

Topic 5:

Sustainable Cities for Smart Urban Growth

Lesson Plans for Children and Youth

Rise Up Against Climate Change!

A school-centered educational initiative
of the Inter-American Development Bank



Rise Up

Against Climate Change

A school-centered
educational initiative
of the Inter-American
Development Bank

Developed by Emma Näslund-Hadley, María Clara Ramos,
Juan Paredes, Ángela Bolívar, and Gustavo Wilches-Chaux

Editor: Steven Kennedy

Design and illustration: Sebastián Sanabria

Copyright © 2016 Inter-American Development Bank. This work is licensed under a Creative Commons IGO 3.0 Attribution-NonCommercial-NoDerivatives (CC-IGO BY-NC-ND 3.0 IGO) license (<http://creativecommons.org/licenses/by-nc-nd/3.0/igo/legalcode>) and may be reproduced with attribution to the IDB and for any non-commercial purpose.

No derivative work is allowed.

Any dispute related to the use of the works of the IDB that cannot be settled amicably shall be submitted to arbitration pursuant to the UNCITRAL rules. The use of the IDB's name for any purpose other than for attribution, and the use of IDB's logo shall be subject to a separate written license agreement between the IDB and the user and is not authorized as part of this CC-IGO license.

The link provided above includes additional terms and conditions of the license.

The opinions expressed in this publication are those of the authors and do not necessarily reflect the views of the Inter-American Development Bank, its Board of Directors, or the countries they represent.



Rise Up Lesson Plans

Our Climate Is Changing

Energize!

Water to Treasure

Intelligent Consumption

Sustainable Cities for Smart Urban
Growth

You Are What You Eat

Ensuring Healthy Environments

Protecting the Land

People Committed to Fight Climate
Change



Rise Up

Against Climate Change

Rise Up is a climate change education initiative of the Inter-American Development Bank that seeks to encourage children and youth to use their creativity and energy to come up with feasible, sustainable, long-term strategies to mitigate and adapt to climate change. This set of lesson plans is one of nine on different climate change topics that can be used independently or together with the

other lesson plans and materials of the Rise Up initiative, including instructional videos, learning games and a Green School Toolkit. Each set of lesson plans includes an introductory text about the topic that can serve as a background material for the teacher or as a text for older students. The lesson plans can be used at the primary and secondary levels of education; they are divided into basic, intermediate, and advanced plans to help each teacher determine what activities are appropriate for his or her students. To find all the Rise Up materials please go to **www.iadb.org/riseup**

*Emiliana Vegas, Chief, Education Division,
Inter-American Development Bank*



Sustainable Cities for Smart Urban Growth

General Introduction to the Lesson Plans	6
» When cities disrespect nature	8
» A dangerous move	8
» Urban heat islands	9
» What can be done?	9
» Sustainable cities: Challenging but not impossible	11
» Defining the sustainable city	12
» Sustainability: Balance makes it real	12
» Adopting principles for sustainability	14
» Sustainability starts with awareness	14
» Ongoing initiatives for sustainable cities	14
» Permaculture: An interesting alternative to sustainable development	15

Lesson Plans at the Basic Level	16
» Basic lesson plan 1: Once upon a time there was a city...	17
» Basic lesson plan 2: I live in a city	26
Lesson Plans at the Intermediate Level	30
» Intermediate lesson plan 1: Sustainable habitat	31
» Intermediate lesson plan 2: Cities vs. natural phenomena	38
Lesson Plans at the Advanced Level	43
» Advanced lesson plan 1: Are we on a heat island?	44
» Advanced lesson plan 2: Is my city sustainable?	49





General Introduction to the Lesson Plans

Once upon a time, there was a place with good soil for plants and good sources of water for wild animals. Many, many plants grew there, and many wild animals made it their home. People liked it too. In fact, so many people wanted it to be their home, they built a city.

The world's big cities—that are now full of skyscrapers and wide concrete avenues, and where the only wild animals live in zoos—once looked very different. Many were farms. A few were jungles or swamps. A handful were desert oases.

Even today, cities cannot be separated from the natural environment. Natural ecosystems provide the resources that cities need to develop and grow, including water, clean air, soil, food, and energy.

Can you imagine what your city looked like before it had so many buildings? Because people want to be near good sources of water and food, many cities are built on top of ecosystems rich in wildlife, such as wetlands and forests. Most are built near sources of fresh water, used for drinking, and waterways, used for transportation.

Some cities can easily tap groundwater, while others must rely on complicated networks of pumps and pipes to get water to their inhabitants.

Cities require many other natural resources as well, such as oil, and construction materials that include timber, sand, gravel, and stone. Some resources must be brought in from distant places, while others are available locally.

Often, cities take natural resources from rural areas and process them in some way, either converting them into another product or refining them. Bread, clothes, and lumber are a few such products. Most of the food that city inhabitants eat is produced in the countryside and brought to the city for processing. For example, wheat may be grown far away and ground into flour before being driven to a city bakery. Likewise, cotton is grown on large farms and shipped to textile factories, where it is transformed into clothes; and lumber from far-away forests is converted into other products, like paper, furniture, and construction materials.

As these examples show, cities and rural areas depend on each other in many ways. Cities depend on rural areas for natural

resources, while people in the countryside look to cities to turn these resources into products. They may also benefit from city services, such as education and health care.

But even though they depend on each other, the relationship between cities and rural areas is increasingly unbalanced. The prices of city products and services are much higher than the original resources from rural areas. Farmers and other rural residents can easily fall into poverty. Many move to cities in search of a better life. In the absence of these migrants, opportunities and services in rural areas may dry up. Meanwhile, increasingly overpopulated cities generate ever-larger environmental impacts:

- » **A transformed landscape.** Expanding cities permanently transform and damage the environment (air, water, biomass, soil) as concrete replaces nature.
- » **Natural resource depletion.** Cities' huge demand for natural resources exceeds the Earth's regenerative capacity, creating shortages.
- » **Waste generation.** Cities create large volumes of household, biological, industrial, and commercial wastes that are not easily assimilated by nature. Some types of waste require specialized waste management systems.
- » **Growing pollution levels.** Cities discharge substances that are harmful to the air, water, and soil, as well as to human health. Meanwhile, pollution from rural areas, such as from chicken and livestock farms, drains into water sources, affecting rural and urban residents alike.
- » **High levels of noise and light.** Vehicles, industries, machines, commerce, streetlights, advertisements, and billboards contribute to noise, light, and visual pollution in cities, affecting the well-being of both wildlife and people.

Mounting waste and pollution, combined with shrinking space, create complications: public health problems, the inadequate supply of basic services, and inadequate housing. Liquid and solid wastes are often dumped indiscriminately into rivers or other ecosystems, with drastic consequences for wildlife, rural communities, and, ultimately, cities themselves.

When cities disrespect nature

Everything in nature is cyclical. Some cycles are quick, such as tidal changes, day and night, the lunar phases, and the seasons. Others are more gradual, such as glaciations, the Earth's changing angle on its axis, and changes in the polarity and convection processes of the Earth's interior. Combined, these cycles regulate and maintain the planet's natural balance.

