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PULCHRA

Participatory Urban Learning Community Hubs through Research and Activation

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D5.1 Requirements and operational patterns for Science Teams

WP5	Define the themes of the City Challenges – Set requirements and develop the Science Teams
Due Date	31/05/2020
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Table of Contents

Executive summary

This document is the Deliverable 5.1 of the PULCHRA project. It aims on describing the provisional synthesis, thematic targets and operational patterns of the Science Teams as a function of the themes of the City Challenges. It contains detailed information about the methodology used to define the City Challenges as well as a short list of themes selected.

Version History

Version	Date
0.1 Draft	27/05/2020
0.2 Final	29/05/2020

Part A: Defining the themes of the City Challenges

Introduction to the City Challenges

According to the projections of the European Environment Agency (2017) by the year 2030, 75% (on average) of Europeans will live in cities. As a result of urbanization, a number of environmental, social and economic problems have developed, directly affecting the quality of life of people and resulting in social disparities. To face such challenges there is a need to look at the cities as "living organisms" which exchange heat, mass, energy, information, ideas and culture – cities functioning as urban ecosystems, which in the context of humans and their environment, can be regarded as a complex system of: (a) the natural environment, (b) the built environment and (c) the socio-economic environment.

In a world that's becoming increasingly complex, there is a need to prepare especially young people for a future that will require good scientific knowledge, a solid understanding of the opportunities and challenges arising from modern technology and active participation for shaping the future. While schools provide a particularly effective starting point to teach students about cause and effect relationships, putting knowledge into action requires the engagement of the communities at large including parents, families, neighbourhoods, universities, local authorities, businesses, etc.

Specially designed pilot themes – termed as City Challenges – which create know-how, built trust in the science approach based on own experience, facilitate skilled use of tools and support community building taking note of the identity of the communities in which they take place, should help to explore common issues related to the city as an urban ecosystem.

Methodology of work on the list of City Challenges

This list was prepared by UNEP/GRID-Warsaw Centre's experts with reference to the European well-known strategic documents identified in the PULCHRA proposal (such as the "Roadmap for moving to a competitive low-carbon economy in 2050", "Urban Agenda for the EU", "Smart Cities - Smart Living"), as well as other EU strategies such as the "European Green Deal", "Clean energy for all Europeans package", "A European Strategy for Low-Emission Mobility" and "Resource efficiency Europe".

In addition, the UNEP/GRID-Warsaw Centre's experts took note of the document "Cities Alive: 100 issues shaping future cities"[1], as prepared by Arup – an independent firm of designers, planners, engineers, architects, consultants and technical specialists, working across every aspect of today's built environment.

[1] https://www.arup.com/perspectives/publications/research/section/cities-alive-100-issues-shaping-future-cities

During an expert discussion, thematic groups have been established to work on different spheres of urban life and integrate them in nine (9) different challenges/opportunities. All of the challenges are closely correlated to the UN Sustainable Development Goals (SDG), particularly Goal 11, as well as to UN Habitat's "New Urban Agenda".

This list includes themes which are inter-related and should be thus not approached and treated individually. It should be noted that the project considers a city as a living organism; thus, it should avoid a "silo" view of different policies and rather follow a comprehensive approach, integrating all aspects of sustainability to achieve maximum synergy. In order to facilitate the above interlink, a number of keywords were defined per each City Challenge.

Furthermore, the proposed list was presented to the PULCHRA partners and an open deliberation was promoted resulting in the integration of comments, both in terms of the suggested themes for the City Challenges as well as for any other theme which may be of merit for the project.

Upon conclusion of the preparatory process, a short list of 6 themes was finalized, providing a wider, as compared to the scope of PULCHRA, perspective of the cities. This was considered necessary so as to allow a thorough understanding of the multitude of challenges in cities as well as their inter-relations. During the 1st implementation year of the project, learning material and research guidelines will be prepared for a limited number of case studies closely related to urban climate (thus mostly connected with City Challenges no. 1, 2, 3 and 6). During the 2nd implementation year of the project, additional case studies will be prepared, whereas City Challenges 4 and 5 may be also activated following to an evaluation of the schools' preferences, the experience gained by the partners during the 1st implementation year and the opinion of the Steering Committee of the project.

Each partner will choose the City Challenge which fits most to the local priorities as well as to the profiles of the selected schools. It will then choose one of the case studies/learning experiments as developed in WP6, support the implementation of the City Challenge and populate the City Challenges Platform accordingly.

City Challenge	Theme	Main elements
1	Powering Cities without Harming the Climate	Climate Neutral Cities, Clean energy and energy efficiency
2	Buildings for the Future City	Climate Neutral Cities, Green Buildings, urban heat mitigation, thermal comfort
3	Regenerating Urban Space to connect People in a Healthy Environment	Sustainable urbanization, nature based solutions, air quality, public spaces

City Challenge	Theme	Main elements
4	From waste disposal to resource efficiency – Circular economy at the city scale	Waste management, resource efficiency, circular economy
5	Mobility Patterns that support Community Development	Climate Neutral Cities, green transport, air quality, social cohesion
6	Innovation for Social and Environmental Benefit	Smart city, carbon footprint, earth observation, big data

Short list of Challenges

In the section below, detailed description of each Challenge, including a number of indicative discussion points and exemplar Science Teams' projects per Challenge is provided.

