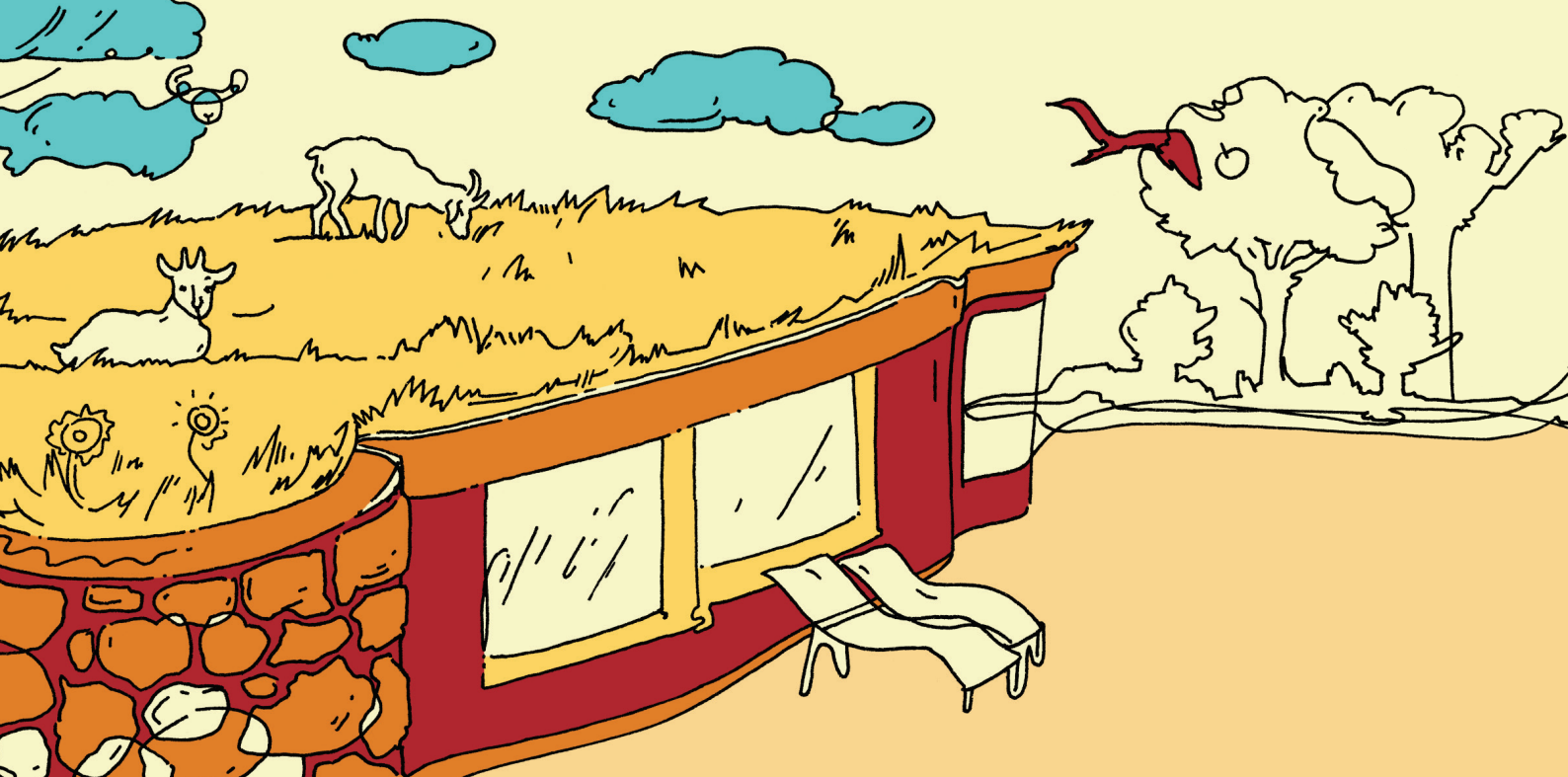


# HOW CLIMATE CHANGE AFFECTS OUR HEALTH



# INTRODUCTION

This indicator book was created as part of the Teaching Green project and should support teachers of students aged 10 – 16 years who are implementing education about climate change.

The educational process is divided into 4 steps. The first step is the creation of a group of students who will implement the project activities. In the introductory part, students fill out also a questionnaire about their attitudes linked to the indicator mentioned below. The second step is theoretical preparation. You can use online learning models or your own resources. The third step consists of practical monitoring of the indicator (at least twice). The result of the monitoring is a presentation prepared by the students containing findings from the practical part. In the final fourth part, students fill out the attitudes questionnaire again and the changes in their character qualities are evaluated.



**Project activities support development of 6 essential character qualities:**

 **mindfulness**

 **curiosity**

 **courage**

 **leadership**

 **resilience**

 **ethics**

You can find these icons next to the exercises.



**Mindfulness**

*wisdom, self-awareness, observation, insight*  
“The awareness that emerges through paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experiences moment by moment.”

**Curiosity**

*open-mindedness, exploration, passion, initiative, enthusiasm*  
“The essential desire for information, the drive to resolve uncertainty.”

**Courage**

*bravery, determination, confidence, risk taking*  
“The ability to act despite fear or uncertainty, in risky situations or when we are feeling vulnerable.”

**Leadership**

*responsibility, accountability, dependability, reliability, selflessness*  
“The relational and ethical process of people attempting to accomplish positive change.”

**Resilience**

*perseverance, grit, tenacity, resourcefulness, self-discipline*  
“The ability or set of qualities that allow one to overcome obstacles.”

**Ethics**

*benevolence, humaneness, integrity, respect, justice, fairness*  
“The moral principles that govern a person’s behavior or the conducting of an activity.”

