Buildings for the Future City
A pathway towards a City Challenge: The case of cool materials

Which kind of a city do we want to live in?

More and more people live in urban areas. Until 2050, Europe's level of urbanization is expected to increase to more than 80%. Thus, most of us will live in urbanized areas. While we enjoy the advantages of these cultural, societal and economic centers, we also have to cope with the problems of urban areas such as traffic, pollution, climate effects and many more. Climate change puts another burden upon cities, which affects all, poses a particular challenge, and which requires the contribution of all members of the society. Thus, it is essential to develop ideas and concepts of our future cities and to help shape our own living environment.

Cities can be understood as living organism. They grow, change, have a metabolism and an own character. Cities shape many aspects of our lives ranging from **a**rchitecture / housing to **z**oological gardens, from culture to economics, from history to future, from local identity to global interaction. As many aspects and dimensions a city has to offer, as many city challenges are there to address. The PULCHRA project encourages the participants to use their own imagination, their creativity and their potential to make the school an open learning environment and to help shape the future of your own city.

While the relevant or interesting issues for each city and school may vary from place to place, climate change and climate adaptation is an issue, which affects all of us. Thus, we chose this topic to exemplify the development of a city challenge. This example may serve as a blueprint or just merely as an inspiration to start rethinking the societal role of schools based on the Open Schooling concept. In the process, schools become central sites for innovation and social participation, spreading new concepts for the future throughout society.

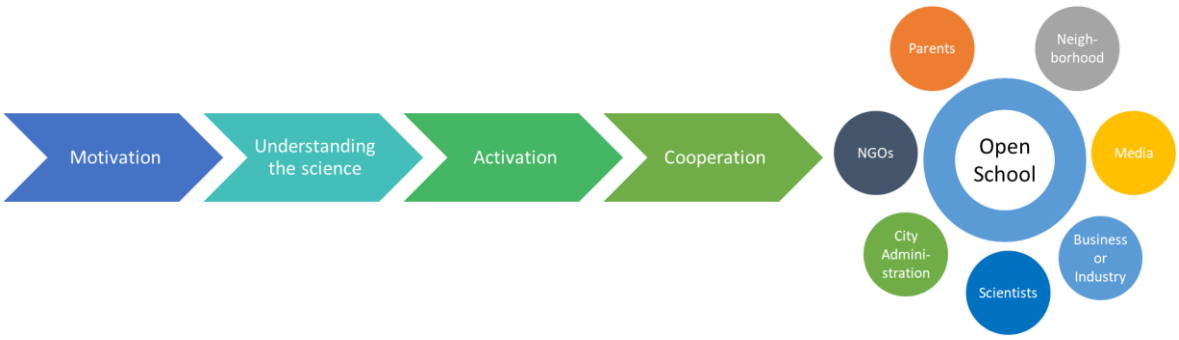

Figure 1: Concept of a city challenge

Thus, this example for a city challenge builds upon the above-described educational materials. Figure 1 provides an outline of the concept of a city challenge. Students are motivated and oriented towards an issue of interest. Here we chose the example of different types of urban surfaces and their effect upon the urban climate. This example shows how the different participants and stakeholders have an impact upon the urban climate. An owner of a house

may choose to cover the property with a natural surface thus reducing the urban heat through evaporation or to build a tared parking lot. A city, businesses, NGO's etc. have similar choices to make and scientists help to understand the impacts and consequences.

Understanding the effects of the choice of different surfaces and materials used to build a city is a good example to apply an Open Schooling concept to illustrate the need for cooperation and participation and to provide a mechanism to facilitate active citizenship for all participants.

As the choice of materials used in a city has a decisive impact upon the local climate, all participants have the ability to help building a healthy and pleasant urban climate, which provides a good living environment. However, with climate change we will be faced with temperatures more frequently exceeding a comfortable range, with all its negative effects upon human wellbeing, health, economy, society and ecosystem functions. Mapping the school environment (educational material P12) is a good starting point to understand the different materials, which exist in an urban environment. Building and experimenting with the Cool City Lab (P30, P31) allows investigating the thermal effect of different surfaces in terms of energy transfer mechanisms and resulting heat in a building (or in the climate box of the experiment).