Challenge 1: Powering cities without harming the climate

One of the main targets of the European Green Deal is renewable energies to account for 32% of energy production by the year 2030. As a matter of fact, clean energy production is only one side of the coin as there seems to be some underestimation of the importance of energy efficiency and energy saving. Needless to say, it will be much easier to meet the clean energy goals as far as the reduction of the emissions greenhouses gases is concerned, when the overall energy demand is much lower.

Saying this, there is a strong need to push for Climate Neutral Cities; yet some important questions are still to be answered e.g. What improvements are necessary to improve energy efficiency at the city scale? How do we introduce renewable energy in the city operation? How should we shape our energy mix to avoid problems related to instability of some of the renewable energy sources? Do we perceive coal or nuclear power as a recommended solutions for providing energy? Keywords: Energy production and consumption, energy efficiency, decarbonization and Climate Neutral Cities, clean energy, air pollution

Proposed discussion points:

- What are the energy sources used to supply your city?
- What is the impact of each energy source to climate as far as the production of greenhouse gases is concerned?
- What is a Climate Neutral City?
- Which are the goals of the European Union for energy production and consumption;
- How do these goals relate to climate change?
- In what way can you use less energy while retaining high quality of home and school-life? Which of these solutions have a scale-up potential?

- How can we include renewable energy in the city operations?
- What are the challenges (e.g. environmental, economic) in scaling-up the development of renewables and how can we overcome them?

Exemplar Science Team's projects:

Towards climate-friendly cities. How to turn our city into Climate Neutral one? – Science Teams investigate the energy status of their city – which are the energy sources used to supply the city at present, how do they affect the state of the environment (potential pollution, use of non-renewable resources, emissions of air pollutants) as well as human lives (quality of air, smell/noise etc.), what is the average energy consumption per person? etc. Following, the Science Teams research for solutions to decrease energy demand and supply the city with clean energy.

Let's work with energy! How to reduce energy consumption of our city or our neighborhood or our school? – Science Teams investigate the energy status of their city/neighborhood/school – which activities are the most energy-consuming ones? What can people change to save more energy? Afterwards, Science Teams look for solutions to reduce energy consumption of the city/neighborhood/school.

Resources to find out more about this Challenge:

- Information about The European Green Deal https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN (available in 23 European languages);
- Urban Agenda for the EU https://ec.europa.eu/futurium/en/urban-agenda-eu/what-urban-agenda-eu;
- Clean Energy for all Europeans https://ec.europa.eu/energy/topics/energy-strategy/clean-energy-all-europeans_en;
- A Roadmap for moving to a competitive low carbon economy in 2050 – factsheet in EN https://ec.europa.eu/clima/sites/clima/files/strategies/2050/docs/roadmap_fact_sheet_en.pdf; full document https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52011DC0112 (available in 23 European languages).

Linked to Sustainable Development Goals (SDGs):

Challenge 2: Reforming the built environment for the future city

There are technical issues of buildings that can be easily referred to, such as energy and water-saving parameters. There are also materials used in the construction

process that can influence the local microclimate and the capacity of buildings to cope with extreme heat or cold.

We can also look at buildings from a different perspective: they have an important role to play, especially when we think how they impact the city functions and shape. For example, housing patterns may raise the city's density and thus positively influence non-motorized transport, as well as limits urban sprawl.

We spend a significant part of our lives in buildings, so they impact the life-attitude we have. Limited urban space makes us think about the buildings not only as providers of their usual services but also from the perspective of greening the city, thanks to e.g. green walls and roofs, and even as "carbon sinks" storing carbon dioxide.

Buildings and their vicinity are important for yet another reason. Different construction materials as used in cities, practically all of the infrastructure and buildings and everything we need to make our cities function, burden the thermal environment and generate the urban heat island.. In such case, tthe nnual mean air temperature of a city with 1 million people or more can be 1-3°C warmer than its surroundings. Few degrees doesn`t sound like a lot but in the evenings the difference can be as high as 8-12°C, especially in southern European regions.

Heat islands can affect cities by increasing energy demand for cooling and costs forair conditioning, air pollution and greenhouse gas emissions, water pollution and can also cause heat-related illness and mortality. Solutions to urban heat island are simple and nature based – like using light colored and cool construction materials, reducing traffic in cities (which acts as a heat source), developing pocket parks and planting more trees and other vegetation, increasing shading, etc.

Keywords: buildings, standards, water management, heat islands, green spaces, energy efficiency, greenhouse gases (GHG) emissions, living comfort, vertical gardens, green rooftops, accessibility

Proposed discussion points:

- What would you change in a building you are currently using or residing (and to its close surrounding area) so as to make it more environmentally friendly?
- What were the local, traditional building patterns and materials used in your area? Are they environmentally friendly and – if so – could they be more widely used?
- What is your preferable place and type of building to live and work in? Discuss your choices with colleagues and check which of these are the friendliest for the environment.