# CLIMATE CHANGE IMPACT

This indicator is mainly connected to the assessment of the thermal perception and evaluation of comfort or discomfort for the body that may also lead to health risks (for instance in connection to air temperature, humidity etc.) especially in vulnerable areas of our cities.

The rise in temperature caused by the urbanisation can contribute to the escalation of heat-related illnesses, such as heatstroke and dehydration, posing a significant threat to the well-being of urban residents. Furthermore, prolonged exposure to high temperatures can worsen existing health conditions, including respiratory problems and cardiovascular diseases, making it crucial to address the issue for the sake of public health and urban sustainability.

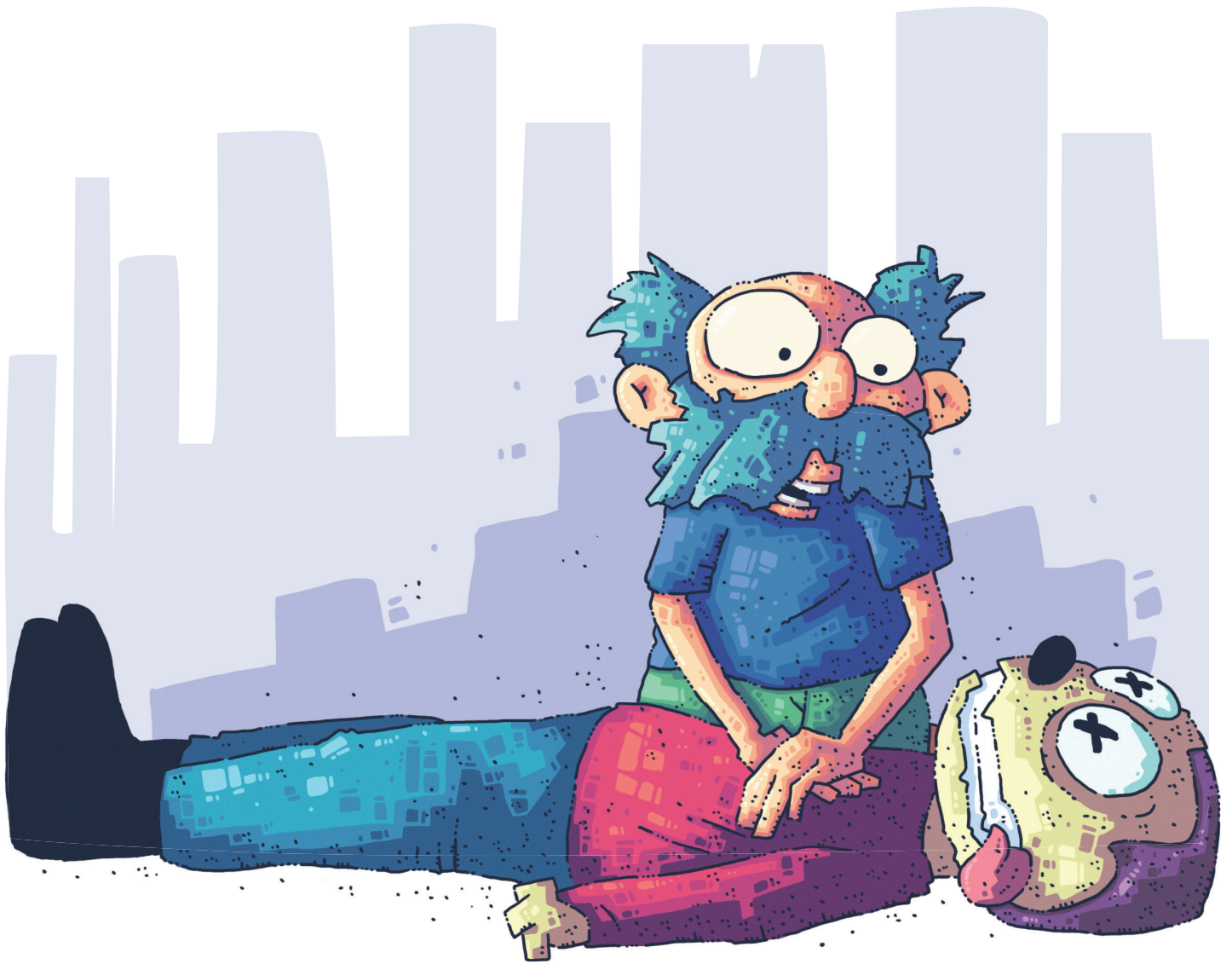
**CITIZEN SCIENCE:** Suggested activity: understanding what is the personal sensation and comfort to environmental conditions and possibly analysing the average population comfort level through online search, interview to the local health service regarding the number of patients for diseases caused by/related to climate change, such as cardiovascular diseases, respiratory diseases, diseases of civilization and their relation to climate change, especially in the summer months.

Sharing the results of the activity (e.g. measured indicators or resulting statistics (e.g., from the questionnaire regarding the thermal comfort) and comparing them with the results of other schools of the same country or foreigner countries.

More health risks connected: air pollution, other extreme weather events which have an effect on mental health, human health, ecosystems health, global health.

