

CONNECT

Inclusive open schooling
with engaging and
future-oriented science

GOOD PRACTICES

Description for the site:

Title: Global Warming and Chemical Pollution

This good practice presents an open school education initiative for the co-teaching of pollution in Biology and Chemistry courses within the Horizon 2020 Research and Innovation Program, No 872814, developed at Neas Alikarnassos High School in the 2021-2022 school year by the teachers of Penelope Charalambidou and Giakoumaki Kondylia from (1/2022 to 4/2022). Four scientists participated in the activities: Nikolaos Kalyvitis, who works at the Laboratory of Environmental Chemical Processes of the Department of Chemistry at the University of Crete, responsible for the Research and Innovation Hub of the University of Crete in Foinokalia Lasithi, Michael Fourgiarakis, Msc Biologist and Antoniadis Danai, Marine Biologist who work at ELKETHE and Georgiou Maria, Chemical Engineer Msc who works at the Unified Waste Management Association of Crete (ESDAK). Supported by Toubaniaris Panagiotis, Physicist. This practice was previously presented on the connect platform:

https://connect-eu.exus.co.uk/el/?attachment=79&document_type=folder&download_document_file=1&document_file=79

Care: The students recognized the environmental problems that arise from human-made activities in shaping the climate, and in particular dealt with the factors that cause global warming and chemical pollution. In this phase, parents raised awareness together with their children about climate change, recognized the extent of chemical pollution and chose together the environmental issues that would be interesting to work with. We also created a padlet entitled "You can too to save the planet!" where we invited students to write down their thoughts on climate change or formulate a slogan for the good of the planet. The students who participated in the activities were 23 3rd grade high school students.

Know: The students used knowledge from unvalidated scientific sources for environmental problems and then talked with special experts on chemical pollution of the air, water table, and the surface of the Earth and asked their questions based on the scientific data they presented. The modern teaching approaches that were used for the scenario were: the inquiry learning method that introduces scientific research into school practice, the experiential method, the cooperative teaching and the problem-solving method (Kalathaki, 2015). , discussing claims and evidence, drawing conclusions and composing group assignments.

Do: At the end, students:

- calculated their ecological footprint together with their parents based on a specific questionnaire given to them
- come up with proposals that they believe can reduce their ecological footprint
- chose an environmental problem and did a research paper of their own choice and inspiration.
- created nine climate change awareness posters.
- they made a construction about the importance of recycling.
- created a presentation on acid rain





- created a board game with ecology questions called "The Eco-Snake"
- wrote lyrics to a rap song about the climate
- presented their work in the form of a report to their school for world environment day
- presented their work at the 4th Panhellenic Student Conference CONNECT2022 held online 20 & 21/05/2022

They completed the activities in groups or individually, supported by their teachers and families.

Conclusions on Open Schooling:

The change/innovation was supported by: School management school association/network
 Local government Other: _____

Student results: The students were very satisfied with their participation in the activity, enjoyed the field trips and scientific discussions with the experts, raised awareness around many environmental problems, discussed what they learned from the expert panel at home with their families and took action. They created personal energy saving charts to track how often they managed to reduce their energy use each day for a week and recorded daily activities that had a positive environmental impact. As an example, one student reported "that thanks to this program he learned a lot about climate change, met for the first time up close scientists who deal with environmental issues, and saw that he can make interventions that will lead to a more 'green' future".

This practice contributed to the increase of:

engaging families with sciences involving girls in science raising awareness among students about careers in the natural sciences

Please specify: Parents participated in the collection of questionnaires for the student survey. The girls actively participated in the mapping and literature review and in general all students showed a special interest in digital maps and the contribution of geomorphological terrain to road construction.

Select the most relevant photo related to your initiative (which will be public and published under an open license) to represent the practice.