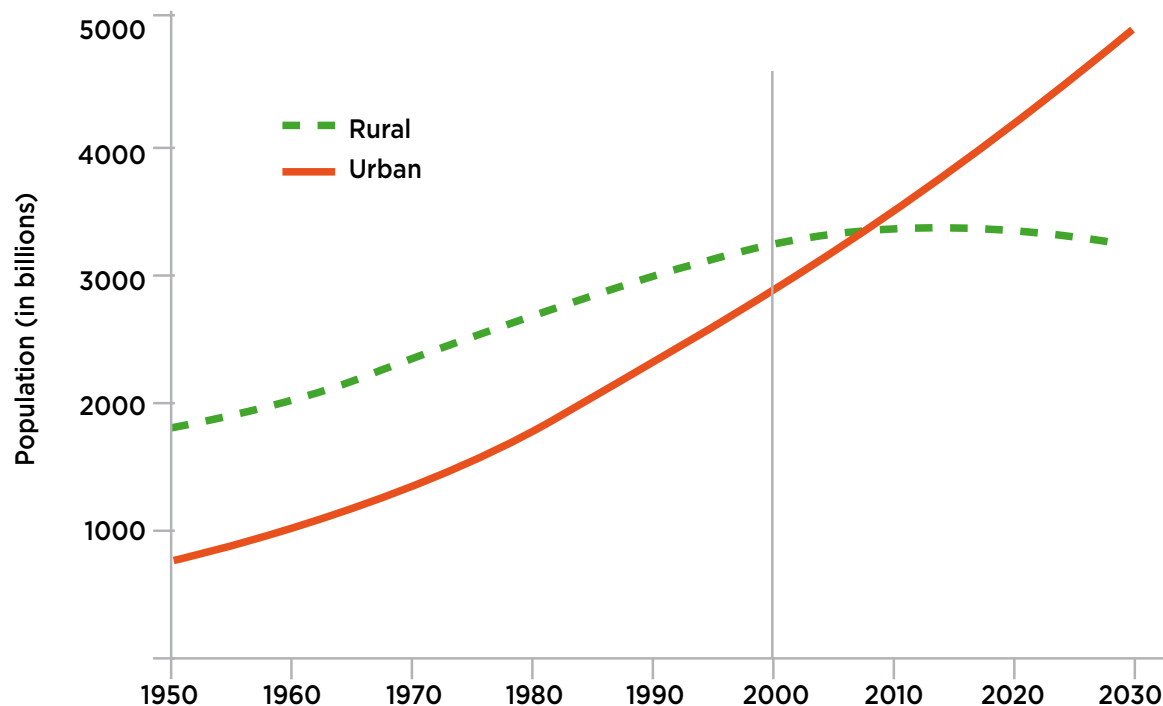
However, in our never-ending quest for comfort and convenience, humans have looted, destroyed, and altered various components of this planetary balance, adjusting the Earth to meet our needs. When we ignore the cycles and processes of the planet, it is at our own peril. We know that the Earth has immense power and is capable of making sudden shifts in order to regenerate itself, and

yet we insist on developing high-risk areas for our own use. Such deficient planning makes us highly vulnerable to natural events (floods, landslides, earthquakes, tornadoes) and costly losses of both human life and economic assets. Still, people continue moving into increasingly crowded cities and building their homes in ever-more precarious locations.

A dangerous move

We have become a world of migrants, as more people than ever leave the countryside to move to the city. Currently, more than half of the world's population lives in urban areas, and it is estimated that by 2050, more than two-thirds of the world's population (70 percent) will live in towns and cities.

Figure 1. Diverging trends in the world's rural and urban populations: 1950-2030



Source: <http://www.worldbank.org/data>.

According to the United Nations Human Settlements Program (UN-Habitat), as of 2012, Latin America and the Caribbean was the most urbanized region in the world: almost 80 percent of the region's population lived in cities.

Major metropolises generate huge demand for infrastructure, roads, sidewalks, water distribution and sewage systems, electricity, fuel, and public services in general. Demand for transportation also increases as the distances between peoples' homes and workplaces grow, and they are separated from sources of food and other resources. Long daily commutes and the long-distance transportation of food and goods increase the demand for fuel. They also increase the consumption of industrial products and energy, as well as pollution and waste. This spiral of increasing demand can have dire consequences when good urban planning is overlooked and cities are built in areas vulnerable to the effects of climate change and natural disasters, without protective structural adaptations or disaster contingency plans.

Meanwhile, cities degrade air quality and the climate by producing a strange increase in temperature, forming "heat islands." We will now explain this phenomenon and its risk to public health. We will also explore possible solutions.

Urban heat islands

Environmental scientists sometimes call cities "heat islands" due to the way they absorb, process, and produce excess heat.

When cities are poorly planned, their high population density and the materials used to construct buildings and cover streets produce heat. The large amounts of greenhouse gases produced by factories, transport vehicles, and landfills compound the problem. As cities grow—and even more streets, buildings, industries, vehicles, power grids, and people are added—their temperature continues to increase relative to their rural surroundings.

The so-called "heat island" phenomenon has many causes beyond solar energy absorption:

- » Cities usually have few parks or green areas. Trees provide shade, and grass and other plants accumulate moisture, which cools the air and soil.
- » Large numbers of people living close together produce heat.

- » The size and spatial structure of the city also affect heat production. Large numbers of compact buildings that are built very close to one another produce the most heat.

- » Buildings and houses with dark roofs absorb heat.

Other causes include air pollution from greenhouse gases, pollutants, and particle emissions; heat and water vapor from burning fuel, cooling and heating systems, and other sources; and the use of waterproof asphalt or concrete.

The higher temperatures found in heat islands change the local climate, producing warmer midday temperatures and less frost at dawn, for example. More heat causes more water evaporation, meaning that local rainfall and the occurrence of cumulus nimbus (low, water-filled clouds) increase. All of this also increases energy usage (for cooling or heating) and water usage (to irrigate crops, for example). Plus, extreme temperatures are not only uncomfortable for people, they can also have health impacts, since heat can exacerbate stress and support the spread of disease.

The combined effect of these phenomena simultaneously warms the atmosphere and soil above and below the urban heat island areas, creating air temperatures that are on average 0.5°C–0.8°C higher than those of surrounding areas. In the winter, temperature differences may even exceed 1.5°C.¹

This phenomenon is generally not uniform throughout entire cities, though. It tends to occur primarily in city centers and near large factories, industrial plants, power plants, and busy highways.

What can be done?

While you may not be a city planner, there are some things you can do to reduce the heat island effect in your city:

- » Plant trees or vines to increase green areas and shade surfaces, especially on south-facing facades, walls, or roofs. Vegetation also contributes to cooling through evapotranspiration.
- » Advocate with city officials to increase the number of small bodies of water: wetlands help regulate soil and air temperatures and they also supply water systems.

¹ Register, R. (1987). *Ecocity Berkeley: building cities for a healthy future*. North Atlantic Books.

- » Promote policies requiring more space between buildings to improve air circulation and prevent heat from being trapped.
- » Use white or light-colored materials for roofs and pavement or, even better, plant vegetation on your roof. Dark colors absorb more heat than light colors, which reflect light, while plants and grass cool the soil and atmosphere.

As more people take action to keep the heat island effect at bay, cities' negative environmental impact will decline as they advance toward long-term sustainability.