**INDICATOR:** Increased health risks associated with the changing climate.



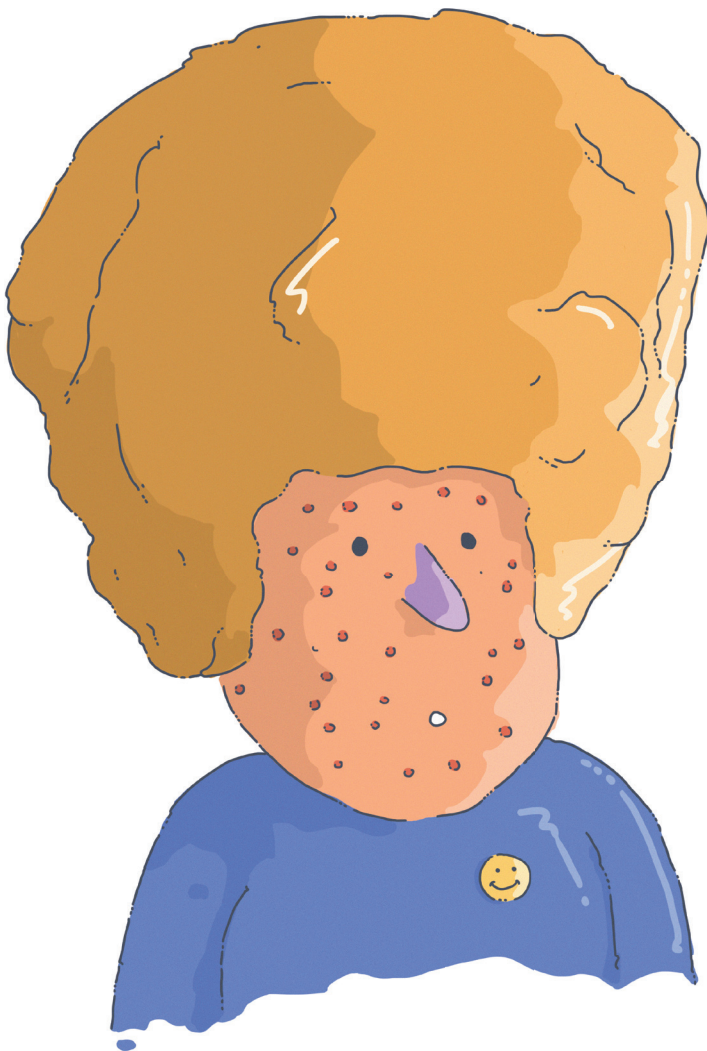


# THEORETICAL PART

## Introduction to students

Most of the people now live in cities. Cities cover an extensive portion of land whose characteristics are changed by urbanisation. Soil is sealed by the concrete surfaces of streets, squares and buildings. Therefore, the micro climate is also affected by this change, since concrete surfaces absorb more energy during the day and release it slowly during the night, creating the so-called **Urban Heat Island (UHI)** effect, which means that in town, air temperature can be from 3 to 9 °C higher than in the rural surrounding area.

The increasing occurrence of heat waves is a major threat to vulnerable people like elders and people affected by diseases like cardiovascular diseases. Due to UHI, heat waves are more intense in cities, and temperatures at night can increase causing negative affects on the quality of sleep. This is an important issue, since sleeping well is important to recover energy at night and being more resilient to heat.



## CITIES AND MICROCLIMATE

UHI can vary greatly from point to point in cities. Each part of a city has its own climate, called **microclimate**, that is caused by the presence of concrete surfaces, buildings, green areas and trees nearby. Not only the presence and the quantity of these elements influences the UHI, but also their spatial distribution: many sparse trees do not have the same cooling effect as a dense and big park. Microclimate conditions affect our **thermal sensation** and **health**.

Outdoor **thermal comfort** is a measure of the feeling and physiological response of our body to the climate conditions around us. The best condition is **thermal neutrality**, when the body temperature is in balance with the external temperature. If our body measures 25 °C as external temperature, it is necessary to maintain this temperature: by wearing clothing in cool seasons and by compensating

for overheating due to higher air and radiant temperatures in the summer. Body disperses heat mainly through radiation (heat loss) and transpiration (sweat uses latent heat to evaporate and cools the skin). A little loss is due to conduction to other surfaces (e.g. pavement).

Among the most frequent symptoms of heat stress are the increase of heart beats to push blood to the skin, where it can cool down; tiredness due to the low quality of sleep which leads to poor decision-making and injuries, and has a detrimental impact on people's mental health; and in extreme case, heat stroke.

Therefore, policy makers need good weather forecasting and thermal comfort evaluation services and warning systems in order to inform and warn the population about health risks when the environmental conditions become extreme. Several indices of thermal comfort have been defined and they take into account the effect of air temperature, relative humidity, wind speed and sun radiation on our thermal sensation while other variables that influence such sensations are generally only partially considered by automatic calculators (e.g., clothing, physiology (e.g., age, gender, metabolic rate etc.)). Thermal sensation can be also estimated qualitatively through questionnaires aimed at describing the thermal sensation of respondents in a given place, who can indicate also which are the environmental factors that influence that thermal sensation.

By performing a survey with such tools (i.e. questionnaires) in specific sites of our towns (i.e. performing a Thermal Walk), it is possible to assess the level of thermal comfort (or discomfort) and reflect on the possible solutions to improve the sites.

For instance, mitigation solutions to reduce the effects of heat waves, can include urban greenery such as trees, green walls, or by placing shading meshes, building insulation, shadow blinds etc.