ABOUT THE CONNECT PARTNER that supported the school

ORGANISATION	Regional Directorate of Primary and Secondary Education of Crete (RDE)
COUNTRY	Greece
Όνομα συνεργάτη	Georgios Panselinas
Implementation period	Starting date: 18/01/2022 Ending date: 20/04/2022

ABOUT THE TEACHERS PARTICIPATED

SCHOOLS	Gymnasium of Nea Alikarnasso
TEACHERS names (for Good Practices' Certificates)	Charalampdou Penelope, Biologist Giakoumaki Kondilia, Chemist
Gender	F
SUBJECT (Natural Sciences, Physics, Chemistry, Biology...)	Chemistry, Biology
How many subjects were used in open schooling?	Chemistry, Biology
Title of open school education resource used	Toumpaniaris, P. (2021) Global (Over)warming and chemical pollution
Type of learning scenario of science activities (structured or open scenario)	Open Scenario
Curriculum modules	The specific scenario was used to teach pollution in the 3rd High School Chemistry and Biology course, but it can also be applied in the context of 2nd High School Geography and in the Skills Workshops in the "Take Care of the Environment" Unit.





ABOUT THE STUDENTS PARTICIPATED	
Class	Third grade (Gymnasium)
Age (average)	15 years old
Number of students participated that concluded the educational scenario	23
Number of students who completed the educational scenario of scientific activities	23
SCIENTISTS PARTICIPATED:	
Name	Nikolaos Kalyvitis, Chemist
Field	PhdChemist, Laboratory of Environmental Chemical Processes, Department of Chemistry, University of Crete Head of the Research and Innovation Hub of the University of Crete in Finokalia Lassithi
Name	Antoniadis Danae
Field	Marine Biologist, Thalassocosmos Aquarium
Name	Michael Fourgalakis
Field	Msc Biologist, Thalassocosmos Aquarium
Name	Georgiou Maria
Field	Msc Chemical Engineer, Unified Waste Management Association of Crete (ESDAK)

QUESTIONNAIRE

01. How have you (teachers) used open educational resources? Could you describe what you did in your lessons?

Student activities with scientists:

Meeting with experts

First meeting: An online meeting was held on 11-2-2022 with the special expert Nikolaos Kalyvitis, who works at the Laboratory of Environmental Chemical Processes of the Department of Chemistry at the University of Crete, in charge of the Research and Innovation Hub of the University of Crete in Finokalia Lassithi. The online meeting was held with the participation of the Experimental High School of Heraklion and its topic was "From Atmospheric Pollution to Climate Change" and concerned the presentation of data on global warming and chemical air pollution. It was particularly emphasized that climate change is now undeniable and its effects are already visible in the environment and ecosystems so that we can now talk about climate crisis and climate threat. Mr. Kalyvitis showed us that CO₂ has been on a steady upward trend in recent decades recording the highest concentrations recorded in the last 500 thousand years, exceeding the limit of 420 parts per million (ppm). Also of concern is the steady upward trend observed for CH₄, which is a much more potent greenhouse gas than CO₂. Finally, the need to take individual and collective measures to limit air pollution and the greenhouse effect was emphasized.





Second meeting: We attended a two-hour research program "Exploring a marine threat" at the Thalassocosmos Aquarium on 11-3-2022, where we studied the pollution of the seas by plastics. The students came into contact with the museum educators Michael Fourgialakis, Msc Biologist and Antoniadis Danai, Marine Biologist who work at ELKETHE and presented them with data on sea pollution. Our students learned to distinguish plastic packaging, distinguish microplastics from sand with the help of a stereoscope, and found the percentage composition of microplastics in a sample of sand on a nearby beach. Finally, the researchers highlighted the effects that chemical pollution of the sea has on ecosystems and marine organisms and explained how the phenomenon of bioaccumulation threatens humans as top consumers in food chains.

Third meeting: A live meeting was held with the special expert Georgiou Maria, Chemical Engineer Msc who works at the Unified Waste Management Association of Crete (ESDAK) on 3-31-2022 at the Nea Alikarnassos High School. The theme of the meeting was "Is waste garbage?" and it was a comprehensive presentation of the waste management programs based on the European directives from the ESDAK and aimed at reducing the environmental footprint in Crete. The students got to know the CHADA (Uncontrolled Waste Disposal Areas) and the model landfills (Sanitary Waste Disposal Area), the Waste Pretreatment Unit, the Organic Waste Management Program from hotel units for the manufacture of LIFE4F animal feed (FOODforFEED), the pilot program for the preparation of bio- of plastic from organic waste A2UFOOD and the landfill biogas production program.