Figure 2. Urban heat islands and their effects

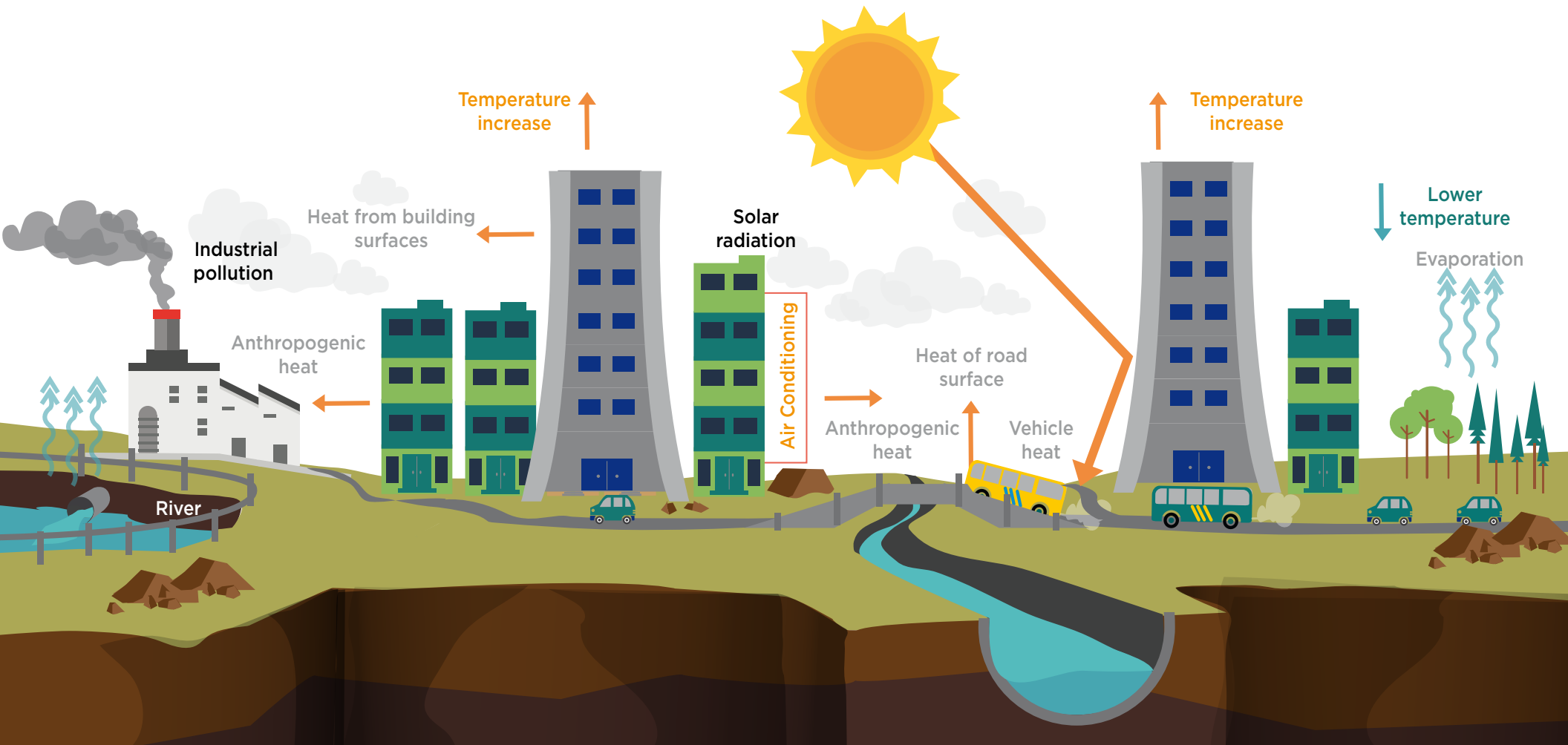
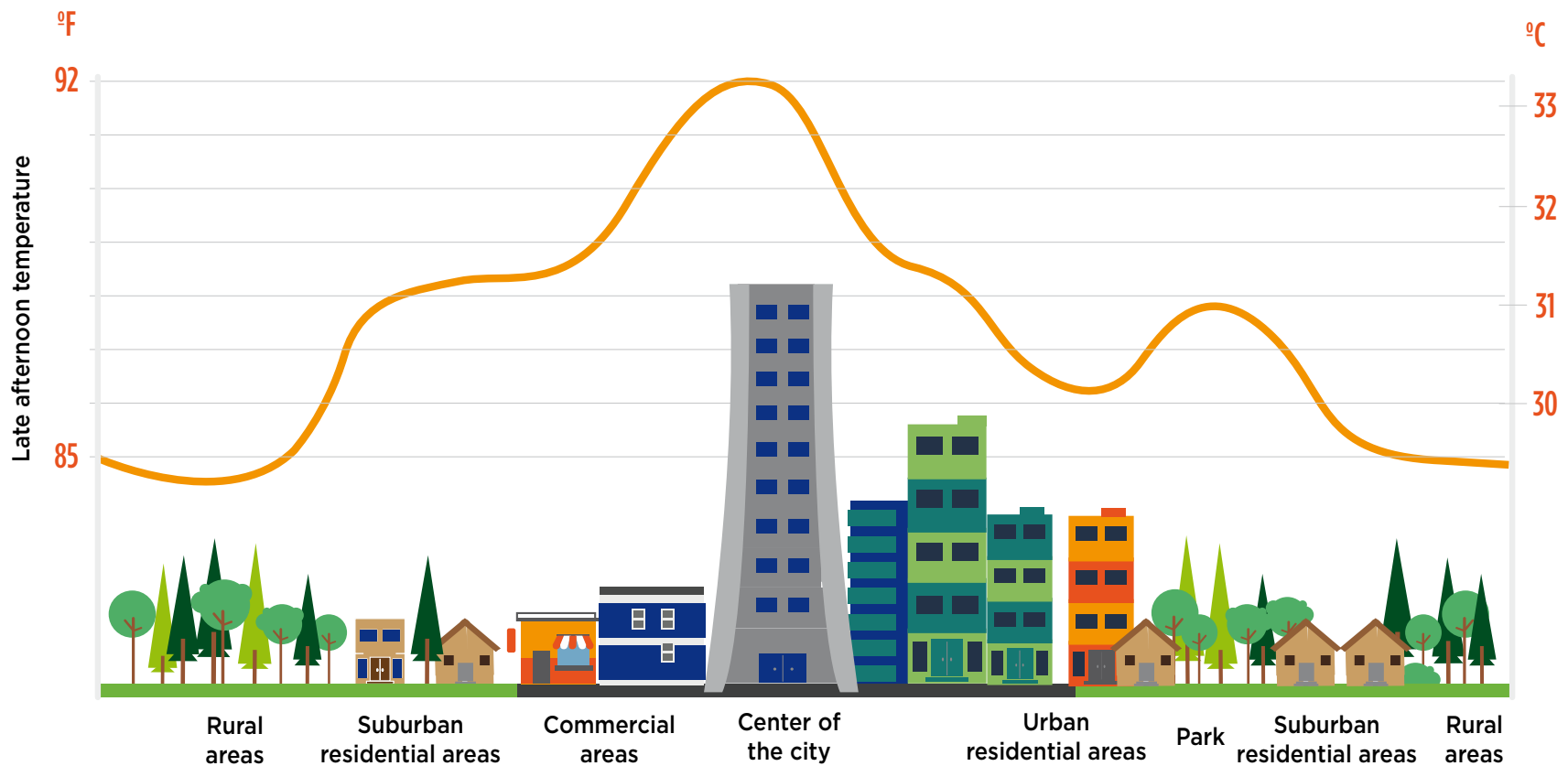


Figure 3. Temperature differences between cities and rural areas



Sustainable cities: Challenging but not impossible

The United Nations Environment Programme (UNEP) describes sustainable development as “improving the quality of human life while living within the carrying capacity of supporting ecosystems.”

Cities can be sustainable. After all, resources can be conserved when people live near one another and share green areas, roadways, public transportation, education, recreation areas, and

other public spaces. Sharing resources can, in turn, create and further economic opportunities. Sustainability depends on careful city planning and design and on peoples’ attitudes.

When citizens are aware of and measure their energy and water use, they consume fewer resources. This reduced demand leads to lower economic and environmental costs linked to energy transportation, fuel consumption, and greenhouse gases, and less damage to the water, soil, and atmosphere.

Understanding the relationship between cities and rural areas is important to sustainability. We need to know which resources are produced locally and which must travel long distances to reach us. This helps us make better decisions, such as buying locally grown produce rather than imported varieties. By consuming local produce, not only do we help improve farmers' quality of life, we also protect our environment.

Cities and rural areas are interdependent; they must take care of each other if either is to achieve sustainability. When they do this successfully, everyone wins.