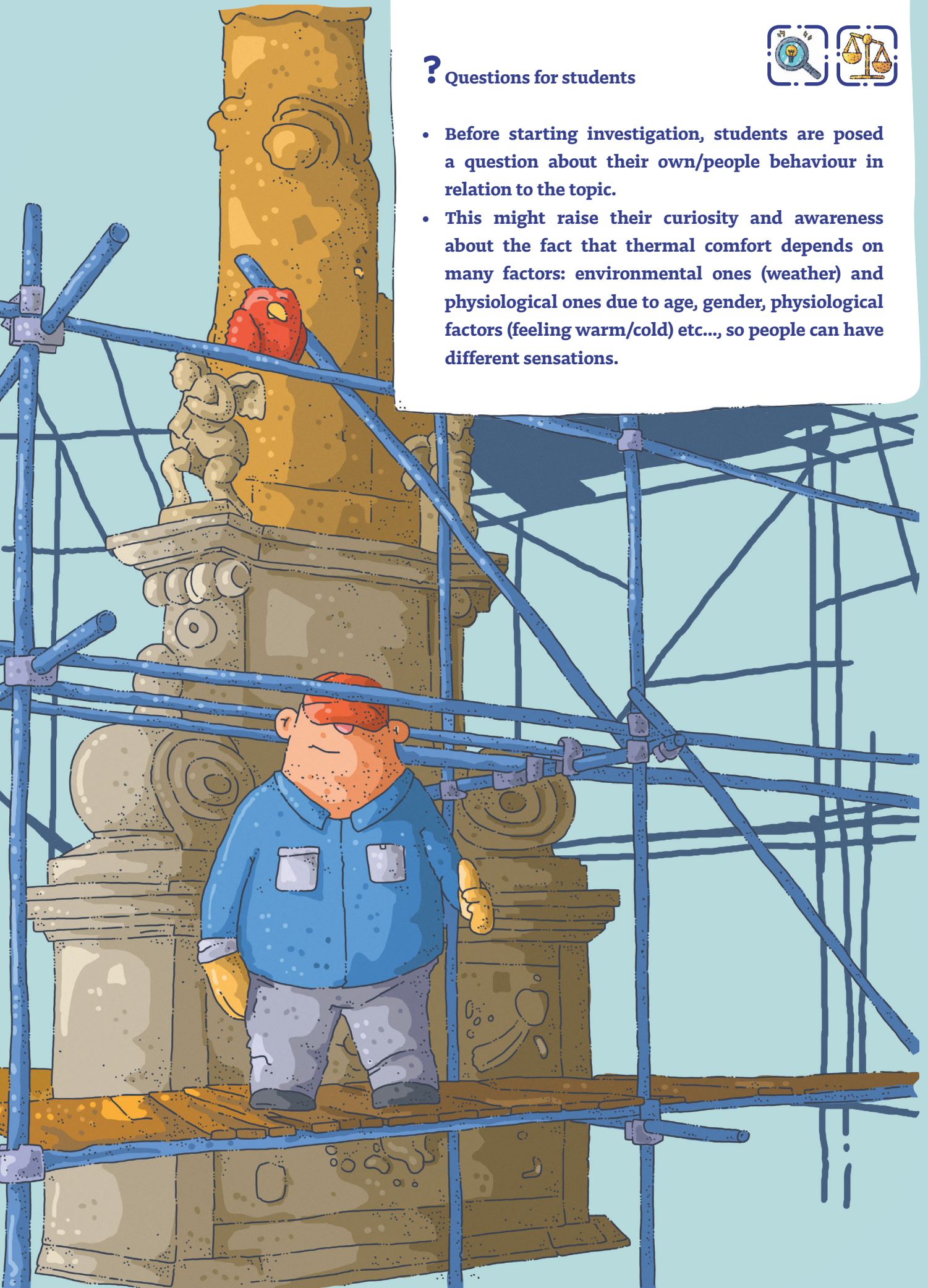
- **Did you know that in cities, calls to the emergency number 112 and mortality rates increase, especially during periods of summer heat?**
- **On one hand, air conditioning reduces indoor temperatures, but on the other hand, it can dangerously pollute the indoor air if the filters are not regularly changed. Additionally, air conditioning units warm up the outdoor air.**

The current lifestyle of humanity, the burning of fossil fuels, and private transportation not only increase greenhouse gas emissions but also deteriorate air quality, leading to health issues for city residents such as respiratory diseases and cardiovascular problems.

Moreover, excessive noise in cities can lead to stress, fatigue, and disruption of sleep cycles. Modern urbanization must take all these factors into account and strive to create an integrated and sustainable urban policy focused on reducing emissions, improving air quality, and promoting a healthier living environment for all residents.







? Questions for students



- Before starting investigation, students are posed a question about their own/people behaviour in relation to the topic.
- This might raise their curiosity and awareness about the fact that thermal comfort depends on many factors: environmental ones (weather) and physiological ones due to age, gender, physiological factors (feeling warm/cold) etc..., so people can have different sensations.





# RESOURCES FOR FURTHER STUDING:

- MODULE 1

- **Powerpoint presentation** in Teaching Green - Activities folder



- MODULE X



- **Videos:**



Cool Towns  
EN with subtitles



Walking in the Shade

## NECESSARY TOOLS:

Questionnaires on thermal comfort, along a route of stops on a map.  
Air thermometer and air hygrometer for air relative humidity.  
The questionnaires are available online.



### HOW TO ORGANISE A THERMAL WALK:

1. Create your own route near the school or in a specific neighborhood of your town, on a paper map or in Google Maps (My maps).
2. Identify 4 stops with different characteristics (e.g., open spaces on asphalt, places with some shade, parks etc.) and mark the stops STOP 1, STOP 2, STOP 3, and STOP END.
3. At each stop of the thermal walk fill in the printable version of the questionnaire at these links alongside the form for INITIAL and FINAL PART:

INITIAL & FINAL  
PART



STOP 1



STOP 2



STOP 3



STOP END



At the end of the thermal walk, in the classroom, Assess the results with the students and discuss the main findings

A full worksheet (with space for additional stop) can be found at:





# PRACTICAL PART

## Aim of activity

To raise awareness of thermal comfort and wellbeing by measuring the environmental variables (**air temperature** and **relative humidity**) and the thermal comfort of a person (with questionnaire) during a **“thermal walk”**.

This is analysed in specific and different urban situations (or around the schools) such as a street canyon, a concrete square, a green square, a park, along a river, trees along a street. It is good to select areas with completely different situations: shade vs. sun; open paved surface vs. tree shade (the stops can be decided by the students).