Student activities with their families:

The students investigated which human activities contribute to chemical pollution and global warming and calculated their ecological footprint, based on a specific questionnaire given to them, with the help of their parents. They compiled their results, thought about how they can reduce their energy footprint, discussed what they learned from the expert panel at home with their families, and took action. They created personal energy saving charts to track how often they managed to reduce their energy use each day for a week and recorded daily activities that had a positive environmental impact.

02. How have your students used the CONNECT resources? Do you have (or could describe) samples of better scientific actions (for our site/rewards)?

Any examples of what the students prepared?

- Made nine handmade climate change awareness posters.
- Created 2 posters with the After Effects program, for environmental pollution
- They made a construction about the importance of recycling.
- They created a presentation about acid rain
- They created a board game with ecology questions called "The Eco-Snake"
- They wrote lyrics for a rap song about the climate
- They organized an exhibition at school to present their work
- They presented their work at the 4th Panhellenic Student Conference CONNECT2022

Slide? Poster? Video?

(Add an image if possible)

Exhibition at school for world environment day with children's works





Presentation on acid rain

ΟΞΙΝΗ ΒΡΟΧΗ

Με τον όρο **Οξίνη Βροχή (acid rain)** εννοούμε τη βροχή με pH χαμηλότερο του φυσιολογικού.

- Ανάλογος ορισμός ισχύει και για τα άλλα μεταβατικά κατακρημνίσματα (χένι, χυδαλά, ομίχλη)
- Το pH είναι το μέγεθος που δηλώνει αν ένα διάλυμα είναι ουδέτερο (pH=7), όξινο (pH μικρότερο του 7) ή αλκαλικό (pH μεγαλύτερο του 7).

ΠΩΣ ΔΗΜΙΟΥΡΓΕΙΤΑΙ Η ΟΞΙΝΗ ΒΡΟΧΗ

- Η οξίνη βροχή δημιουργείται από την **απόδραση του διοξειδίου του θείου (SO₂) και των οξειδίων του αζώτου (NO_x) με το οξυγόνο και τους υδρατμούς της ατμόσφαιρας.**
- Η απόδραση αυτή δημιουργεί αντίστοιχα θειικό (H₂SO₄) και νιτρικό οξύ(HNO₃) τα οποία στην συνθήκη βροχής σε υγρή μορφή μετατρέπονται με τη βροχή.
- Η **πλήρη αποκλινομή** δρα καταλυτικά, αυξάνοντας το ποσοστό αυτών των αετιόσεων.

Οξίνη βροχή

Can you tell which one was exposed to acid rain?

ΟΞΙΝΗ ΒΡΟΧΗ

Ιουλία Ανδρουλιόδη
Γιώργος Γακουριάς

Ποιο είναι το μεγαλύτερο πρόβλημα με την Οξίνη Βροχή;

- Ένα από τα μεγαλύτερα προβλήματα που συνοδεύουν την οξίνη βροχή είναι η **υπερβολή των εθνικών συνόρων.**
- Συνγά α χώρες που υφίστανται τις επιπτώσεις της οξίνης βροχής, **δεν είναι εκείνες που προάβλεσαν την ογκωπή ρύπανση.** Χαρακτηριστικά αιωρούμεν ότι το 95% των ποσοτήτων του θείου και του οξζώτου που ρυπαίνει τα νορρηγικά εικοσαστήματα προέρχεται από καυτές από τη Μεγάλη Βρετανία και τη Γερμανία.