Defining the sustainable city

How do we know if a city is sustainable? What would an environmentally friendly city actually look like? In *Ecocity Berkeley: Building Cities for a Healthy Future* (1987), Richard Register offers the following description:

- » The ecocity is an ecologically healthy city.... It should be compact, so as to waste little land and consume little energy. [It should] use local building materials and change only slowly over many generations.... [It should] adopt recycling technologies, solar and wind power ... creek and stream restoration projects, urban gardening and fruit tree planting.... [It should] give preference to pedestrians, cyclists and public transportation systems over automobiles.... [It has] people who are concerned about resource depletion, pollution, overpopulation and the extinction of species. Its residents care about the future and, in many cases, work toward it.

Paul F. Downton envisions how sustainable cities may be built and managed:

- » The ecopolis is a city that lives in cooperation with nature rather than in conflict; designed for people to live whilst keeping the cycles of atmosphere, water, nutrients and biodiversity in healthy balance.... The biophysical environmental processes are sustained through conscious intervention and management of human activities in order to build housing and urban spaces that sustain human

culture ... as opposed to the culture of exploitation present in today's cities.²

Timothy Beatley thinks sustainable cities should take their cue from nature:

- » A biophylic city is more than simply a biodiverse city. It is a place that learns from nature and that integrates into the natural systems; that incorporates natural forms in its buildings and cityscapes. And where designing and planning is in conjunction with nature ... cherishing the natural features that already exist, but also working to restore or repair what has been lost or degraded.³

The director of sustainable development for Asia and the Pacific at the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the editor of the *Journal of Green Building*, Steffen Lehmann, believes the starting point for sustainability lies in being "energy efficient, using a zero-carbon model based on renewable energy sources and smart buildings." He says city planners should consider climate change and implement "new concepts of density and expansion, designed with energy efficiency and sustainability as the main criterion." His idea of "green urbanism" includes "zero waste" systems and reengineering of neighborhoods based on a new kind of compact, socioenvironmentally sustainable development.⁴

Sustainability: Balance makes it real

As diverse as these ideas seem, they converge on one point: sustainability is based on people maintaining a deliberate give-and-take balance with their environment. While each person has a role to play in creating this balance, cities must also provide the right conditions for sustainable living. This involves the careful consideration of three interrelated and complementary subjects: the economy, culture, and the environment.

2 Downton, P. F. (2008). *Ecopolis: Architecture and cities for a changing climate* (Vol. 1). Springer Science & Business Media.

3 Beatley, T. (2011). *Biophilic cities: Integrating nature into urban design and planning*. Island Press.

4 Lehmann, S. (2011). *Principles of Green Urbanism*.

Economic balance means that people have sufficient income to meet their basic needs, such as for food, housing, education, health care, and recreation, as well as savings for the future. It depends on access to fair, well-paying employment opportunities in safe working environments. Economically balanced cities tend to have a good social balance too.

Sustainability is cultural in that it involves respecting and protecting the vision, traditions, and customs of local residents. People tend to be more productive and make more sustainable choices when they feel valued and are able to keep traditions alive (whether by living in traditional homes or maintaining traditional dress, habits, and respect for values). Protecting a city's cultural balance furthers sustainability by ensuring the continuity of old perspectives and philosophies that value living in harmony with the environment.

Obviously, sustainability also means living in ways that ensure a healthy environment, with fresh air, unpolluted water, the optimized use of energy and natural resources, and a full understanding of the value of nature and its role in maintaining the planetary balance for future generations.

A sustainable city seeks to ensure an ongoing equilibrium among society's economic, cultural, and environmental elements by using innovative technologies and fostering healthy attitudes and mindsets. However, many cities in our region were not designed for the long term, and remain highly vulnerable to natural disasters and other climate-change-related damage. City planners need to make changes in order to protect both infrastructure and citizens; governments and institutions are beginning to discuss ways to ensure these cities' survival (such as through adaptation; see box 1).

Box 1. What is adaptation?

Change can pose a threat to us when we act like passive spectators and refuse to embrace it. But when we are part of change, understand its meaning and purpose, and know how to lower our vulnerability or weakness in the face of it, then change doesn't necessarily constitute a threat.

One of the harshest realities to be faced is that our hometowns and communities are not always safe havens. Sometimes we must flee them to save our lives. When disaster strikes at home, not only are there tremendous physical and economic losses, we also lose part of our identity—our relationship with the landscape we called our home.

Perhaps the best way to protect our cities is to prevent disasters from occurring through adaptation. Adaptation refers to investing in infrastructure and programs to help cities manage the risks posed by climate change and protect people from the adverse effects of natural phenomena. It's about making proactive changes to the way we live now, so we are less likely to suffer the pain of disaster down the road.



Adopting principles for sustainability

Concerns about what might happen if countries continue following their current development models have prompted governments, organizations, and individuals to propose reconceiving entire cities based on the principles of sustainable development. According to this train of thought, cities become sustainable when:

- » Their residents care about one another and value social justice and peace
- » Natural ecosystems are protected and resources are used conscientiously
- » Comprehensive human development—that is, development that meets everyone's basic needs—is a high priority
- » Decisions are made fairly and democratically

Policy makers making sound political and economic decisions in line with these goals is a good start, but that alone won't make a city sustainable. Sustainability takes a real commitment from every individual, young and old, to generate positive changes in both personal habits and citywide policy. This is how we can build a culture of respect for one another and our environment.

Sustainability starts with awareness

It's up to us to learn about the place where we live, not only to understand and appreciate the role and importance of city agencies and policies, but also to know the best approaches to take when caring for our environment and improving our own quality of life. Here is a little food for thought to get you started:

- » Many water sources—such as springs, creeks, and rivers—pass through our cities. Diverting, drying, or polluting them for manufacturing, urban development, or other purposes does great harm. *Taking care of urban rivers is caring for life. We can help by educating people, advocating for clean rivers, and cleaning them ourselves.*
- » Wetlands play a very important role in flood control: during winter they absorb excess water and in summer they are important sources of water for wildlife and crops. *Protecting wetlands is essential for maintaining the balance of our ecosystem and for controlling flood risks.* Many cities that

were built after their ecosystems were drained or buried tend to experience severe flooding.

- » Even if we live in a city, *sustainable rural development* is vital to our well-being. We can support it and help protect our environment by *buying only local, organic products when possible, and encouraging fair trade to ensure that people are adequately paid for their work.*
- » Cities create an *environmentally friendly culture* by encouraging *responsible use* of resources such as water and energy and adopting *efficient* processes for transportation, commerce, and production.
- » *Responsible consumption* must start with cities and the people living there, creating a ripple effect that extends to cities *generating less waste and improving waste management services.*

Ongoing initiatives for sustainable cities

A number of organizations are trying to help the world's cities become more sustainable. One Planet Communities, a bioregional planning organization, approaches sustainable cities using 10 “Principles of a Living Planet” (<http://www.oneplanetcommunities.org>).

These principles are as follows.

- » **Zero carbon:** Making buildings more energy efficient and using renewable technologies to produce all energy.
- » **Zero waste:** Reducing waste, reusing it where possible, and sending zero waste to landfills.
- » **Sustainable transport:** Reducing the need to travel and encouraging low-emission modes of transport.
- » **Sustainable materials:** Using locally sourced, renewable, or waste resources to make sustainable products.
- » **Local sustainable food:** Eating low-impact, local, seasonal, and organic food, and reducing food waste.
- » **Sustainable water:** Using water more efficiently in buildings and production; tackling local flooding and water pollution.
- » **Land use and wildlife:** Protecting and restoring biodiversity and natural habitats through appropriate land use and better use of the natural environment.

- » **Culture and heritage:** Reviving local identity and wisdom; supporting and participating in the arts.
- » **Equity and local economy:** Creating bioregional economies that support fair employment, inclusive communities, and international fair trade.
- » **Health and happiness:** Encouraging active, sociable, meaningful lives to promote good health and well-being.