## Orientation or Engagement

Ask students! As an example:


- **“Why did you choose the clothes you are wearing today?”**
- **“Have you seen someone wearing unexpected clothes? (e.g., light sweater in winter, jacket in summer)”**
- **Why do you think you / they made such a choice?**



Students should reflect on the fact that each of us wears clothes depending on the actual weather and weather forecast but also on our personal feeling of thermal comfort.

The different choices might be connected to gender, age, fashion, sport activity and metabolism, acclimation (with different nationalities adapted to the climate of one's own country).

For example, Northern people adapted to coldest climates thus are more sensitive to heat waves and hot temperatures of the Mediterranean climate, because they are not adapted to such conditions.

- **In general, do you prefer to stay in the shade or in the sun at midday in the summertime in your country?** 
- **Do you know anyone who (or have you ever) experienced a health problem on a very hot day?**  
*(tips: Who was he/she? An elder/a friend/yourself? What was the situation?)*
- **What did you do?**

### ? Questions for students

- **What would be necessary to do to reduce such risks or unpleasant situations? (e.g. teach people how to deal with heat waves, increase the shading of squares and streets, increase the number of fountains, the number of trees and green spaces etc.).**

### Conceptualization

What do you think is the main environmental variable that affects thermal sensation? (e.g. air temperature, humidity, wind, radiant temperature, clothing, age, metabolism etc.)

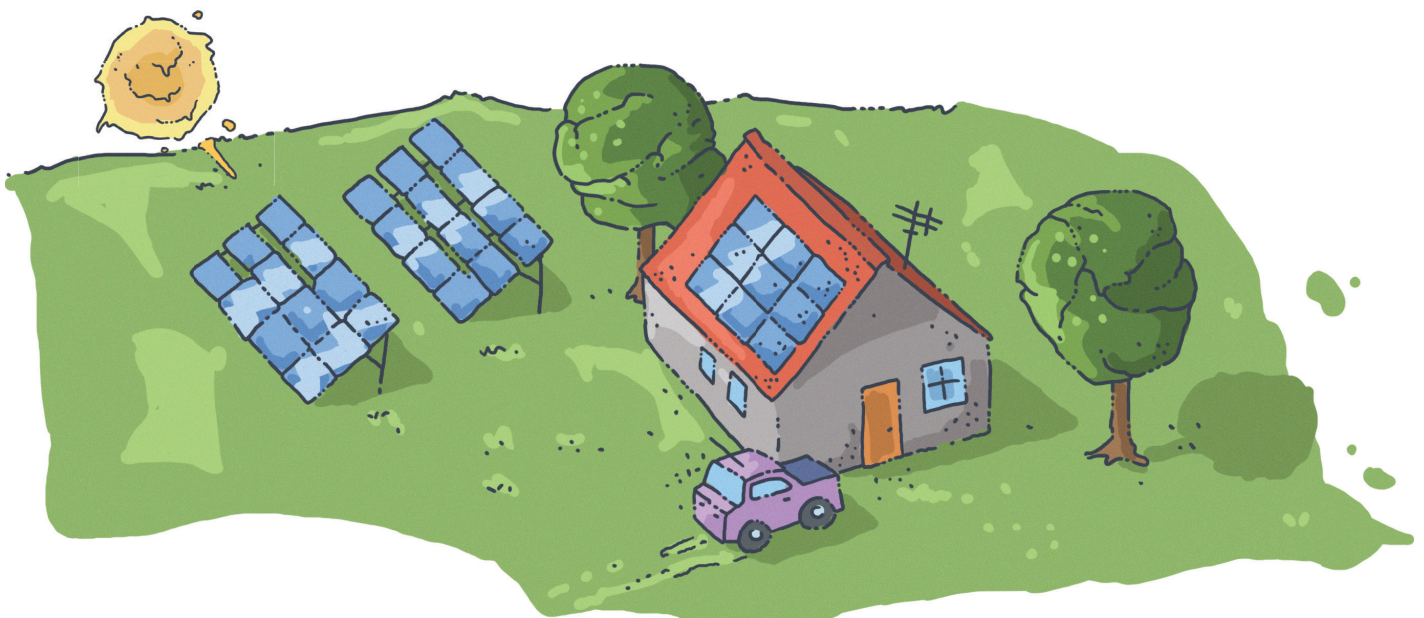
The conceptualization makes students create a hypothesis about the factors and external variables that influence thermal perception and comfort.

Students are then invited to apply these reflections at the level of their town or neighbourhood, for instance, identifying the most vulnerable groups of citizens (e.g. people with health problems, elders and babies) and how urban planning affects it.

### Working in groups, they have to think about the points above:

e.g. on the map, mark their ideas on which areas are the most uncomfortable sites (the hottest in summer) in a specific neighbourhood (or town) and describe them from the architectural point of view, the surfaces and soil cover, investigating how many people are elders and babies (this data can be found in the public statistics).

The reflection deals with the equitable distribution of sites that provide conditions for thermal comfort and wellbeing.





## Investigation

This is the active part in which students assess their hypothesis formulated in the conceptualization. Students become aware of what “thermal comfort” actually means, the variables and the factors that make thermal comfort or discomfort in a real place.

1. Students define a real route in town (walking distance) and decide a few sites (3-4) with different urban characteristics along this route for the investigation (e.g. a street canyon, a concrete square, a green square, a park, along a river, trees along a street, in the shade or in the sun);
2. Students are provided with a questionnaire (the link to the google maps itinerary and the stops will be shared with the students by sending a link or by a QR code to the map) to assess their thermal sensation in each site (or they can develop their own questionnaire on the basis of the annex) and an air thermometer (plus air hygrometer, if possible) (by using low cost devices).
3. Students go along the route and at each stop they observe the characteristics of the site, they measure the environmental variables and fill in the questionnaire (each student).
4. They collect the forms from all students (Google Sheet for Excel) and they calculate simple statistics to identify which were the warmest or the coolest sites, which were the most pleasant variables, the most annoying, if they felt comfortable or not. They can also calculate differences between males and females, sportive people and sedentary etc.