- Do you feel the difference between being close to buildings within green urban spaces and to ones that are in dense city areas with limited, if any, greenery?
- How can buildings and their vicinities be changed to make them greener and more resilient to extreme weather events, such as rain downpour, or to urban heat? Can nature-based solutions play a role in this regard?

Exemplar Science Team's projects:

Warm, warmer, hot! How to cool down our city/neighborhood/school? – Science Teams investigate temperature conditions in their city/neighborhood/school (air temperature /surface temperature – different parts of the city / different times of a day, a year/different materials etc.) looking for the specific places where a heat island effect is the most visible and how it affects citizens. Afterwards, Science Teams look for solutions to cool down those spaces using cool materials and nature-based solutions (green solutions) at the first place.

Drought in the city. How to keep water in our school yard? – Science Teams investigate conditions for water circulation in the surrounding of the school building (rainfall measures, investigation of surface permeability and presence of green areas – land cover, rainwater drainage system). Afterwards, they look for solutions to keep water in their school yard so it can be used more effectively.

Growing cities. How to provide equal place for humans and nature in the city? Science Teams investigate how the city and the wider region have changed in the past years – how much has it expanded in the last 10-20-30 years? What was the share of green spaces with years? Has the city center changed (new buildings, change in land use or land cover) and what are the impacts to the city's identity and to the quality of life? What are the plans for development of i.e. their school surrounding? Afterwards, Science Teams look for solutions to redesign particularly "grey" part of their city (or maybe the one which will be revitalized by the city council in the next few years?) to propose solutions, also in view of providing more space for humans and nature.

Resources to find out more about this Challenge:

- Urban Agenda for the EU https://ec.europa.eu/futurium/en/urban-agenda-eu/what-urban-agenda-eu;
- European resources on energy efficiency https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/%20energy-performance-buildings-directive_en;
- A Roadmap for moving to a competitive low carbon economy in 2050 – factsheet in EN https://ec.europa.eu/clima/sites/clima/files/strategies/2050/docs/roadmap_fact_sheet_en.pdf; full document https://eur-lex.europa.eu/legal-

content/EN/ALL/?uri=CELEX%3A52011DC0112 (available in 23 European languages).

Linked to Sustainable Development Goals (SDGs):

Challenge 3: Regenerating urban space to connect people in a healthy environment

Infrastructure is not only about the construction sites and the materials that are used in the process, but also about the shift in the way we imagine how infrastructure looks like. Thankfully our perception is already changing – not all of the infrastructure has to be built and be the so-called grey one. Wider applications of Nature-Based Solutions are necessary, especially for urban dense neighborhoods or the already overloaded sewage systems, not to mention urban heat or heat waves.

Nature-Based Solutions are a key aspect for protecting the city's biodiversity as well as balancing its microclimate. They must also be seen as an integral part of caring for public health. Green and blue infrastructure offers solutions to a wide range of environmental, climate and social problems – from limiting the urban heat island effect to ameliorating the impacts of extreme weather conditions, also associated to climate change.

Regenerating urban spaces to green areas contributes to a balanced thermal environment with less air pollution; a healthy environment is thus developed for all city residents, especially the most vulnerable ones. At the same time, green areas support social exchange and to this end they can ameliorate social divides.

Keywords: nature-based solutions, green areas, urban biodiversity, water management, air pollution, urban microclimate and climate change, public health, urban farming, public spaces, social cohesion.

Proposed discussion points:

- How has your city and the wider region changed in the past years? What much has it expanded in the last 10-20-30 years?
- Has the city center changed (new buildings, change in land use or land cover) and what are the impacts to the city's identity and to the quality of life?
- What new modes of transport or other infrastructure were developed recently?

- Do you remember a situation in which there was a conflict between a city investment and urban nature? What was its outcome? Would you resolve it in a different way?
- How and where would you create new green spaces in your city? And how does a green space close to home or at school improve quality of life?
- Do you know about parts of your city in which the quality of life is particularly low?
- Is there a pollution source close to the place you live or study that you find particularly disturbing?
- In what way, regenerating urban space can influence less privileged communities?
- Do you consider biodiversity protection an important part of urban policy?

Exemplar Science Team's projects:

Warm, warmer, hot! How to cool down our city? – Science Teams investigate temperature conditions in their city (air temperature / surface temperature – different parts of the city / different times of a day, a year etc.) looking for the specific places where a heat island effect is the most visible and how it affects citizens. Afterwards, Science Teams look for solutions cool down those spaces using nature-based solutions (green solutions) at the first place.

Stay green – stay connected. How to create a city with a good social climate? – Science Teams investigate location of different green spaces in their city and how they affect the quality of local residents' life (How do they use those spaces? What do they think about them?). Afterwards, Science Teams look for solutions to redesign/regenerate those green spaces (or create new ones) so they can help local communities (particularly those less privileged) to flourish.

History of growing cities. How to provide equal place for humans and nature in the city? Science Teams investigate how the city and the wider region have changed in the past years – how much has it expanded in the last 10-20-30-50 years? (Students are looking for maps for 50 years ago. They choose few most characteristic maps to work with. Then they make coverage map of the city as it grows so as to assess the changing patterns of the city. How has the location/status of green spaces, local biodiversity centres, changed over the years? Has the city center changed (new buildings, change in land use or land cover) and what are the impacts to the city's identity and to the quality of life? What are the plans for development of i.e. their school surrounding? Afterwards, Science Teams look for solutions to redesign particularly "grey" part of their city (or maybe the one which will be revitalized by the city council in the next few years?) so as to provide equal space for humans and nature. The greatest attention should be paid to the development or disappearance of green areas and its impact to healthy environment and healthy people. The task is also to predict how city will be growing in a future.

