

CITY CHALLENGE FINAL REPORT

City Challenge Title: Regenerating Urban Space to Connect People in a Healthy Environment-
Study of the influence of green areas on air quality

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Identifying the Challenge:

This project aims to improve the urban life by using the energy in a more efficient way, reducing the pollutants and the level of pollution, the carbon footprint of each of us as well as the entire community.

According to global statistics published by IQAir [1] in 2020, “the highest levels of European pollution are found in Eastern and Southern Europe, with about half of European cities registering high values of solid and liquid pollutants (suspended dust - PM_{2,5} and PM₁₀) as well as other types of air pollutants.”

About 75% of the EU population has chosen to live in urban areas [2]. The impact of urbanization extends beyond urban boundaries. Europeans have adopted urban lifestyles and use urban facilities such as cultural, educational or medical services. Although cities are the engines of Europe's economy and the generators of Europe's well-being, they depend to a large extent on the resources of the regions located outside to be able to meet the demands of energy, water, food and to manage waste and polluting emissions.

Data published by the European Environment Agency [3], show that in Romania in recent years there have been increased values of air pollutants, which has both immediate and long-term effects on human health. The highest values are noticeable in urban areas, especially near cities with a population of more than 300,000 people. As for Bucharest, its residents have less than 10 m² of green space per person [4], according to information provided by the Green Space Register, while other European capitals, with a larger population than Bucharest, have surfaces from 3 to 12 times larger.

The number of cars registered in Bucharest [5] is also very high, about 1.46 million registered cars, according to DRPCIV¹ statistics. Among these, only 10% are new registered cars (0-2 years), the rest of them being very old (more than 16 years). Compared to the population of Bucharest, it results that approximately 70% of the capital's inhabitants own a car. To these we can add the cars that transit the city daily, but also those that are not registered in Bucharest but are used on its streets.

According to the air quality monitoring platform aerlive.ro, the problems observed [6] in Bucharest, regarding air quality, are related to: diminution/disappearance of green space, accelerated industrialization, urban pollution (noxious substances, temperature, noise), expansion of spaces indoor (malls, office buildings).

From the information presented, it emerges the need for a careful monitoring of air quality parameters but also the need for practical solutions to the problem of air pollution.

Preparing the topic and approach of the research, we also mention that the students' observations on the influence of the environment on the quality of personal life were the starting point of our research within the PULCHRA project. From the preparation meetings of the project,

¹ General Directorate for Driving Licenses and Car Registration.

emerged the idea that the starting point of the study would be the application of a questionnaire to identify the perception of Bucharest residents on the impact of pollution of all kinds in everyday life and also on possible solutions to reduce the degree of pollution both in the city and in its surrounding areas.

Our research starts with the fact that the city of Bucharest exceeds, in many areas of it, the permissible limits of pollution even in the morning, before traffic is the main reason for these values. According to the waqi.info platform, which provides real-time data on air quality around the world, there are many areas [7] of the city where we can find nearly or even exceeding pollution values for the comfort limits regarding the atmospheric air. In this context, we aim to study air pressure, temperature and humidity in several areas close to our school, as well as in school, while identifying opportunities to improve air quality in the areas studied. It is known that both the ambient temperature and its humidity are influenced by altitude, physical and geographical position, human activity but also by the chemical composition of the air, respectively by the presence of different types of particles in its composition.

Our research starts from the following hypotheses:

I1 -Environmental temperature is influenced by the presence of plants;

I2 - Atmospheric pressure is not influenced by the presence of green plants;

I3 - Air humidity is influenced by the presence of green plants.

We expect the data collected by our students, using the weather stations they built, to confirm these hypotheses.