The Emerging and Sustainable Cities Initiative⁵ (ESCI) of the Inter-American Development Bank aims to help cities of intermediate size in Latin America and the Caribbean identify, prioritize, and structure projects to improve their environmental, urban, and fiscal sustainability.

The Brazilian Sustainable Cities website (www.cidadessustentaveis.org.br/eixos) offers a color wheel guide called “Sustainable Cities Concepts and Platform.” Each color introduces and explains a sustainable activity that cities and towns may want to undertake.

Permaculture: An interesting alternative to sustainable development

While it is true that we live in a consumer society, it is possible to improve the way we consume and produce through real and measurable changes that benefit everyone, especially when we work together toward this goal. Sometimes, as in the case of permaculture, it just takes a small community action to start making a difference.

Permaculture complements efforts toward sustainable development. It is an ethics-based system with principles that can be used in the establishment, design, coordination, and improvement of efforts made by groups, families, and individuals toward a sustainable future.

Permaculture involves an international movement of practitioners who have adopted a lifestyle based on a common vision, without any support from corporations, institutions, or governments. Its central themes are clean food and energy production as well as

⁵ <http://www.iadb.org/cities> (the text initially appears in Portuguese, but can be translated into English by clicking the top right link).

the design of organized communities that are in balance with their environment. These communities merge current technology with cultural traditions and ancestral knowledge to create innovative design strategies. As one author on the subject puts it:

- » For many people, the concept of permaculture is so global in its scope that its usefulness is reduced . . . I see permaculture as the use of systemic thinking and principles of design . . . to bring together diverse ideas, skills, and ways of life that must be re-discovered and developed to gather the power needed to make the shift from being addicted to consumption, to becoming responsible and productive citizens.
- » Permaculture is not the landscape, or practices such as organic gardening, organic agriculture, energy efficient construction or even the development of ecovillages. Rather, it is everything that can be used to design, establish, operate and improve all these aspects and all the efforts that individuals, households and communities make toward a more sustainable future.⁶

⁶ Holmgren, D. (2002). *Principles and pathways beyond sustainability*. Holmgren Design Services, Hepburn.



Lesson Plans at the

Basic Level

1

Basic lesson plan 1: Once upon a time there was a city...

General objectives

- » Help students connect with their local area and its environment.
- » Learn about how cities use natural resources and where these resources come from.
- » Understand how cities affect natural resources.
- » Observe the relationship between the countryside and the city.

Class activity 1: My city

Objectives	Time	Place
<ul style="list-style-type: none"> » Understand that cities need environmental goods and services and are part of a larger geographical area. » Observe the impact of cities on the environment. 	2 hours (1 hour to create the model and 1 hour for questions and discussion)	Classroom

Materials for each group

- » Sheet of plywood or fiberboard, phenolic foam bars or hard foam (recycled), aluminum foil, recycled objects used to represent houses or buildings (gas caps, cardboard, plastic packaging), modeling clay, X-acto knife, markers, toothpicks, glue.

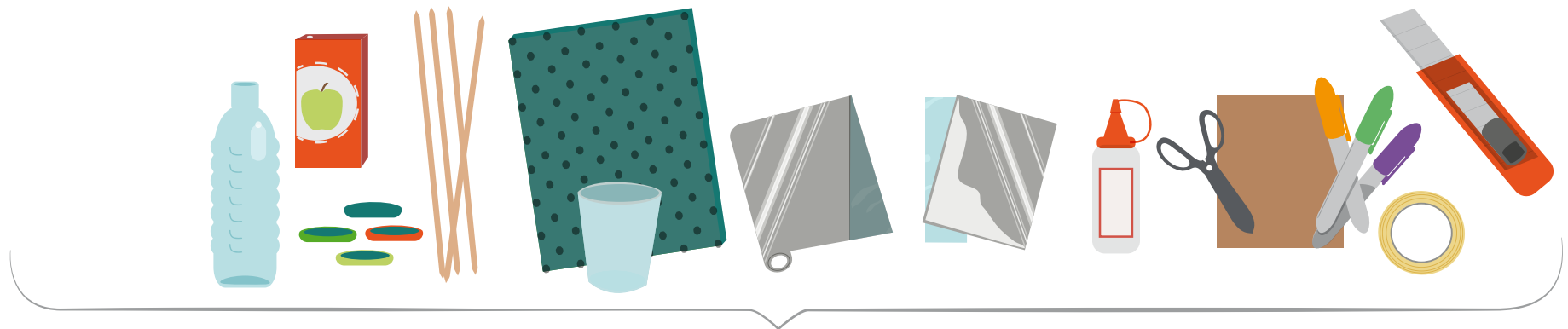
Class preparation

Make sure that all groups have sufficient materials.

Step by step

- » Organize students into groups of four or five and allocate materials.
- » Explain that the aim of the activity is to build a model of their city (if they live in a rural area, they can create a model of the nearest capital city).
- » Ask your students if the city is changing. If so, what causes the changes? What decides their pace? Do changes in cities affect natural resources?
- » Explain that each material in their model symbolizes one city component, such as:
 - *Sheet of plywood or cardboard*: the city's geographical space
 - *Foam bars*: soil and land on which the city is built
 - *Aluminum foil*: asphalt, roads, and avenues
 - *Modeling clay*: city trees, parks, and people
 - *Toothpicks*: lamp posts
 - *Lids, packaging, and cardboard*: houses, buildings, or city structures (for example, a bottle may depict the center of the city)
 - *Markers*: draw the city limits and components such as green areas, city sectors, and so on

Figure 4. My city!



Piece of wood or cardboard

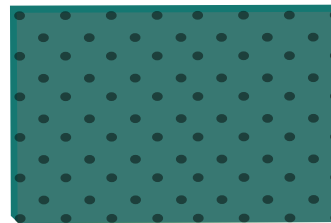


Geographic space where the city is built



Materials

Phenolic foam bars



Soil and topography on which the city is built



Clay
Trees, parks,
and people

Lids,
packaging,
and
cardboard



Houses and buildings

Sticks



Lampposts

Aluminium foil



Asphalt, roads,
and avenues



Markers
To define
city limits



Instruct students to first lay down a sheet of plywood and strips of foam to create a base. Then build the city, starting with its landmarks (historical center, airports, shopping areas, parks, main streets, stadiums, hospitals, city limits, etc.). Ask them to pay attention to how their model changes.

- » Once students have built their city, compare the models to see how students perceive the area where they live (or the nearest capital city) and how familiar they are with it.
- » Ask and discuss the following questions to help students better understand the area and the city's impact on its environment (and add your own to the list):
 - What was here before the town was built?
 - What elements do cities need to exist?
 - Which of these come from nature?
 - Where do the city's water, food, and energy come from? Do we have enough of these resources? Are they of good quality?
 - Where are green areas located? Why do we have them?
 - What is the main means of transportation in the city?
 - Are there many industries in the city?
 - How do transportation and industries affect (positively and negatively) peoples' quality of life and the environment?
 - How many people live in the city? How many can the city hold?
 - Does the size of a city's population affect the availability of natural resources? Why?
- » At the end, ask your students:
 - What are the advantages and disadvantages of cities?
 - What are the differences between cities and rural areas?
 - How do cities affect natural resources?

Class activity 2: Habitat gallery

Objectives	Time	Place
Observe transformations in cities or communities over time. Understand people's impact on their hometown.	3 hours (0.5 hour to prepare; 1 hour for stage one; 1.5 hours for presentations and discussion), plus follow-up over the course of two weeks	Classroom

Materials

- » Pieces of cardboard, colored pencils, tape, current town or city map (students may choose any area in their city), pictures or photos of important places in the city or area.

Class preparation

Gather and hand out materials to the students. Find a place to exhibit your students' drawings. Invite other teachers and students to observe the transformation of their town.

