analysis of a set of microscopy images in the platform cellspotting

http://pybossa.socientize.eu/pybossa/app/cellspotting/

- From the resulting database, ML platform will be trained.

Aim of the activities plan and learning objectives

The aforementioned goals will be achieved through different subjects:

BIOLOGY:

The cell

- Cellular structure: the parts of the cell (complete)
- The cell life cycle. Cellular death (complete)
  - Apoptosis
  - Necrosis

ICT:

- Algorithms
  - Use of libraries in programming
  - Introduction to Machine Learning

MATHS: (to average the answers of different students on the same picture)

- Geometry and distance
- Statistics: averages

PHYSICS:(to estimate the error we can produce when selecting a wrong middle point for the cell)

Error analysis

Summary of activities

Number of activity	Name of activity
1	Talk by an expert
2	Presentation by the teacher
3	Introduction to the platform
4	Analysis of the images
5	Evaluation
6	Talk by an expert

3. Detailed description of each activity

Activity 1: Talk by an expert

First Part: Aim of the activity

Main researchers of the project will give students a talk, explaining and describing the most important contents which will be addressed during the implementation of the pilot. During this session, concepts such as cell biology and machine learning will be explained. Moreover, researchers will explain students which are the main goals of the project and which is their role in the process.

Second Part: Suggested procedure

Preparation time	2 hours
Teaching time	55 minutes (1 session)
Online teaching material	https://view.genial.ly/56c358f31561ec0fe052cd49/interactive-content-cells

Citizen science purpose of the activity (if any) *	To bring students closer to true scientific research and make them understand the purpose of the research project they are going to join
***Guidance for teachers**	Teachers need to make sure students are acquainted with basic keywords: cell death; tumor; cancer; cell cycle; machine learning. It is a good idea to start reviewing cell theory, basic structures, ..

Third Part: Advice on methodology

Try not to give a long talk to avoid students being distracted. In addition, this talk should include simple explanations of the technical concepts addressed, to assure younger students understand them.

Fourth Part: Educational analysis

Visual Search & Learning: images and multimedia are more powerful than verbal stimuli.[8]

Activity 2: Presentation by the teacher

First Part: Aim of the activity

With regards to Biology lessons, this activity consists in introducing students to the concept of cellular death and the biological meaning of each cellular death type, thus their characteristics and differences will be explained. Consequently, this activity aims to provide the necessary background on the biological content for the students to be able to follow the experiment.

Concerning ICT lessons, in previous classes, students will be introduced to programming languages and they will learn basic concepts of Python programming. After that, they will be introduced to machine learning: what it is, what programming languages and what it is used for. The purpose of this introduction to programming and ML is to provide students with the background for understanding the implications of the experiment.

[8] Pintó, R., Couso, D.; Hernández, M. I. (2010). An Inquiry-oriented approach for making the best use of ICT in the classroom. *eLearning Papers, 20*.

Second Part: Suggested procedure

Preparation time	3 hours
Teaching time	55 minutes (1 session)
Online teaching material	Genial.ly presentation: https://view.genial.ly/5fa1be365ef4550d7bcc02cf
Offline teaching material	Same presentation
Citizen science purpose of the activity (if any) *	To understand apoptosis and necrosis processes. To associate apoptosis with cellular and tissular growth and renewal. To become aware of the main morphological features in both types of cellular death. The use of real images will allow the construction of more realistic cellular models.
***Guidance for teachers**	Provide the necessary background on the biological content for the students to be able to follow the experiment.

Third Part: Advice on methodology

Be visual, use different kinds of microscopy images for showing regular cells and their structures and main organelles. Diagrams and charts are ideal for explaining two types of death processes and their differences.

Regarding the basic programming and ML concepts, the main suggestion is to keep explanations clear and easy to understand. The goal of this introduction is that our students understand the basic structure of ML programs and what they are used for. We do not intend them to fully understand the ML platform lying beyond Cellspotting, just its basic working procedure.

Fourth Part: Educational analysis

Visual Search & Learning: images and multimedia are more powerful than verbal stimuli.[1]

Activity 3: Introduction to the platform

First Part: Aim of the activity

In this activity the teacher will train students to perform the analysis of microscope images in the platform.