Objectives:

- Collecting data on air quality in Bucharest, especially around our school;
- Studying the influence of environmental factors (vegetation, traffic, industry, etc.) on the degree of air purity;
- Providing arguments and solutions to improve urban life by reducing the carbon footprint of each of us, but also of the entire community;

The main activities of this stage of the project were related to introducing the project to students, establishing the student's roles in the teams, but also online training sessions dedicated to research, methods and stages of scientific research (February), and online search about topics related to the City Challenge. During these sessions, aspects were discussed regarding the scientific research activity, the formulation of hypotheses, the ways of conducting the research, the research devices, the skills that a good researcher develops as well as practical ideas regarding the construction of vertical gardens and plants, that can form these (mini) gardens. A photography mini-workshop for the Reporters Team was also held. In the Table 1, below, there is a more detailed presentation of the activities.

Table 1. Activities for identifying the challenge

Activity	Description	Resources needed	Location
Online Lectures -1	Project presentation -cca 1 hour	Computers and a stable source of Wi-fi Students, teachers, and stakeholders School platform- Google Meets@cnghsincai.ro	Online
Online Lectures -2	The students's roles -cca 1 hour	Computers and a stable source of Wi-fi Students and teachers School platform- Google Meet@cnghsincai.ro	Online
Online Lectures -3	Methods of presenting scientific information -cca 1 hour and a half	Computers and a stable source of Wi-fi Students, teachers, stakeholders, PULCHRA Romania staff, Lucian Cremeneanu- journalist School platform- Google Meet@cnghsincai.ro	Online
Online Lectures -4	Photography workshop - photo-video processing -cca 1 hour and a half	Computers and a stable source of Wi-fi Students, teachers, stakeholders, PULCHRA Romania staff, Andreea Drilea-photographer School platform- Google Meet@cnghsincai.ro	Online
Online Lectures -5	Research stages -cca 1 hour and a half	Computers and a stable source of Wi-fi Students, teachers, stakeholders- Mihaela	Online

		Gheorghiu- researcher School platform- Google Meet <u>@cnghsincai.ro</u>	
Online search	Search for information on platforms indicated by the teacher about: air pollution, massive urbanization, plants, vertical gardens.	-Key words (pollinators, urban biodiversity, risk factors, smart gardens.) -Computer and a stable source of WI-FI.	Online

Exploring the challenge

The first step of our research was to develop and distribute to students, teachers, mentors, parents and friends a questionnaire about “How much does the quality of the environment influence us?” (the questionnaire applied in March). This questionnaire aimed to explore the needs of the inhabitants of Bucharest and surrounding areas regarding the environment, trying to answer two key questions: "How does it influence the area where we live, the quality of the air we breathe?", "How does it influence the green space, the vegetation, the environment we live in?" The questionnaire was distributed using Whatsapp in groups of students and teachers from the school, the Facebook page of the project or by e-mail, and was completed by a number of 59 people from all social categories and of different ages, but most were young. An important step of our research was the training of students, conducted through online sessions and in-class sessions at school. In this sense, introductory sessions in Arduino were held using Tinkercad, component presentation sessions, installation and configuration of sensors (April-May). Arduino [8] generically refers to both an open-source program and a community that uses and develops programming languages for microcontrollers, as well as other components used to make digital devices. Tinkercad [9] is a free web application that familiarizes students with the coding mode, how to connect microcontrollers to Arduino data acquisition boards. It is an application that allows users to virtually build their electronic devices, track how they work and correct any errors in their operation. It is very useful for students who thus develop skills to work with data acquisition boards without destroying the real components. The students supported by the mentors built data acquisition boards, small weather stations that they used to collect data on the state of the environment. In the Tables 2 and 3, below, you can find a more detailed description of the activities from this stage.