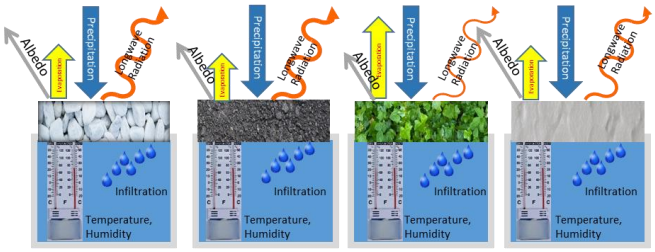

Figure 2: Conceptual design of the Cool City Lab

Figure 3: Picture of a Cool City Lab

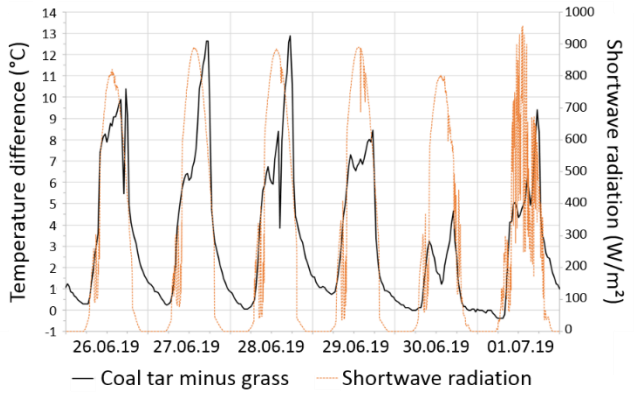

Figure 4: Example of the temperature differences in two box with different cover (black line) and shortwave radiation (orange)

Figure 2 shows a sketch of the conceptual design of the Cool City Lab. Figure 3 shows an image of such a lab.

> Tasks: Use an infrared thermometer to measure the different surface temperature and to investigate the effect of evaporation at the surface.

Particularly during a day with clear sky and lots of sunshine, a clear effect of the cooling by vegetation will be visible in the Cool City Lab (see Figure 4).

The temperature in the box will change as a result of the energy fluxes at the surface. In fact, the color of the box does not matter much, since the boxes are made of styrofoam, which is a well insulating material. Only the lid of the boxes are made of different materials (here tar, grass, sand, and stones). Students can easily exchange the

surface used at the top and pursue their own hypotheses regarding different materials.

Task: Take a piece of aluminum foil and measure its surface temperature with an infrared thermometer. Take the measurement outside. While measuring, place the aluminum foil on a surface and hold it above your head, respectively.

Do you get the same result if you measure the temperature of the aluminum foil from below and from above? Why?

If done properly you will observe large differences in the surface temperature reading. Why is this the case? The answer is hidden in the physics of this measurement. Not all materials have the same ability to produce longwave radiation. This is called the emissivity of the material and the Stefan-Bolzmann law explains the relationship between actual temperature and radiation temperature that is measured by an infrared thermometer. Some materials can be apparently cool, while others really keep a city cool. The latter is the case, if the shortwave radiation energy is either reflected straight back into the atmosphere or if the absorbed radiation is used to evaporate water.

Based upon this understanding of science which connects physics, environmental sciences and chemistry (e.g. the choice of the kind of paint determines the reflection of radiation) students may explore their neighborhood and identify surfaces which either contribute to cooling the city during a heat wave or do not do so. Documenting their findings may lead to a discourse with parents, families, neighbors, scientists, city administrators and other stakeholders, which shape the development of the city. This discourse in an open schooling approach helps to develop the notion that it is possible, worthwhile, rewarding, and necessary to become an active participant of the urban society, regardless of age, gender, heritage or other criteria. Putting the schools into the center of a City Challenge underlines the role of schools in our society for all from student to city administrator, from parent to politician or businessperson.

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