## Conclusions



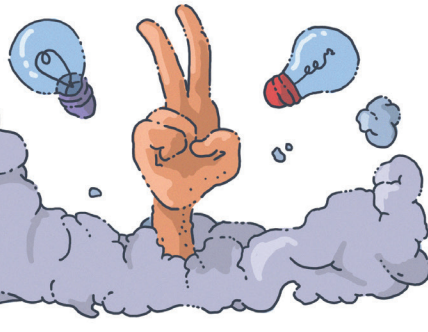
From the results, students think about possible solutions to enhance the thermal conditions and improve the wellbeing and comfort (e.g. suggesting a different urban planning by increasing green areas, trees, and water bodies such as fountains, ponds, rivers..)

**What can be done to enhance the conditions of outdoor spaces for the vulnerable citizens and improve the use of outdoors spaces** (e.g. outdoors activities, playgrounds etc.) and also stimulate green transportation (e.g. green corridors may stimulate walking or biking).



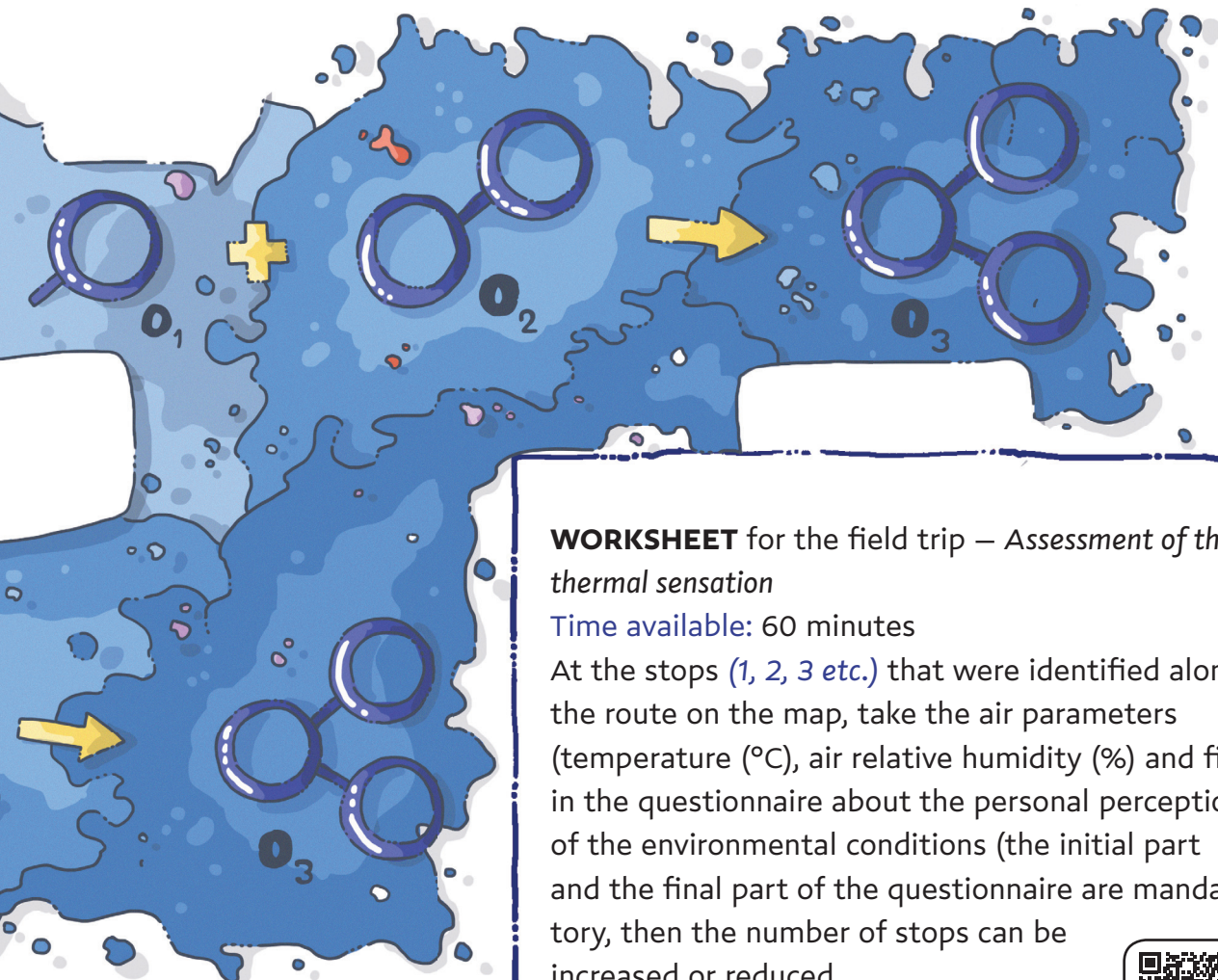


# ACTIVE PART



Students think about the explored area and design a way to improve the thermal comfort e.g. increasing the shade, or implementing green infrastructure to mitigate the urban heat island effect.

They explain the project and the motivation to their peers, school director or mayor, and if they can, can try to implement it.



## **WORKSHEET** for the field trip – *Assessment of the thermal sensation*

**Time available:** 60 minutes

At the stops (1, 2, 3 etc.) that were identified along the route on the map, take the air parameters (temperature (°C), air relative humidity (%)) and fill in the questionnaire about the personal perception of the environmental conditions (the initial part and the final part of the questionnaire are mandatory, then the number of stops can be increased or reduced).