Table 2. Online activities for exploring the challenge

Activity	Description	Resources needed	Location
Online survey	<p>Applying a questionnaire about the influence of the environment on the life of the city inhabitants.</p> 	<p>-Online Questionnaire- How much does the quality of the environment influence us?</p>	<p>Online</p>
Online lecture-1	<p>Introduction to Arduino and Tinkercad -cca 1 hour and a half</p>	<p>Computers and a stable source of Wi-fi Students, teachers, stakeholders-Ileana Dugăeșescu- lecturer School platform- Google Meet @cnghsincai.ro Arduino, Tinkercad soft</p>	<p>Online</p>
Online lecture-2	<p>Simple assemblies using tinkercad -cca 1 hour and a half</p>	<p>Computers and a stable source of Wi-fi Students, teachers, stakeholders-Ileana Dugăeșescu- lecturer School platform- Google Meet @cnghsincai.ro</p>	<p>Online</p>

Activity	Description	Resources needed	Location
		Arduino Platform Tinkercad soft	
Online lecture-3	Configuration of sensors using Tinkercad and Arduino -cca 1 hour and a half	Computers and a stable source of Wi-fi Students, teachers, stakeholders-Ileana Dugăeșescu- lecturer School platform- Google Meet @cnghsincai.ro Arduino Platform Tinkercad soft	Online
Online lecture-4	Sensor programming and connection -cca 1 hour and a half	Computers and a stable source of Wi-fi Students, teachers, team IFIN, School platform- Google Meet @cnghsincai.ro Arduino Platform Tinkercad soft	Online
Online lecture-5	Information and exercises on data acquisition using weather stations -cca 1 hour and a half	Computers and a stable source of Wi-fi Students, teachers, team IFIN, School platform- Google Meet @cnghsincai.ro Arduino Platform Tinkercad soft	Online

Table 3. Face-to-face activities for exploring the challenge

Activity	Description	Resources needed	Location
Outdoor activity – Assembling vertical garden	Building a suspended mini garden -cca 2 hours  	plants, pots, soil Participants: students, Contesina Rusu – teacher	At school

Activity	Description	Resources needed	Location
Outdoor activity – Sensor programming and connection	Setting up sensors on Arduino boards -cca 2 hours  	Arduino kit, sensors Participants: students, Ileana Dugăeșescu – lecturer, Contesina Rusu – teacher, Tudor Anghel - university student	Physics lab at school
Outdoor activity – Sensor programming and connection	Setting up meteo stations -cca 6 hours 	Arduino kit, sensors Participants: students, Alexandru Dănesc – teacher, IFIN researchers team	"Horia Hulubei" Institute of Physics and Nuclear Engineering

Activity	Description	Resources needed	Location
	 		
Outdoor activity – Sensor programming and connection	Data acquisition using weather stations -cca 6 hours	Weather stations Participants: students, Antici Mirela –teacher, IFIN researchers team	"Horia Hulubei" Institute of Physics and Nuclear Engineering
Outdoor activity – Data acquisition using weather stations	Target observation - temperature, atmospheric pressure, humidity Three sessions on different days - cca 2 hours per day	Weather stations Participants: students- researchers team	Indoor and outdoor different location – "Piața Unirii", Carol and Tineretului Parks, "G.Șincai" National Highschool

Communicate the solution and project results

Results from the online questionnaire

The results obtained from our online survey (59 subjects) reveal that most of the respondents are interested in the quality of the environment. Thus, cca 97% of them are considering the environment they are living in, either urban or rural, is polluted and that daily our activities are influencing and will lead to destroying the environment.

The main challenges of the urban environment identified by the subjects, are: air pollution, noise pollution, traffic congestion, lack of green spaces. The existence and storage of waste or water and soil pollution were less seen as challenges.

Results from physical measurements

Following the measurements taken in 3 different areas in Bucharest- Piata Unirii, National Highschool "Gheorghe Șincai", and Tineretului Park, we found that the temperatures, pressure, and humidity values are considerably different when comparing the busy areas, intersection, town center, and the green spaces. Thus, the temperature may vary by 1.2 C° when comparing the town center and the green areas in the park. The humidity difference is also relevant, the humidity being higher in the park by about 4% compared to the Piata Unirii area. There are no significant pressure differences.

Also, we noticed differences of temperature between spaces that have plants or mini-gardens inside and those that don't. The collected data are confirming the hypothesis that space with more plants is a cleaner space, less polluted, contributing to the healthy development of individuals.