Resources to find out more about this Challenge:

- Urban Agenda for the EU https://ec.europa.eu/futurium/en/urban-agenda-eu/what-urban-agenda-eu;
- European resources on Nature-Based Solutions https://ec.europa.eu/research/environment/index.cfm?pg=nbs.

Linked to Sustainable Development Goals (SDGs):

Challenge 4: From waste disposal to resource efficiency – circular economy at the city scale

Many natural resources are fundamental to our health, well-being and quality of life, so it is essential that we respect the natural limits of the planet. Growing global demand is adding pressure on the environment, whereas the quest for more resources is increasing.

Resource efficiency means using the Earth's limited resources in a sustainable manner while minimizing impacts on the environment. It allows us to create more with less and to deliver greater value with less input. It also supports the shift towards sustainable growth via a resource-efficient, low-carbon economy and promotes a fundamental transition towards the reuse of resources as well as the minimization of waste, thus away from a linear economy where resources are simply extracted, used and disposed.

A circular economy is an economic system aimed at eliminating waste and the continual use of resources. Circular systems employ reuse, sharing, repair, refurbishment, remanufacturing and recycling to create a close-loop system, thus minimizing the excessive and unnecessary use of resources and the production of waste, pollution and carbon emissions. This regenerative approach is in contrast to the traditional linear economy, which pursues a "take, make, dispose" model of production.

A truly sustainable urban policy requires local authorities to act towards recourse efficiency, thus creating added value for their citizens and a vibrant local and regional economy.

Keywords: production and consumption, resource efficiency, waste management, circular economy.

Proposed discussion points:

- Is it possible to produce more value with fewer inputs, to lessen our impact on the environment, and to consume in a more intelligent fashion?
- Can we use resource efficient alternatives and boost recycling?
- Have you ever considered repairing or reusing things that you already have over buying new ones?
- Do you think such a mindset could be employed by the city's authorities as well as its people?
- Do you know what happens to waste produced in the city? Do you know where does it end – in a landfill, incinerator, or where it may be recycled?
- What are the types of resources that are not widely available in your city and therefore are imported? Do you know if they are re-used in the local economy?

Exemplar Science Team's project:

Towards less-waste / zero-waste cities. How to turn our city into eco-one? – Science Teams investigate the waste management system in their city – what happens with the waste produced? Where does it end – in a landfill, incinerator, or maybe gets recycled mainly? – as well as customs habits – What is the average production of waste in the city? Do (and what) people think about the waste they produce? Afterwards, Science Teams look for solutions to decrease amount of waste produced as well as to improve waste management.

Let's repair. How to turn our city into eco-one? – Science Teams investigate a map of repair points (shoemaker, tailor, repair of household appliances and computers). Afterwards, Science Teams campaign in their school to encourage the use of these points. Students can also organize a repair action at their school. They should find people who can, for example, sew clothes or repair the computer. In return, a person in need of repair could repay them with help in learning or a delicious cake.

Resources to find out more about this Challenge:

- Roadmap to a Resource Efficient Europe https://ec.europa.eu/environment/resource_efficiency/about/roadmap/index_en.htm; full document https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011DC0571 (available in 23 European languages);

- A new Circular Economy Action Plan for a Cleaner and More Competitive Europe https://ec.europa.eu/environment/circular-economy/index_en.htm.

Linked to Sustainable Development Goals (SDGs):

Challenge 5: Moving around the city – green transport and mobility patterns for community development

Despite the fact that more and more activities, especially related to work, can be done at home, it is hard to imagine a significant decrease in demand for transport around the city. The growing number of urban inhabitants will make us rethink our transportation habits, whether we like it or not. Individual motorized transport is highly inefficient in urban areas, both from the economic and environmental perspective; alternatives can be sought in public transport and non-motorized movement around the city.

New, environmentally friendly, modes of transport are needed, taking advantage of new technologies and better fuels. In addition, the redesign of the urban space may allow the necessary facilities such as shops, schools and greenery within walking/cycling range so as to reduce motorized transport. The latter produces noise and air pollution, increases energy consumption and contributes to the emission of air pollutants and greenhouse gases.

It is important to note that revitalizing neighborhoods has positive environmental and social effects. Yet, it also has a positive mobility dimension, as the relocation of people mainly to the city center is avoided and traffic is thus controlled.

Keywords: transport, mobility, spatial planning, air pollution, non-motorized transport, pedestrians, biking, public transit

Proposed discussion points:

- How do you move around your city?
- Do you think it is easy to visit afriend of yours living in a different neighborhood or a place of high environmental significance (such as National Park) in the metropolitan area?
- Which are the connections between dominant transport modes and other aspects of urban life, such as spatial planning?
- What inconveniences of current mobility patterns in your area can you point out?
- What types of air pollution resulting from transport do you see?
- Are there any new transport technologies or new types of fuels which can support a green shift of transport?
- What barriers exist in your area for non-motorized transport (e.g. biking)?