Step by step

- » On cardboard, draw a map of the place where you live (sector, city, or municipality). Include important places (distribution centers, hospitals, parks and natural sites, colleges, universities, government buildings, recreation areas) and prominent geographic features (rivers, hills, etc.). Images can be drawn separately and pasted onto the map.
- » Ask people (parents, grandparents, neighbors, acquaintances) who have lived there a long time:
 - How did the area look 10, 20, 30, or 40 years ago?
 - What places have changed?
 - What was in those places before?

Figure 5. Creating a habitat gallery



- Why were they changed?
 - Do you have any photos of places before they changed?
When were these photos taken?
- » Identify places that have changed on your map. Add any old photos that students found and ask them to share the information they learned with one another.
- » Have students display their maps and share their knowledge about the transformations that have occurred over time.
- » Compare the current city map with older versions and discuss any observable differences.
- » Discuss how changes have improved and adversely affected the area.

Class activity 3: Game—“Opposite cities: Find the differences”

Objective	Time	Place
Compare two cities and find at least 20 differences in how they use resources.	1 hour	Classroom

Materials

- » Printed versions of the images in figures 6 and 7.

Class preparation

Invite your students to watch the video “It’s a give and take,” which you can find at www.iadb.org/riseup.

Step by step

- » Hand out copies of the images to your students.
- » Ask your students to find the differences between both images.
- » At the end of the game, ask students to:
- Provide five examples of actions that maintain the balance between cities and the environment.
 - Discuss why it is important for people in the city to actively protect the environment.

Figure 6. City 1 of 2, "Opposite Cities"



Figure 7. City 2 of 2, "Opposite Cities"



Class activity 4: Find the differences

Time	Place
1 hour	Classroom

Materials

- » Printed versions of the image in figure 8.

Class preparation

Hand out copies of figure 8 to your students.

Step by step

- » Ask your students to compare the images and find the differences between them.
- » Gather your students in groups of four and ask them:
 - In which of these two cities would you like to live, and why?
 - What are the good practices being followed in the city you want to live in?
 - Which are the bad practices being followed in the other city?
 - How do these actions influence the environment?
 - How do these actions influence people's lives?
- » Gather the class and ask them to present what they discussed in groups.

Formative assessment

Before proceeding to the next topic, make sure students:

- » Recognize the components of a town.
- » Understand how cities affect the quality and quantity of natural resources.
- » Are aware of the main resources that ecosystems provide to their city and can identify where they come from.
- » Relate the passage of time with changes that have taken place in their cities.

Integration with other subjects

- » **Science:** Research three examples of ecosystems or natural resources that cities use.
- » **Art:** Draw a cartoon showing how human activities affect the area where students live.

Remember

- » The main natural resources that cities use are drinking water, clean air, and fertile soil to grow food. Most cities are in areas with easy access to these resources.
- » When cities ruin or pollute these resources, they lower people's quality of life and hurt the environment.
- » Population and structural growth in cities increase the demand for natural resources.

Tips for the teacher

- » Save the best models and maps and ask your students to present them to the rest of the school.
- » Take a field trip to the local market and make a list of foods that are brought in from the countryside for sale in the cities. See if your students can identify all the foods they see.
- » Use the photos from the "Habitat Gallery" activity to tell your city's story. If you don't have enough photos, try to imagine and draw the changes that have occurred over time.

Suggested reading and viewing

- » The website of the U.S. Environmental Protection Agency provides information on urban heat islands and healthy homes. <http://www.epa.gov/>.



2

Basic lesson plan 2: I live in a city

General objectives

- » Learn what makes a city sustainable.
- » Learn how we can make our own city more sustainable.

Class activity 1: Build your ideal city

Objectives	Time	Place
<ul style="list-style-type: none"> » Learn what makes a city sustainable and how people benefit from living harmoniously with the environment. » Recognize that everything we do, individually or collectively, counts on the path to sustainability. 	3 hours (2 hours to create the model and 1 hour for final assembly, questions, and discussion)	Classroom

Materials for each work group

- » Sheets of plywood or cardboard (recycled) of various sizes, paintbrushes, watercolor paints, recycled objects (newspapers, magazine clippings, bottles, containers, plastic, cardboard, lids, straws, toothpicks, foam, etc.), old toys (cars, dolls, houses, etc.), modeling clay, glue, and scissors.

Class preparation

Check that all groups have the materials needed. Find a place in the classroom or school where students can display and present their models.

Step by step

- » Organize students into six groups and ask each to devise part of a city using the foundations for sustainability. Each group must address one of the following topics.
 - **Ecological construction or green buildings:** How can houses use resources efficiently? What would buildings that use water, soil, air, and other resources optimally look like?
 - **Environment and recreation:** Where will green spaces and rivers be located? Where will we dispose of trash?
 - **Ecological transportation:** Which modes of transportation reduce air pollution?
 - **Industry and responsible commerce:** How can industry and commerce lower their environmental impact?
 - **Health and education awareness:** What should schools and hospitals look like?
 - **Alternative energies:** Which alternative energies are the best options for the city? Check the Power module, class plans 1 and 2.
- » Each student should help build the model. For example, in the environment group, two students may build city parks, two may create rivers, one may draw the waste area, and one may make trees to place around the city.

- » Explain that the goal is to build an ideal city and that each team will create part of it.
- » Materials should be shared as needed. Some tasks can be performed by two or three people.
- » Set a time limit for completing this work, observe your students' progress, and encourage them to use their imagination.
- » When time runs out, ask each group to share their ideas and designs.
- » Collectively, build your ideal city. Ask questions to get students thinking about the viability of locating a particular element at a specific site. Try to get the group to assimilate the concept of a sustainable city through trial and error.
- » Finish by asking:
 - What sets a sustainable city apart from other cities?
 - What is your city missing for it to be sustainable?
 - How could you help your city become sustainable?

- » Read and discuss the following passage:

A sustainable city meets the needs of all its inhabitants fairly, without compromising future generations. This means that it does not destroy resources or the diversity of the ecosystems that support it. Every citizen actively exercises his/her rights and responsibilities. This city offers everyone in it a healthy environment, decent and adequate housing, safety, parks, sport and recreational areas, a meaningful social life, decent and well-paid employment, complete and efficient health care, quality education and access to cultural activities.

Government institutions are responsible for its planning and development, and for ensuring its sustainability and the inclusion of all sectors of society. Public policy relating to the design, planning and sustainable construction of the cities of the future, must adapt to the needs of present and future inhabitants and the urban environment.

Cristian Frers (<http://www.cronicayanalisis.com.ar>)

Class activity 2: Our action wall

Objective	Time	Place
Understand that our daily actions can benefit our city.	2 hours (plus monthly follow-up for one semester)	Classroom

Materials

- » Recycled cardboard; rubber foam sheets; pencils, eraser, pencil sharpeners; colored pencils, crayons; watercolor paints, and brushes; old magazines; glue and tape; scissors; bibliographical records.

Class preparation

- » Prepare four posters with the following questions:
 - How can I care for and save water?
 - How can I save electricity?
 - How do I recycle efficiently?
 - How do I take care of nature?
- » Hang these posters on the walls of your classroom.
- » Have the materials ready, making sure that each group has enough.

Step by step

- » Divide students into four groups, one at each poster.
- » Ask them to answer their question as creatively as they can using drawings and magazine cutouts.
- » Set a time limit for completing this work, observe your students' progress, and encourage them to use their imagination.
- » When they're finished, ask them to share their answers with their classmates. Discuss innovative ideas and vote on the best proposals.

- » Paste the posters back on the wall and post a blank sheet of rubber foam next to each. Invite students to add any new ideas on the blank poster by one or more subjects (use the supplemental resources to get them thinking).

Revisit each mural throughout the semester to highlight or change the ideas posted there, as students learn more. Ask students to revisit each wall at least once a month.

- » Remember that our actions set an example for others about environmental awareness. No matter how small they may seem, our consistency helps create healthy habits for our environment, our city, and us.