Proposals and recommendations

The activities carried out by the students of the "Gheorghe Șincai" National College as well as the data collected during the experiments lead to several proposals and recommendations aimed at improving the quality of the urban environment:

- Increasing the surface with green spaces, with plants from the city, to take toxic, harmful substances from the environment. These spaces must be developed both inside and outside buildings, living spaces, schools and offices. This proposal also follows the survey carried out, based on the questionnaire distributed in the project.

- To optimize the space for green areas, we recommend the construction of vertical and suspended gardens, with plants that are resistant to drought and, at the same time, with capacities for absorption and processing of harmful compounds from the environment. Green areas of this type are needed near those in which horizontal planting does not find space. According to data collected in the vicinity or inside areas with vegetation, there is a decrease in ambient temperature in these areas compared to paved, heavily trafficked and with many buildings areas.

- Optimizing public transport, in order to become attractive for the inhabitants of Bucharest, and its adaptation to the "environmental needs" of the city. Thus, a well-developed public transport,

with vehicles that run after a well-established schedule and in be decent travel conditions - seats for all travelers, ventilation of the space, low cost of travel, would lead in time to reduce traffic in the city. Public transport using fossil fuels can also be replaced by much less polluting electric ones. Such measures help to reduce air pollution and increase the comfort of citizens.

- The development of special bicycle lanes on both the main and the least traveled streets, while reducing air pollution would increase the number of people using this mode of transport and would also reduce the degree of air pollution by use of a non-polluting means of transport. Besides that, running a bicycle it's a good way of getting all the work out needed for a healthy body.

These proposals will be sent to all those entitled to take action and support us in continuing our efforts for a cleaner, more human-friendly environment, namely:

- General Council of the Municipality of Bucharest,
- Bucharest Environmental Protection Agency,
- Sector 4 City Hall,
- The Director of the “Gheorghe Șincai” National College.

In the Tabel 4, below, you can find a more detailed description of the activities from this stage.

Table 4. Activities for disseminating the PULCHRA results

Activity	Description	Resources needed	Location
First Open School event – 1.02.2021	First Open School event, to present our project -cca 1 hour and a half	Computers and a stable source of Wi-fi Students, teachers, stakeholders, PULCHRA Romania staff School platform- Google Meet@cnghsincai.ro	Online
Facebook Page posts	-Introducing the project to general public	Computer/laptop/smartphone, internet connection	Online



-Introducing Arduino and Tinkercad



-Promoting PULCHRA activities



Second Open school event-

Meeting involving public and school community

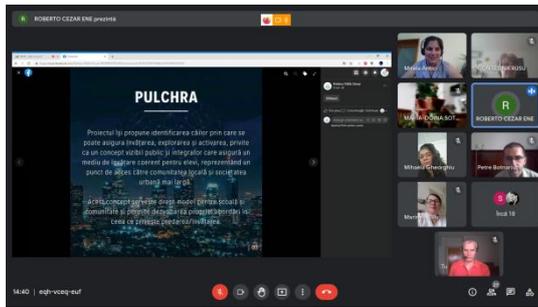
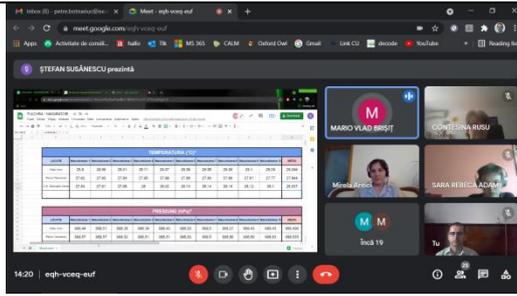
Invitation posters, oral and powerpoint presentation on project results

Computer and WI-fi

Online

PULCHRA PROJECT
WP 10 - UNIUD
04/06/2021

Public
event
07.07.2021



conection

School platform- Google
Meet @cnghsincai.ro

Participants: students,
teachers, PULCHRA staff,
stakeholders, mentors and
collaborators

Lessons from the City Challenge approach

It is important to have as many green areas as possible, with plants that will collect the toxic substances from the environment. These areas must be developed inside the buildings, apartments, schools, and offices as well as outside them.