Second Part: Suggested procedure

Preparation time	1 hour
Teaching time	30 minutes
Online teaching material	Cellspotting platform: http://pybossa.socientize.eu/pybossa/app/cellspotting/
Offline teaching material	None
Citizen science purpose of the activity (if any) *	To discriminate between apoptotic and necrotic cells using fluorescent microscopy images. To connect theory topics with current research advances. To bring students closer to true scientific research. The use of real images will allow the construction of more realistic cellular models. To encourage scientific careers.
***Guidance for teachers**	Show them how to manage the platform, basic areas and information to take into account.

Third Part: Advice on methodology

Teachers should share first platform images (2-3 pics) and make students work all together with teachers guidance. First day, encourage students to share their questions and doubts. After 15 minutes let students work individually and ask questions one by one to point out possible mistakes and tricky images.

Fourth Part: Educational analysis

Visual Search & Learning[1]

STEM Learning[9]

Project-Based Learning

[9] Freedman, M. P. (1997). Relationship among laboratory instruction, attitude toward science, and achievement in science knowledge. *Journal of Research on Science Teaching, 34*(4), 343-357

Activity 4: Analysis of the images

First Part: Aim of the activity

This activity consists of monitoring students' work on the platform. In this way, we will not only know which could be the possible difficulties students have to face, but also have the opportunity to solve any doubts about how the platform works so that they could continue later from home.

Second Part: Suggested procedure

Preparation time	1 hour
Teaching time	4 and a half sessions
Online teaching material	Cellspotting platform: http://pybossa.socientize.eu/pybossa/app/cellspotting/
Offline teaching material	None
Citizen science purpose of the activity (if any) *	Involve citizens in cancer research through analysing real microscopy images of cells treated with different drugs. The use of real images will allow the construction of more realistic cellular models.
***Guidance for teachers**	Let students work independently, be around in case they need your help.

Third Part: Advice on methodology

Just make sure they don’t have issues with the images and ask them questions from time to time.

Fourth Part: Educational analysis

Visual Search & Learning: images and multimedia are more powerful than verbal stimuli[1]

Activity 5 [10] : Evaluation

First Part: Aim of the activity

Students go to a survey for assessing the project and their self performance.

Second Part: Suggested procedure

Preparation time	1 hour
Teaching time	15 minutes
Online teaching material	
Offline teaching material	Final questionnaire
Citizen science purpose of the activity (if any) *	
***Guidance for teachers**	Assist students if they get stuck at any step.

Third Part: Advice on methodology

Individual activity, it could be done in class or at home. Nonetheless, in all cases it was carried out in class.

[10] Angelo, T. A., & Cross, K. P. (1993). *Classroom assessment techniques: A handbook for college teachers.* San Francisco: Jossey Bass.

Activity 6: Talk by an expert

First Part: Aim of the activity

The researcher will present the results from the machine learning platform, explaining it with graphical tools, as the set of evaluated pictures or the plots describing the increase of efficiency in recognition during the learning process.

Second Part: Suggested procedure

Preparation time	1 hour
Teaching time	55 min
Online teaching material	Powerpoint presentation
Offline teaching material	None
Citizen science purpose of the activity (if any) *	To present students the result of the project and how their efforts have contributed to obtain a successful result. Also, the possible future extensions of the idea.
***Guidance for teachers**	Encourage students to share their ideas, questions and suggestions.

Third Part: Advice on methodology

Try not to give a long talk to avoid students being distracted. In addition, this talk should include simple explanations of the technical concepts addressed, to assure younger students understand them.
Involve students in the talk: ask them about their experience participating in the project and using the platform. Make them see the importance of their contribution not only to the project but also to science and society.

Fourth Part: Educational analysis

Visual Search & Learning: images and multimedia are more powerful than verbal stimuli.[1]

4. Assessment after implementation of the activities plan

Student´s learning

The Activity 5 is the method used to assess the learning process of students after the implementation of this Learning Scenario. Students have to fill in a questionnaire (individually) about the contents addressed during the project in order to know what they have learnt and giving their opinion assessing the project itself.