- What changes in local policies would – in your opinion – help in promoting more green transport and mobility in the place where you live?

Exemplar Science Team's projects:

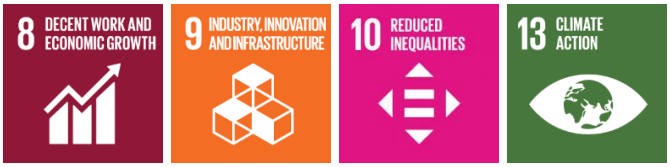
Green moving around the city. How to improve our mobility patterns to help the community flourish? – Science Teams investigate how people move around the city (and in the metropolitan area) and what is the impact of specific means of transportation on environment (pollution, use of nonrenewable sources, etc.) and humans (health, daily routine – time they spent moving around the city etc.). Afterwards, Science Teams look for solutions to improve transportation in the city as well as to convert it to green.

Let's ride! How to make a bicycle-friendly city? Science Teams are looking for places and routes where cycling can be promoted. . Students' base their work on their own experience, observations, discussions with experts and surveys with residents. The result of the project is a cycling map that will be forwarded to the city hall.

Resources to find out more about this Challenge:

- Urban Agenda for the EU https://ec.europa.eu/futurium/en/urban-agenda-eu/what-urban-agenda-eu;
- A European Strategy for Low-Emission Mobility https://www.eea.europa.eu/policy-documents/a-european-strategy-for-low; full document https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52016DC0501 (available in 23 European languages).

Linked to Sustainable Development Goals (SDGs):



Challenge 6: Innovation for social and environmental benefit

While innovations cannot by themselves solve each and every challenge people face in cities, they can be a useful tool in a varied array of topics - from fighting the climate crisis up to broadening possibilities for civic participation in urban life. While most innovations are technological, they also may be also social or governance ones.

A smart city uses innovative data collection and assimilation systems (earth observation, ground sensors, geographic information systems) as well as information and communication technologies (ICT) for better resource use, less emissions of greenhouse gases and improved air quality, smarter urban transport networks, upgraded water supply and waste disposal facilities and more efficient ways to light

and heat buildings. It also means a more interactive and responsive city administration, safer public spaces and meeting the needs of an ageing population.

Attention needs to be given to the fact that innovation alters status quo and therefore can create, if inappropriately used, social unease, for instance in the case of ride-hailing apps, autonomous cars or the use (and abuse) of personal data. To get the most out of the virtues of innovation we must not only be open to experimentation, but also to democratic control over open, public data.

Keywords: innovation, smart city, information and communication technologies, data, carbon footprint, internet of things

Proposed discussion points:

- Do you use any apps having a positive impact on the environment? In what way do they improve quality of life?
- Can you name an innovation that has both positive environmental and social impact, especially at the city scale? What is the role of earth observation in particular?
- What makes a city "smart" in your view? Is technology the only sphere where "smartness" occurs?
- Can you name technologies which make cities smarter for better resource use, less emissions of greenhouse gases and improved air quality?
- How can data help in promoting local sustainable development in your area? What data on the state of your city you find lacking or hard to reach?
- Do you see a risk of "data overload" limiting the scope of comprehension of people? If so, how would you address this problem?

Exemplar Science Team's project:

Innovative eco-city. How to help our city to grow green with use of modern technologies? – Science Teams investigate what kind of innovations of both positive environmental and social impact (technologies, apps, social innovations etc.) have been implemented in their city so far – what is the purpose of their implementation? How do they help the residents? What are the areas which are not covered yet? What are the needs of local communities which can be fulfilled by new technologies? Afterwards, Science Teams look for new possible solutions to help their city grow green (they can initiate 'green hackathon' in their city or develop some simple apps by themselves?). They interview experts. Students are looking for specialists dealing with technologies for innovative cities and promising start-ups in this subject. Then they organize a meeting at the invitation of which experts answer questions from young people.

Resources to find out more about this Challenge:

- Smart Cities – Smart Living Policy https://ec.europa.eu/digital-single-market/en/smart-cities;
- European resources on smart cities idea https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en.

Linked to Sustainable Development Goals (SDGs):

Part B: Requirements and operational patterns of the Science Teams

What is a Science Team?

PULCHRA project will explore the open schooling concept through the theme "Cities as urban ecosystems" with a view to creating new partnerships in local communities to foster science education for all citizens. Schools, in cooperation with other stakeholders, will become agents of community well-being, to be explored through the themes of natural environment, the built environment and the socio-economic environment in cities. This is of considerable importance, given the urgency and need for cities to be approached as urban ecosystems. The project will introduce the new dimensions of data policy and progressive methods of monitoring the urban ecosystems using products and services of the EU science and operational programme, e.g. Copernicus, which support citizen science activities all around Europe.

City Science Team will be created in each school participating in the project, with participation mainly comprised of teachers and students but also parents, professionals from the business community, scientists from Universities and research centers, local administrators, citizens, etc.

The work of the Science Teams will focus on bringing real life projects related to cities as urban ecosystems into the classrooms through focused collaborations of school communities, scientists, professionals and enterprises.