Optimizing public transport should be a priority for those entitled to do so. Public transport using fossil fuels can be replaced by much less polluting electric ones. Also a well-developed public transport, with vehicles that run after a well-established schedule and in which decent travel conditions are ensured- seats for all travelers, ventilation of the space, low cost of travel, would over time reduce the decrease in traffic in the city.

The project allowed the collaboration with researchers in the field of sciences, with lecturers specialized in programming data acquisition boards, and for us, the teachers, it is a continuous source of applicability in practice of the theoretical notions taught to students in class.

Participation in observation and methodological analysis, following observation protocols, evaluating evidence-based experiments increase the sense of familiarity with the scientific approach, builds confidence in the student's ability to engage in specific science activity, and gives students participating in the project responsibility and confidence in themselves.

We end this report with an inspiring testimonial from one of the project's mentors:

"I am sure that this project, as it was carried out by its multidisciplinary team of this high school from Bucharest, adds a much-needed new vision to the idea of "participatory learning" through the organic, tree-like structuring of the complex profile of tomorrow's researcher. Even if they are just "seeds" for the future, I am pleased to note the enthusiasm with which adolescents have learned, in an interdisciplinary approach (biology, physics, ICT, journalism, and photography) that their role in the "life of the city" is not a marginal one, a passive witness to the progress or on the contrary, to the involution of this living organism, but participatory and transformative, and the way they can make a difference is through vision, collaboration and overcoming the formal framework of individual disciplines."

Mihaela Gheorghiu -researcher at the International Center for Biodynamics

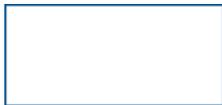
More informations about our project activities can be found on our PULCHRA Facebook Page: <https://www.facebook.com/Pulchra-CNGh-Sincai-102785075323552> and PULCHRA Instagram Page (<https://www.instagram.com/cnghsincaipulchra/>).

References:

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- [5] https://www.economica.net/drpciv-1-46-milioane-de-autovehicule-sunt-inregistrate-in-bucuresti_179509.html
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- [7] <https://aqicn.org/city/romania/municipiul-bucuresti/lacul-morii/str.-lacul-morii/#/w/ro>
- [8] <https://www.arduino.cc/>
- [9] <https://www.tinkercad.com/>

Project Leader from "Gheorghe Șincai" National Highschool

RUSU CONTESINA MARIA



ANNEX. Overview of the activities of the project.

Activity	Description	Resources	Location
The students's roles	Making 2 teams: researchers and reporters	-students -supervisors	Online
Journalism workshop	Open event	-We invited Lucian Cremeneanu a journalist	Online
Photo workshop	Open event	-We invited Andreea Drilea, a photographer	Online
What is research?	Presenting research as a job and also researching methods	-We invited Mihaela Gheorghiu, a researcher	Online
Introduction to Arduino and Tinkercad	Presenting the collecting data board and Tinkercad program	-We invited Ileana Dugasescu, a university professor	Online
Setting up simple assemblies using Tinkercad and Arduino	Familiarizing the students with Arduino board programming	-students -supervisors -specialized soft -Arduino kits	Online- Theoretical part (3 activities) In-person- Physicslab(2 activities)
Building and connecting the weather stations	Building the stations that collected all the data	-station parts -specialized soft -IFIN-HN researchers	IFIN-HN Magurele- 3 activities
Building the mini vertical garden	Choosing the plants and assembling the garden	-plants, special plant pot -supervisors	C.N.G. Sincai
Comparing the measurements	-using the weather station for collecting data about the quality of the air -comparing the results we got with websites -reading and understanding the results	-weather station -special softs	-Piata Unirii -C.N.G. Sincai -Tineretului Park (3 activities plus some done in holiday)
Conclusions	Open event	-students -supervisors -guests	Online