Citizen Science experience

The main challenge was to make students be constantly focused in a repetitive activity for a relatively long period of time without getting a mark. Students began to feel tired and not conscious of the relevance of the pilot project. Moreover, the implementation took part before Christmas, which was not an ideal time of the academic year to do it. Maybe these challenges could have been prevented if teachers have seen the platform before the implementation. Besides, a tutorial could have also been useful to avoid losing time in class finding out how the platform works. On top of that, the presentation given to younger students was very long, so it would be interesting to summarize it for them.
In addition, contact with other teachers could be beneficial as advantages, disadvantages, advices and doubts could have been shared during the implementation.

5. Bibliography

Angelo, T., & Cross, K. P. (1993). Classroom assessment techniques: A handbook for college teachers.

Freedman, M. P. (1997). Relationship among laboratory instruction, attitude toward science, and achievement in science knowledge. *Journal of Research on Science Teaching, 34*(4), 343-357.

Pintó, R., Couso, D., & Hernández, M. I. (2010). An Inquiry-oriented approach for making the best use of ICT in the classroom. *eLearning Papers* (20).

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About the BRITEC project

BRITEC – Bringing Research into the Classroom project (https://britec.igf.edu.pl/) aims to introduce the Citizen Science (CS) approach in schools as a way of engaging pupils in research practices. This project has been funded with support from the European Commission within ERASMUS+ Programme and is coordinated by the Institute of Geophysics, Polish Academy of Sciences.

5. Annexes

Annex 1: Learning Scenario template

BRITEC – Bringing Research Into the Classroom

Learning Scenario template

1. Title

Give your BRITEC activities plan a title

Author(s)

List all the people involved in designing the activities plan, researcher(s) and teacher(s).

Area of research

What area of research is activity plan scenario addressing?

Subject(s)

List all the subjects that the activities plan is intended for. If this is an interdisciplinary approach, list multiple subjects.

Topic

Add here a topic that the learning scenario addresses. For example, if this scenario is intended for a Biology lesson, the topic could be waste management and recycling.

Age of students

2. Introduction

Contribution of the CS project to Science in general

Summary and main goals of the project carried out by students

Aim of the activities plan and learning objectives

Explanation about how the previous goals might be related to the contents which are going to be studied by students in any case, taking curriculum into account or not (if an extracurricular way of working is used).

***Content blocks** and, specially, **specific skills** which students are going to acquire during the implementation of the project, should be highlighted in this section.*

Summary of activities

List all the activities included in the activities plan

Number of activity	Name of activity

3. Detailed description of each activity (to be completed as many times as activities are implemented)

First Part: Aim of the activity

Describe briefly (one or two paragraphs) what the activity consists of and what the students try to learn and to reach in order to achieve the CS project goals.

Second Part: Suggested procedure

Describe in detail the activity, mentioning the materials needed by pupils, as well as the questions or guidelines required for collecting data

Preparation time	
Teaching time	
Online teaching material	*List here all the links of online tools, applications and support documents that you will use during your activities such as: Padlet, Kahoot, etc.*
Offline teaching material	*List here all the offline tools, such as: paper, glue, etc.*
Citizen science purpose of the activity (if any) *	*Outline questions or guidelines required for collecting data*
*** Guidance for teachers**	*Add some kind of guidance for teachers about why it is important to address those questions and collect those data.*

Third Part: Advice on methodology

Add two more paragraphs making suggestions and giving advice to teachers, if possible, about how the activity could be run in the classroom

Fourth Part: Educational analysis

Here you can find a list of educational trends: http://www.allourideas.org/trendiez/results

Which trends are incorporated in the learning scenario of this activity in your opinion?

4. Assessment after implementation of the activities plan

Student´s learning

*Describe here the assessment method of the lesson, if any. For example, if you plan on assessing your students with a **quiz**, include here questions and answer options with color-coding the correct answers.*

*Pupils could also **make a report** and be evaluated by it according to several aspects included in a rubric (explanatory note). Include here guidelines to make this explanatory note.*

Citizen Science experience

Describe here problems or difficulties students may have faced, in order to let other teachers know in advance how to act in these situations.

5. Bibliography

6. Annexes

Any document needed for the development of the activity.

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Online: https://britec.igf.edu.pl/

Social: #BRITECproject

The work presented in this document is supported by the European Commission's Erasmus + programme – project BRITEC, coordinated by the Institute of Geophysics, PAS. The content of the document is the sole responsibility of the organizer and it does not represent the opinion of the European Commission (EC), and the EC is not responsible for any use that might be made of information contained.