ΕΠΙΠΤΩΣΕΙΣ ΟΞΙΝΗΣ ΒΡΟΧΗΣ - ΨΑΛΙΝΑ ΟΙΚΟΓΥΣΤΗΜΑΤΑ

- Τα υδάνια εικοσαστήματα είναι ευαίσθητα στις μεταβολές της οξζότητας.
- Εξαρτημένη μεγάλην αριθμοί γαμπίρι
- Χαρακτηριστικά παράδειγμα αποτελεί η λίμνη Μάλρενχολμ στη Νορβηγία, όπου ζούσαν μεγάλα κίθρινά από **παρπαρες** και πάπιας. Η απόρνη της οξζότητας οξζως αποτέλεσεν την **πλήρη εξοφάνση των κίθρινων αυτών στο τέλος της δεκαετίας του '70.**
- Αλλοίωση οξζωδών: οξζωδών από το οξζωδών
- Προβλήματα φυτοκοοοοοο
- Προβλήματα φυτοκοοοοοο, οξζωδών από το οξζωδών, από το οξζωδών, από το οξζωδών, από το οξζωδών.

Board game with ecology questions called "The Eco-Snake"





Το οικολογικό φιδάκι

Ένα διασκεδαστικό επιτραπέζιο παιχνίδι γνώσεων με ερωτήσεις οικολογίας για όλους!

Κανόνες Παιχνιδιού

Μπορούν να παίξουν από 2 έως 8 άτομα.

- 1) Οι παίκτες βάζουν τα πόδια τους στην αρχή του ταμπλό και το παιχνίδι ξεκινάει.
- 2) Ο κάθε παίχτης ρίχνει ένα ζάρι και αυτός με το μεγαλύτερο αριθμό ξεκινάει πρώτος.
- 3) Ο πρώτος παίχτης ρίχνει το ζάρι και μετακινεί το πόνι του τόσες θέσεις όσες και ο αριθμός που φέρει
 - Όταν πέσει σε ένα άδικο κουτάκι μένει στην ίδια θέση.
 - Όταν πέρτες σε ένα κουτάκι που λέει "πορτοκάλι κάρτα" δώσε στον αντίπαλο σου να σου διαβάσει την πορτοκάλι κάρτα ερωτήσεων.
 - Όταν πέρτες σε ένα κουτάκι που λέει "κίτρινη κάρτα" δώσε στον αντίπαλο σου να σου διαβάσει την κίτρινη κάρτα ερωτήσεων.

Αν απαντήσεις την ερώτηση λάθος πες στην προηγούμενη θέση που ήσουν.

Αν απαντήσεις την ερώτηση σωστά μένεις στο ίδιο σημείο.

- 4) Άμα πέσεις σε ειδικό κουτάκι που να λέει:
 - "ένα πίσω" μεταφέρεις το πόνι σου μια θέση πίσω.
 - "τρία πίσω" μεταφέρεις το πόνι σου τρεις θέσεις πίσω.
 - "ξανά από την αρχή" μεταφέρεις το πόνι σου στην αρχή.
 - "χάνεις ένα γύρο" τότε χάνεις την σειρά σου.

5) Ο πρώτος παίχτης που θα φτάσει πρώτος στο τέρας κερδίζει!!!

Καλή διασκέδαση

Rap song lyrics about reducing the ecological footprint

Θυμήσου...

Θυμήσου είμαστε μαζί σου
 μη χρησιμοποιείς στεγνωτήρα στη ζωή σου.
 Μπορείς και εσύ να κάνεις κάτι
 αυτόν τον κόσμο να αλλάξεις.

Να είσαι δυνατός,
 κρέας πολύ μην τρως,
 φρούτα και λαχανικά να τρως
 τη ζωή να δεις αλλιώς.

Κλείσε το φως για ύπνο όταν θα πας
 και θυμήσου το πρωί μην το ανοίξεις για πολύ.

Βάλε τα πόδια σου να τρέξουν
 στη δουλειά σου για να πας,
 άσε το αμάξι σπίτι, φωνάζει η Ελλάς.

Θυμήσου είμαστε μαζί σου,
 τον κόσμο να αλλάξουμε
 βάλε τη δύναμή σου.

Δασκαλάκη Στέλλα,
 Συκιωτάκη Μαρία,
 Αρναουτάκη Δέσποινα,
 Αγιωτάκη Ελπίδα





Remember...

Remember we are with you
never use a dryer in your life.
You can do something too
this world to change.

Be strong,
don't eat too much meat,
fruits and vegetables to eat
you see life differently.

Dim the light to sleep when you go
and remember in the morning don't
open it too much.