Examples for real life projects are manifold. They may relate to investigating climate effects of urban areas, energy efficiency, nature based adaptation to climate change, transportation and many more. Issues such as how to protect vulnerable persons from excessive heat waves, how to support urban health in the city or how alternative modes of transportation support sustainability goals are mere examples for local research and activation which relates to overarching and global challenges as laid out for instance in the UN sustainable development goals.

City Science Team members will for example:

- "experience science" through the implementation of the City Challenges, also open to the general public, in which they will explore local challenges of the urban areas and look for pathways towards possible solutions and opportunities for participation;
- raise their knowledge and science awareness about science based approaches through own experience with scientific methods and through collaboration with local research centres, Universities and scientific associations, open activities, through the City Challenges themes;
- bring in the concept of the city as an urban ecosystem, as well as challenges, findings and solutions to other students, parents and citizens in general, through a series of open activities and the City Reporters actions.

- co-operate as members of the international group within PULCHRA project and share experiences and results with other teams in their country or other partner countries.

Who can join? Guidelines for development of the City Science Teams

City Science Teams should be inclusive and open for everyone, as long as this person is:

- interested in cities and their development,
- eager to get involved in the actions for the better future of his/her city,
- ready to devote his/her time to share experiences, views, ideas on voluntary basis,
- open to collaboration with other members of the community.

Science Teams can include all kinds of stakeholders: students, teachers, scientists, urban planners and landscape architects, professionals, local administrators and citizens living in the area around school, etc. taking into account the particular City Challenge chosen to be explored within the specific school year (Figure 1).

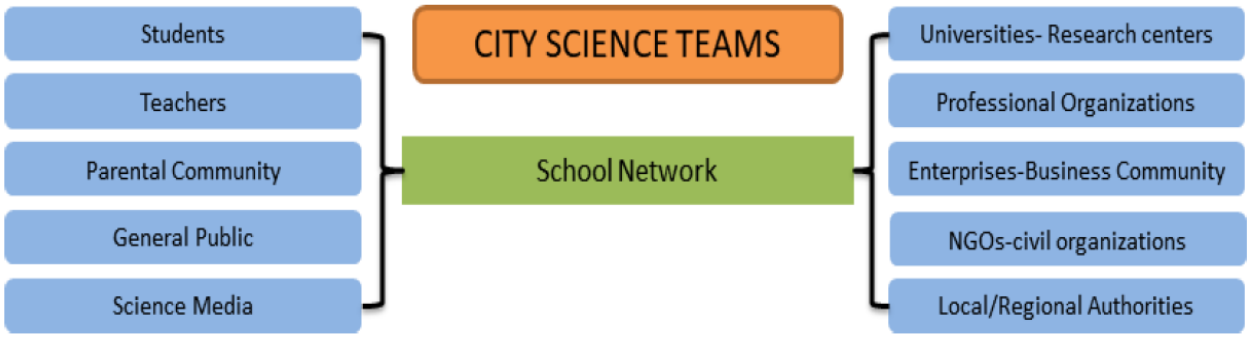


Figure 1. Schematic representation of the Science Teams.

- Main (obligatory) members of the Science Team are students aged 12–18 and teachers.
- Supporting (additional) members of the Science Team can be parents, scientists, professionals, NGO experts, local administrators and citizens living in the area around school as well as students and teachers from collaborating schools , etc. – all people and organizations who can help members of the school community to work on the City Challenge.

Specific supporting members should be selected by each school taking into account the theme of the City Challenge (Annex I).

What is the goal? Tasks of the City Science Teams

Work of the Science Teams will be focused on bringing real life projects related to cities as urban ecosystems into the classrooms through focused collaborations of the school communities with, among others, professionals, scientists and enterprises.

In a frame suitable for the participating schools, e.g. as project weeks, throughout the school year (see the suggested timeline for implementation of tasks in Annex II), in work groups or other organizational settings, each City Science Team will:

- organize its work (enrolment of the main and supporting members), including the organization of the (online or face-to-face) meetings to help all members to get to know each other and build trust between various stakeholders;
- explore the selected City Challenge through a series of activities, including work with educational materials available on the City Challenge Platform and detailed discussion (e.g. during a one-day event organized within the school). During the event, experts from the public/private sectors will engage with students and teachers. Stakeholders such as local citizens (including parents), decision-makers, and representatives of the city, provide their perspectives and expertise, thereby creating a common and broader understanding of the challenge, an understanding of the role of science and technology to address the challenge, barriers to implementation, and some guidance to develop and/or reflect upon possible solutions or solution pathways;
- work on solution ideas – this process includes the exchange of views among the various stakeholders, the engagement of scientists and professionals, guidance to address the challenge with science and technology approaches, and provides the insight to already existing approaches and their limitation to address the city challenge and thereby facilitating and supporting the overall engagement – particularly of the students – in shaping the future of the society;
- present possible solutions to the City Challenge to the local community through an open City Challenge Workshop to take place in the school thus heighten the visibility of schools in the city and the local community;
- discuss exploitation pathways for the solution selected to be communicated to local authorities;
- communicate its work through the Science Reporters[2] and other actions (work of the Science Reporters will be described in details as part of WP9 activities and communications from City Reporters is also covered in WP14 plans and documents);
- populate periodically the City Challenge Platform with the results of the work done.