Tip for the teacher

According to www.greenbuildingsdc.com, buildings developed with advanced environmentally friendly technology are called green buildings. Some of their main features are:

- » Efficient energy and water use
- » Storing of rainwater for irrigation and maintenance of green spaces
- » Ventilation and insulation systems to keep inside

Figure 9. Some everyday actions that conserve and protect the environment



Turn off the tap while brushing your teeth, while using soap in the shower, when washing the dishes, and in general whenever you are not using water.



Choose local, fair trade, or minimally packaged products, or products made using clean production processes.



Always respect and take care of wildlife.



Throw garbage only in designated trash bins. Always recycle and separate organic from inorganic waste.



Turn off and unplug electronic devices, cell-phone chargers, and personal computers when not in use.



Use cloth bags for shopping; avoid using plastic bags whenever possible.



Use mass transit; ride a bike.



Avoid keeping wild animals as pets; report any cases.



Only print when absolutely necessary; use recycled paper and print on both sides.

- » temperatures comfortable during winter and summer without consuming electricity or gas
- » Photovoltaic or solar panels, which supply power without using the electrical grid
- » Efficient waste management and low pollutant emissions
- » Optimized handling of runoff rainwater to minimize erosion
- » Durable construction that can adapt to changes in use
- » Thermally efficient roofs, walls, and windows, which reduce heat loss and improve internal environmental comfort
- » Optimized use of natural lighting and ventilation
- » Efficient water consumption and draining mechanisms
- » Low volatile organic compound (VOCS) emissions, interior finishes (paint, varnish, etc.), and installation methods
- » Landscaping that requires minimal or no artificial irrigation; natural space for recreation
- » The use of a careful cleanup plan when building in previously contaminated areas; also, the avoidance of ecologically sensitive areas to improve or minimize pressure on natural systems.

Formative assessment

Before proceeding to the next topic, make sure students understand:

- » What a sustainable city is and what are some of its elements.
- » How everyday activities can help create an environmentally friendly culture.

Integration with other subjects

- » **Science:** Research the plant species used in the construction of ecological houses. Which are found in your region? What other materials are used to build ecological houses?
- » **Mathematics:** Investigate the cost of traditional buildings and “green” buildings and compare them in a table. Which of the two most benefit the economy?

- » **Citizenship:** Check the Web to find ecotowns and sustainable city projects in Latin America. How can your region start such a project?

Remember

- » Cities are constantly changing; sustainable development models must strike a balance between the environment and its various components.
- » Remind students that we can’t afford to wait until the damage is already done to act on behalf of the environment and ourselves; caring for the planet is one of the greatest joys on Earth.

Tips for the teacher

- » Ask students to commit to talking to others about creating an environmentally friendly culture. Award points for engaging in activities that support the environment, and organize an outing to a nearby park to enjoy the outdoors.

Suggested reading and viewing

- » For information on energy efficiency and tips on waste reduction, reuse, and recycling (presented by the month of the year in which each tip is most pertinent), search the website of the U.S. Environmental Protection Agency website. <http://www.epa.gov/>.
- » The 2008 Teacher’s Guide for Education for Sustainable Development in the Caribbean by Gillian Cambers and colleagues can be found on the website of UNESCO (the United Nations Educational, Scientific, and Cultural Organization). <http://unesdoc.unesco.org>.



Lesson Plans at the

Intermediate Level

1

Intermediate lesson plan 1: Sustainable habitat

General objectives

- » Identify and seek possible solutions to urban environmental problems.
- » Promote changes leading to more sustainable cities.

Class activity 1:

My city, my second home

Objective	Time	Place
<ul style="list-style-type: none"> » Recognize unsustainable elements in students' local environment. » Propose solutions and begin a process of transformation toward sustainability. 	2 hours (1 hour to paint a map, 1 hour for the environmental assessment) plus 30 minutes of follow-up every 2 weeks for 2 months	Classroom

Materials for each work group

- » 1 sheet of cardboard or pasteboard (recycled), colored markers, Google Map images of the city or region.

Class preparation

Print detailed maps of your region using Google Maps (and displaying blocks and landmarks), and distribute alongside the materials.

Step by step

- » Organize students into groups of four. Ask each group to create a map of their city or town, based on the Google Map, and locate and mark or color:

- The main landmarks and buildings (i.e., the city hall, schools, universities, markets, parks and green areas, police precincts, and hospitals) in yellow
- Water sources (i.e., creeks, rivers, lakes, dams, wells, and their paths) in blue
- Factories, companies, and industries in orange
- The main roads and streets in brown
- Their homes in green
- » Once students have finished coloring the map of their city, ask them to compare it with the other maps and add anything they'd like to their own map.
- » Then ask them to add:
 - Places with visual pollution (i.e., posters, billboards, garbage dumps) in red
 - Places with air pollution (i.e., smoke from factories or cars) in gray
 - Noisy areas of the city or town in purple
 - Areas that tend to get flooded or where landslides occur during the rainy season in pink
- » Based on the previous exercise, ask students:
 - Which are the nicest areas to live in?
 - Which are the least nice areas to live in?
 - Which areas are dangerous? Why?
 - What areas are safe? Why?
 - What are the city's major air pollutants? Who discharges them?

- How do they affect people's quality of life?
 - How does pollution affect the place where you live? Is it at risk for disasters? Which kind?
- » Tell students that before building a sustainable city, an environmental assessment must be done to identify problem areas and situations needing improvement.
- » In the next class, ask students to identify the main environmental problems in their city or town.
- » Brainstorm how to solve those problems and analyze the viability of each proposed solution in groups. Each group should create a table modeled after Table 1.
- » Start with simple activities that can be implemented without a lot of preparation so that students can gain experience and build confidence to undertake more complex tasks in the future.

Table 1. Brainstorming solutions to problems

Problem	Solution	Activities	Date	People in charge	Materials
Select and define the problem (one per group): e.g., pollution of water sources	Write one to two viable solutions (max. two) per group	Propose activities they can carry out to implement the solutions	Define tentative dates for each activity	Assign tasks to each group; more than one group can work on some activities	Vary, according to each activity
	e.g., raise awareness about managing and saving water	e.g., make posters on saving and managing water and paste them around the school	August 2	Groups 1 and 3	Colored pencils, recycled paper, cardboard, watercolor paints, scissors, etc.
		Make a presentation on the topic and give talks in classrooms	August 15–20	Groups 2 and 4	Pictures from the Internet, computer, video beam, etc.
		March around the neighborhood	September 10	Whole school	Costumes, posters, etc.

Class activity 2: Hanging urban vegetable garden

Objective	Time	Place
<ul style="list-style-type: none">» Observe how a vegetable garden may be built within a city.» Recognize the usefulness of some waste materials.» Encourage actions that contribute to generating positive life changes.	3 hours	Playground or open space

Materials

- » Plastic (soda, juice, or water) bottles with lids, markers, sharp knife or scissors, candles, medium-size needle, black and colored vinyl thread, large and small brushes, rope or twine (preferably recycled), soil with compost, aromatic herbal (anise, basil, mint, lemon balm) or other seedlings, water.

Class preparation

- » Identify a place in the classroom and the school to set up the vegetable garden.
- » Ask volunteers (preferably adults) to cut and prepare the bottles in advance, if possible.