Get your legs running
go to work
let the car home,
Hellas shouts.
Remember we are with you,
to change the world
put your signal on.

Daskalaki Stella
Sikiotaki Maria
Arnaoutaki Despoina
Agiotaki Elpida

03. How well did the science action learning scenario resources meet your needs?

Example related to the school curriculum:

The specific scenario was used for the co-teaching of pollution in the Chemistry and Biology course of the 3rd High School. The educational framework applied Care - Know - Do, helped the students to see the natural sciences with more interest and to seek answers to their questions from the right experts while involving their families in the learning process. The program helped the children to go outside the confines of the school classroom and express themselves creatively and artistically around environmental issues.

Students involvement:

The students showed great interest in all phases of the educational scenario. They were particularly satisfied with the contact with the experts and this was shown in the multitude of questions they gathered to address them. Finally, they said they learned more by making their creations and thought of imaginative ways to present the data they collected about climate change and chemical pollution to the student community.

In addition, the students especially enjoyed the involvement of their families as they calculated their energy footprint together and explored possible ways to reduce it.

Student interest and confidence in science:

Certainly, the engagement with the specific subject increased the students' interest in science and attracted students who did not show similar interest in the classroom. The majority of the students stated that they would encourage other classmates to engage in this in the future even if this is an activity that is outside the program clock. The contacts with the experts and the skills they developed for the global response to climate change gave a special weight to the educational





scenario and excited the students involved.

04. How easy or difficult it was to use the science action learning scenario resources?

Issues related to materials, procedures, pressure from the interaction with the curriculum:

The subject matter of this training scenario was very large and required very good planning to treat chemical pollution of air, water and soil with equal weight. Although this topic has been reused in the past for air pollution (Toumpaniaris, P., 2021), there was a need to investigate more data from different experts for the comprehensive approach to chemical pollution. To a very large extent the activities carried out were organized for the first time by the coordinators/teachers after an extensive search on the internet and with the help of the scientists involved in the project.

For the needs of the program and to better coordinate the group, an e-course was also created in the e-class entitled [Global Warming and Chemical Pollution](#), which includes worksheets and useful websites for students to explore global warming and chemical pollution. Chemical pollution, autonomously and in their own space and time. In addition, all team members were given the opportunity to submit any questions, observations and ideas that were utilized during the course of the program.

05. What were the benefits of implementing the science action learning scenario for your students?

Describe the results of the students in their scientific actions related to:

KNOWLEDGE	Students had the opportunity to discuss with expert scientists about chemical pollution of air, water and soil and to investigate an environmental problem of their choice in a scientific way.
SKILLS	Students worked in groups and argued creatively and critically about various environmental problems. The contact with the experts strengthened their interpersonal relationships, emphasized their self-confidence and showed them the scientific way of approaching a problem. The presentation of their work in the form of an ecological exhibition at the end of the program, excited and creative students engaged in image, presentation and text processing programs. Finally, some students developed their artistic skills by composing lyrics to a climate rap song and by creating a question board game of their own inspiration (structure, questions, rules).
ATTITUDES	The didactic scenario entitled "Global Warming and Chemical Pollution" guided the students to discover the factors that lead to global warming and made them aware of contemporary environmental issues. With the help of their families, they discussed and proposed solutions that would improve their ecological footprint. They created personal energy saving charts to track how often they managed to reduce the energy they use each day for a week and recorded daily activities that had a positive environmental impact.





06. What have been the challenges of using educational science activity scenarios for your students?

Main challenges faced by students (Please select all that apply):

- Difficult...
- Long duration...
- Boring...
- Other (Please specify): lack of educational time, due to the nature of single-hour Biology and Chemistry courses. Student coordination was done using the e-course and group meetings were held outside scheduled hours.

07. What activities worked well with the curriculum?

What helped the children achieve the learning objectives:

The teaching scenario we implemented entitled "Global Warming and Chemical Pollution" helped students learn about climate change and chemical pollution in a very original and scientific way. Students discussed with expert experts on chemical pollution in air, water and soil and asked their questions. This process excited the children because of the directness of the scientists to answer the students and made them more interested in new knowledge beyond the school textbooks.