Full working sheets can be found:



## RESOURCES

Green Spaces presentation. Available at:

<[https://docs.google.com/presentation/d/19\\_Kx\\_G4511jvnzv3uFOVELNOs1lmCaAX/edit#slide=id.p1](https://docs.google.com/presentation/d/19_Kx_G4511jvnzv3uFOVELNOs1lmCaAX/edit#slide=id.p1)>

Cool Towns. Available at:

<<https://www.youtube.com/watch?v=98RLMMVxgyI&feature=youtu.be>>

Walking in the Shade. Available at:

<[https://www.youtube.com/watch?v=ebVgyoe\\_xLE](https://www.youtube.com/watch?v=ebVgyoe_xLE)>

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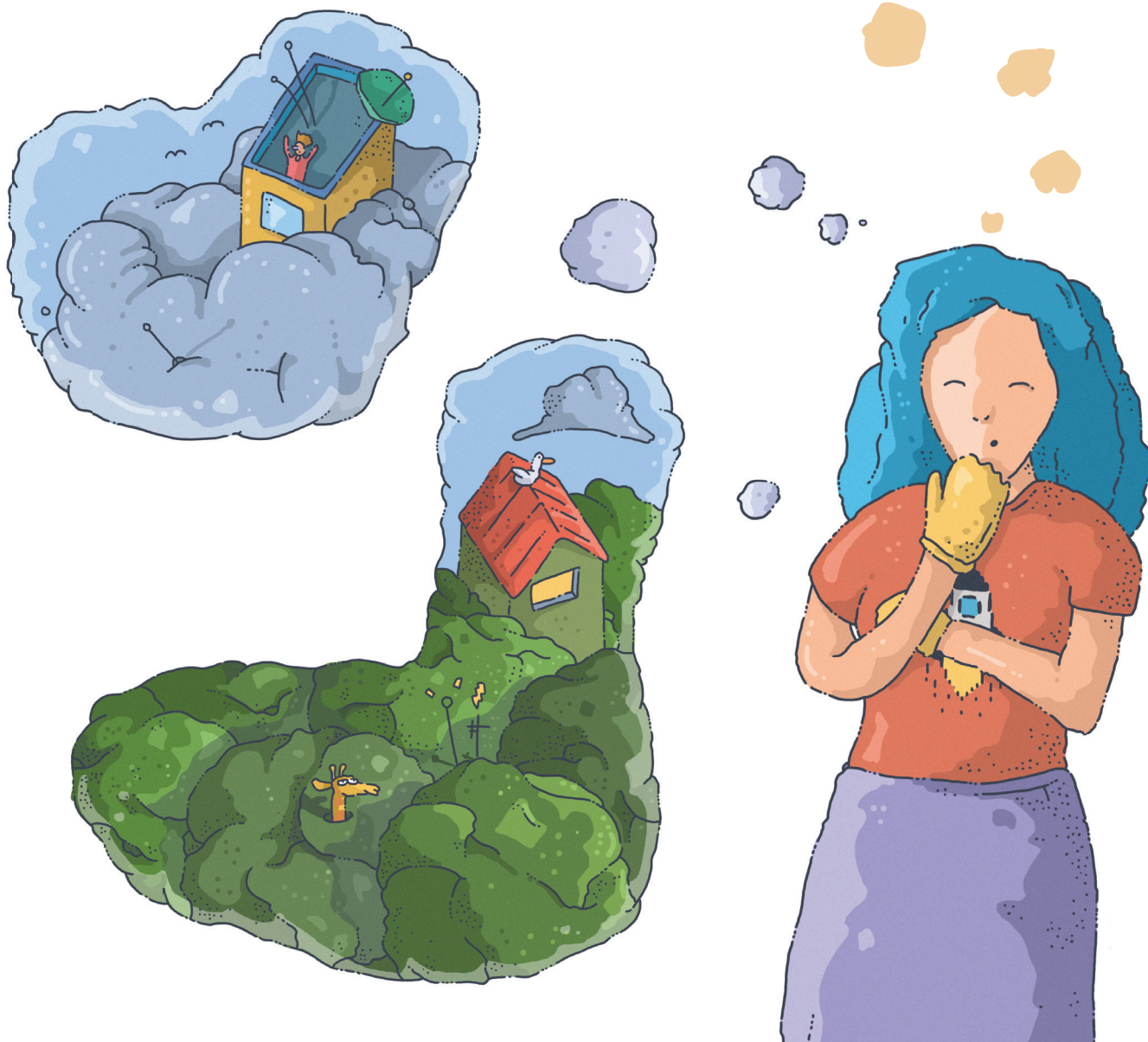
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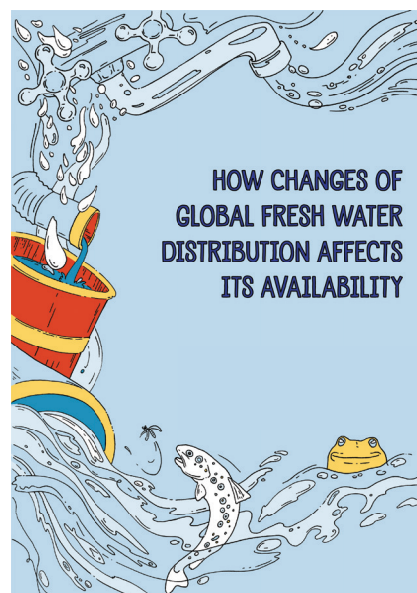
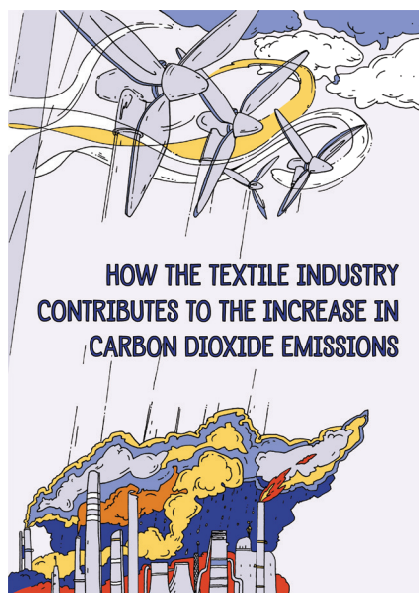
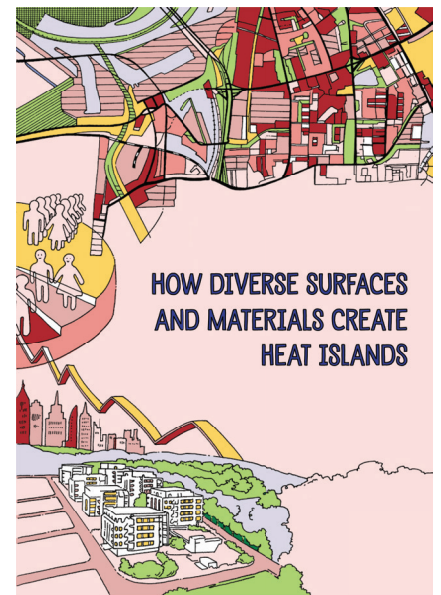
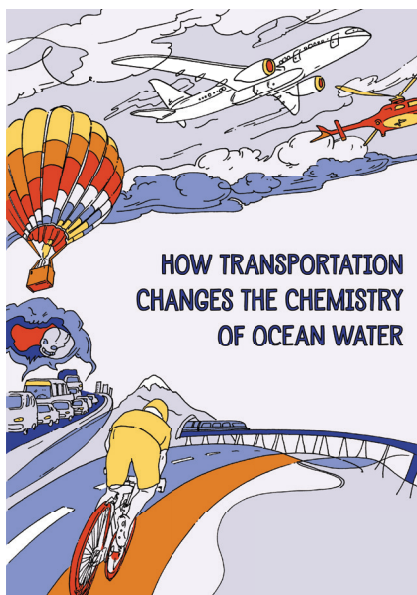
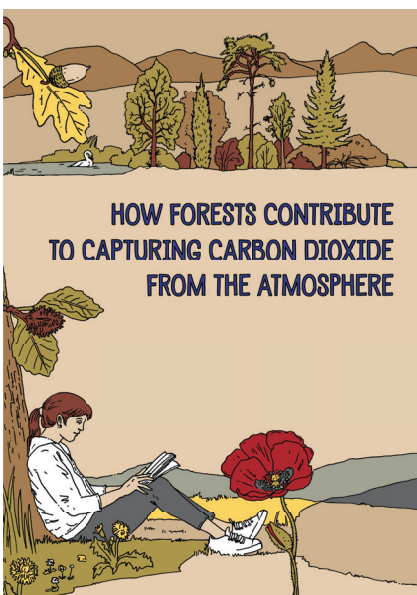
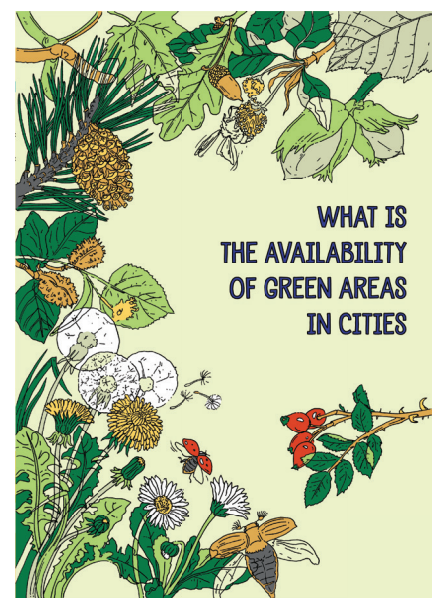
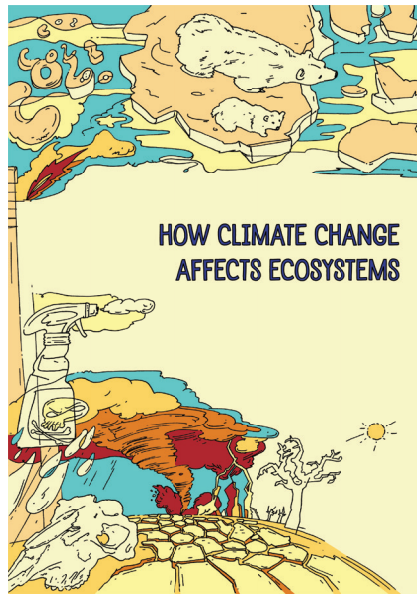
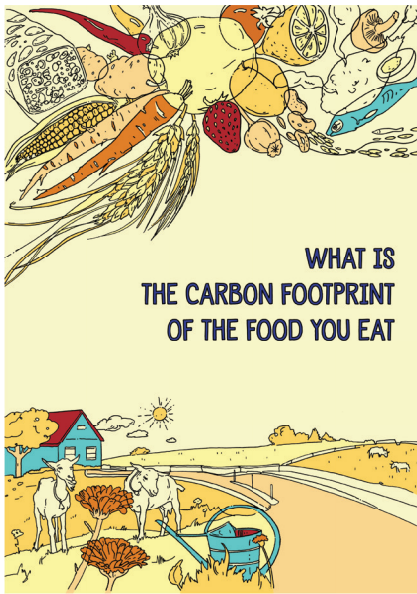
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