Each member of the Science Team (main or additional) should take an active part in at least one of those tasks.

[2] Science Reporters take two essential roles: a) documentation of the project for the participants and b) communication with the broader audience.

How is the work of the Team organized? Operational patterns of the City Science Teams

General rules:

- Each school participating in the project creates its own Science Team at the beginning of the school year.
- If there is more than one Team operating in the same city at the same time, it is recommended to link the efforts of these Teams. Schools will be advised by the national project coordinator on how to foster their communication and collaboration.
- Members (teachers, students, supporting members) who joined the group in the first year can continue their work in the second year. However, if preferred by the school community, at the beginning of the second school year a brand new Science Team can be created.

Membership:

- A Team consists of main and supporting members (see the section "Who can join?");
- A Team should consist of at least 1 teacher (Science Team Supervisor) and at least 10[3] students interested in the topic and ready to follow operational rules of the Science Teams;
- A Team should include at least 2 supporting members. They are invited to join the Team by the school community according to the specific needs of the project. The national project coordinator will support schools in this process. However, the final invitation for collaboration should be prepared and sent out by the Science Team itself;
- There is no maximum number of members defined;
- Additional main or supporting members can join the Science Team in the course of the project, if interested in the work done and ready to actively take part in the action;
- Students should take part in the whole project. If a student has to leave a Team during the project, the Science Team Supervisor and Challenge Captain (roles specified below) should make sure that his/her role is taken by some other member (current or new);
- Supporting members can also join the Team only for a specific period of time – to support specific task(s). In that case, no replacement is needed if they leave the group.

[3] The number of students may be less than 10, in the event of the selection of a school in a small town or city.

Roles:

- Each member of the Science Teams should undertake a specific role, adequately described as far as the the work to be done. Each school will define the roles of the participating members of the Science Team on the basis of the structure of the school and the priorities set. Roles can be combined, if needed.
- Teachers can become for example:
    - a Science Team Supervisor – a teacher who takes care of the whole Team, helping to organize its work, supervising students and staying in constant touch with the national project coordinator,
    - a Science Team Mentor – a teacher supporting scientific background of the project, helping students to get in touch with specific researchers, professionals, experts, companies and supervising this cooperation,
    - a Science Reporters Mentor – a teacher supporting work of the communication group with a Team, i.e. language teacher, IT teacher, etc. Thus, this teacher may not have a specific scientific background.
- Students can take the role of:
    - Challenge Captain – this student coordinates the work of the Team (takes care of a timeline, tasks to be done, etc.) Some Deputy Captains can be also assigned depending on the general number of the City Science Team members;
    - Group Leader – leaders of specific task groups (Explorers, Researchers, Science Reporters etc.) who report to the Challenge Captain;
    - Explorer – students who look for information needed (and find people who can deliver this info) and share the results with other members of the Science Team;
    - Researcher – students who focus on organization and conduction of the (field) research;
    - Science Reporter – students who are responsible for communication and dissemination of the project results. They get in touch with local media, prepare infopress, promote the activity in social media, etc. (work of the City Science Reporters will be described in details as part of WP9 activities);
- Supporting (additional) members of the Science Team can also play different roles for example:
    - experts sharing their knowledge and skills during educational activities for the wider community (workshop, online meetings, etc.),
    - experts/tutors who help the students with data collection, and analysis,

- mentors supporting the students in their work and enhancing their potential by suggesting new learning approaches, elements to be further examined, etc.
- volunteers supporting the implementation of specific actions (i.e. parents helping to organize and promote workshops etc.)

Internal organization of the Science City Teams' work:

- Every Science Team should prepare its own Work Plan which should be followed throughout the year.
- It is also recommended to organize regular meetings of the Science Team members (at least Science Team Supervisor, Challenge Captain and Group Leaders) to evaluate work done, discuss further plans, etc.

Cooperation with the national project coordinator:

- Each Science Team will have its own advisor designated by the national project coordinator; the advisor will support the Team with the organizational issues as well as will take care of the establishing links with experts in view of supporting the Team. The advisor can work with more than one Team at the same time.
- The Science Team should stay in regular touch with the advisor through email and phone communication. Moreover, it is recommended to organize at least 3 online or face-to-face meetings between selected Science Team members (at least Science Team Supervisor, Challenge Captain and Group Leaders) and the advisor to discuss the project's progress. Meetings can be combined with other activities such as workshops organized at school for the public, etc.

Annex I: Examples of the supporting members who can join the Science Team

The following Table shows City Challenges as examples for Themes, which relate to the local living environment and at the same time relate to overarching societal issues. The relationship to these overarching issues is evident, as these themes link to the UN and EU sustainable development goals. However, this list is not exclusive. It should be understood as inspiration for the participants to identify their specific City Challenge. Teaching materials and research guidelines for selected themes listed in the Table, will be provided by the PULCHRA team to support the development of city challenges and the implementation of the science projects.