They particularly enjoyed visiting the aquarium and working with the 'Exploring a Marine Threat' program as they dealt with water pollution in an experiential way and separated microplastics from sand using a stereoscope. The meeting held at our school on the topic "Is waste garbage?" it was particularly enlightening as it highlighted ways of utilizing waste that we had not imagined and motivated the students to investigate soil pollution and the importance of recycling. The online meeting that took place on the topic "From Air Pollution to Climate Change", although it was very scientifically documented and timely, did not satisfy the children since the communication was not real-time and had several interruptions in the connection, which took away from the immediacy of the response expert.

In addition, the students particularly enjoyed the involvement of their families in the learning process as they calculated their energy footprint together and explored possible ways to reduce it. By implementing the personal energy saving table, our students tried to change their daily lives for the benefit of the planet and to awaken their families in this direction. Finally, they said they learned more by making their creations and thought of imaginative ways to present the climate change data they collected to the student community.

08. What activities did not work well with the curriculum;

Anything that could be done differently or avoided:

The main problem that had to be addressed was the lack of instructional time that we faced, due to the nature of the one-hour Biology and Chemistry courses, so coordination with the students had to be done also using the e-course and most of the time the group meetings took place outside of scheduled hours.





09. The school Principal's opinion about CONNECT:

In the period January 2022-May 2022, an educational scenario on Global Warming and chemical pollution was implemented at the Nea Alikarnassou High School, within the framework of the CONNECT program under the supervision of teachers Charalambidou Pinelopi PE04.04 and Giakoumaki Kondylia PE04.02. 23 3rd grade students of our school participated in this scenario.

The implementation of the program followed the original plan. Two educational trips took place, to the Aquarium of Crete and the Museum of Natural History of Crete, an online meeting with Mr. Nikolaos Kalivitis from the environmental measurement station in Finokalia Lasithiou and a live meeting with the ESDAK expert Mrs. Georgiou Maria.

The actions of the program were presented by the students at the 4th Panhellenic CONNECT conference while the specific educational scenario was presented by the teachers in charge at the 8th Educational Innovation Conference in Larissa in October 2022. Also in August 2022 the team participated with the specific educational scenario at the 9th LSME international conference on 'Global Education and the Green Economy' where won an award for best presentation.

The topic of the script was very interesting and topical, it mobilized our students and sensitized their families. The students' contact with four distinguished scientists who analyzed the issue of chemical pollution in the air, water and soil was important. The participation of our students in all the actions of the program is considered completely successful. They followed the briefings by the experts with particular interest and tried with their actions to promote recycling at school and reduce their ecological footprint in their family environment.

To this end, they eagerly organized an exhibition at the school on World Environment Day on 25 May, where they presented their original work, an environmental board game and composed the lyrics for a song about reducing the ecological footprint which received rave reviews wherever it was performed. After the very successful outcome of the program, the teachers in charge decided to implement the CONNECT program also for the current school year 2022-2023, with a renewed theme.

Michael Sfyarakis

Principal of Nea Alikarnassos Gymnasium

10. Parents' opinion about CONNECT:

The program my daughter participated in had only good things to offer her. The subject of the program was very important and always relevant, and it was very important that the students were engaged in the school context with it.

By completing the brochure with the ecological footprint we leave as a family, we all understood together how much we damage the climate with our choices and how much we can help by changing small daily habits.

My daughter acquired a lot of knowledge and consolidated it with various activities, excursions and assignments. The children found themselves out of class and in a very creative way, made





constructions to present the object they had chosen (acid rain).

It is always a blessing to have such teachers and such programs. The knowledge is a part of the gain from it, the sparkle in the children's eyes and how pleased they were, is the biggest.

Moraitis Maria

Mother of the student Androulidaki Ioulia

Submission:

1. Please save the file in the following format: **YEAR MONTH DATE COUNTRY SCHOOL** (e.g. 20220326GR1stPrimarySchoolHeraklion. docx)
2. Please send this form to CONNECT Panel: <https://tinyurl.com/Connectbestpractices2022>