City Challenge	Theme	Examples of recommended supporting members to join the Science Team
1	**Powering Cities without Harming the Climate** (linked to Climate Neutral Cities, Clean energy and energy efficiency)	experts from the energy sector, climatologists, geoscientists, engineers
2	**Buildings for the Future City** (linked to Climate Neutral Cities, Green Buildings, urban heat mitigation, thermal comfort)	experts from real estate and construction sector, energy experts, architects and civil engineers, city/urban planners
3	**Regenerating Urban Space to connect People in a Healthy Environment** (linked to Sustainable urbanization, nature based solutions, public spaces)	environmental scientists, landscape architects, city/urban planners, sociologists
4	**From waste disposal to resource efficiency – Circular economy at the city scale** (linked to waste management, resource efficiency, circular economy)	experts from a reuse or recycling company, waste management experts, local economy analysts
5	**Mobility Patterns that support Community Development** (linked to Climate Neutral Cities, green transport, Clean Air, social cohesion)	city/urban transport planners, expert from the public transport company, air quality experts, local authority officials
6	**Innovation for Social and Environmental Benefit** (linked to Smart city, carbon footprint, earth observation, big data)	IT/big data experts, earth observation analysts, geographic information systems experts

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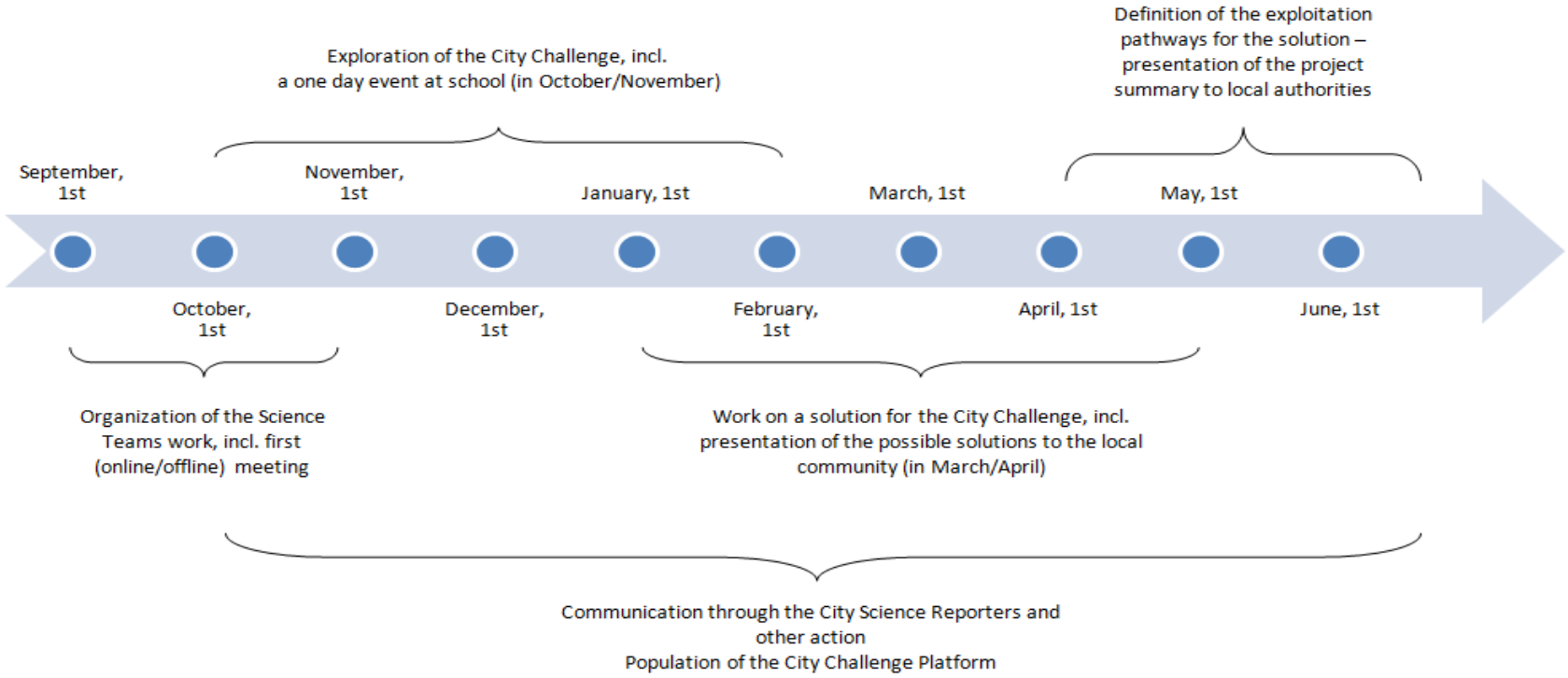
Annex II: Suggested timeline for implementation of the Science Teams' tasks[4]



[4] The timeline for researching a City Challenge requires some flexibility to suit the needs and prerequisites of the participating schools. However, the different steps outlined in the text and the figure should be observed. Furthermore, in exceptional cases as related to covid-19 and its impacts to the school system of the partners' countries, adjustments to the timeline may be applied (e.g. delayed organization of the 1st one day event, potential organization of the event virtually, etc.). In such cases the provisions of the Consortium agreement as far as decision making will apply.