Step by step

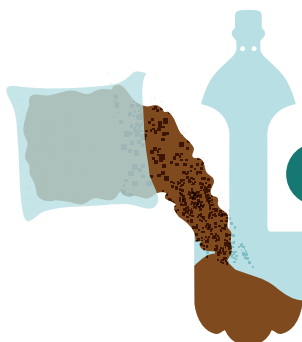
- » Organize students into groups of four or five.
- » If bottles have not been pre-cut, ask each group to take a plastic bottle, clean it, remove any labels, and dry it. Using a marker, have students draw one to two squares halfway down the bottle, and carefully cut them out with a sharp knife or scissors. Make sure they leave enough space to fill the bottle with soil (figure 10).
 - » Mark and carefully drill holes in the base and neck of each bottle, in the spaces indicated above, using a hot needle (use the candle to supply the heat).
 - » Decorate the outside of the bottle and use black vinyl on the narrow end.
 - » Assemble the model using rope (as shown above).
 - » Once the model has been built, fill each bottle with soil, and plant and water the seedlings.
 - » Hang the model in an area that gets good sunlight, and water it regularly.
- » To finish, ask your students:
 - How can an urban vegetable garden make a city more sustainable?
 - What else can we do with recycled materials to solve problems in our city?

Figure 10. Vertical garden made from plastic bottles

Materials



- 1 Choose the plants you want to grow, for example, flowering plants, aromatic plants, or vegetables.



- 4 Put some potting soil in the bottle. To give roots room to grow, don't pack the soil too tightly.

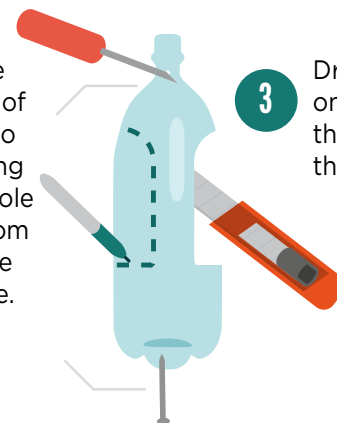


- 5 Sow some seedlings; push them into the soil so they are well anchored.



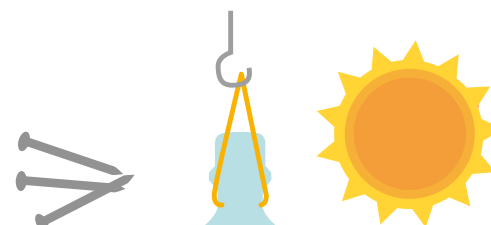
There are many ways of planting vertically with these materials. Search the Internet for more ideas.

- 2 Make a hole in the neck of the bottle so you can hang it. Make a hole at the bottom of the bottle for drainage.

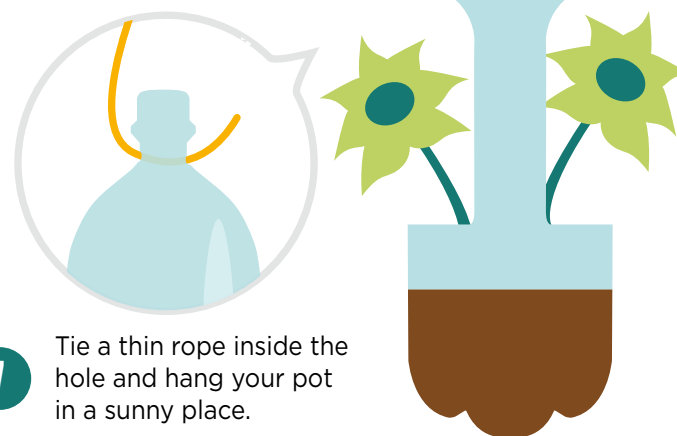


- 3 Draw two squares on both sides of the bottle and cut them out.

- 6 Hang the bottles using hooks or nails.



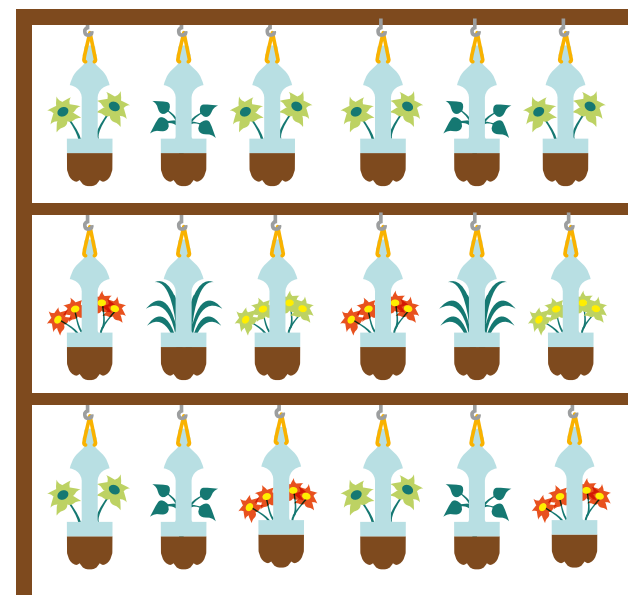
- 7 Tie a thin rope inside the hole and hang your pot in a sunny place.



Example 1: Fence



Example 2: Wood structure



These are some examples of the way you can organize your PET bottles.

Class activity 3: Experiment with ecological soap

Objective	Time	Place
Learn how to make organic soap from recycled oil.	2 hours	School lab

Materials

- » Small stove, gloves, mask, protective goggles, pot, fine strainer, wooden spatula, wooden box, 1 liter of recycled cooking oil, 1.25 liters of clean water, 100 grams of caustic soda, four tablespoons of glycerine, natural fragrances, plastic containers.

Class preparation

Make sure that you have all materials prior to the experiment. Be sure to use protective gear, since students will be working with open flames and using flammable materials and caustic soda. Perform the experiment in advance.

Step by step

- » Ask your students what they do at home with used cooking oil. How else can they use it? Tell them that they can use it to make ecofriendly soap.
- » Tell them that every liter of cooking oil poured down a household drain or into a body of water contaminates hundreds of liters of water. Instead, the oil can be reused and made into “soap” for washing clothes and cleaning floors.
- » Filter the used oil with a strainer to remove fried food particles.

- » To avoid burns or an injury, put on safety goggles, gloves, and a mask. Then in another pot, dissolve the soda in water and bring it to a boil. This product is called bleach.
- » Pour the oil into the bowl containing the water and soda and stir to form a thick, consistent paste.
- » Add fragrance and glycerin to give it a good smell and consistency.

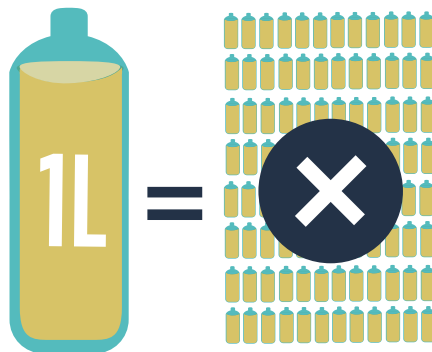
- » Pour the hot paste into a mold (such as a wooden box) and let it cool for a day. Place the mold into another container when cooling, as some of the bleach may drain out during this process.
- » Once cool, cut the biodegradable soap into small bars and distribute the pieces to the students. Encourage them to make soap at home with their families, friends, and neighbors.

Figure 11. Eco-friendly soap

Eco-Friendly soap

If cooking oil

is poured down a household drain or into a body of water, it will contaminate hundreds of liters of water.



Formative assessment

- » Before proceeding to the next topic, make sure your students can:
- » Identify major environmental problems in their city or sector
- » Pose practical solutions to local environmental problems
- » Think of practical solutions to make their city more sustainable

Integration with other subjects

- » **Language:** Interview people in the community and ask them: What is sustainability? What is it meant for? Why is it important?
- » **Social studies:** Explore sustainability projects around the world and evaluate their success.
- » **Civics:** Research the things that companies or industries need to do to cause less harm to the environment.

Remember

People are increasingly becoming aware of the problem of sustainability, and many are applying relevant solutions. While there's still much room for improvement, our adaptive nature enables us to make changes and take action to rebuild our planet.

Tips for the teacher

- » Hold a project fair and reward the most innovative ideas and the best projects that improve the quality of life and help the environment. This fair can be carried out in each class and the best projects can be presented to the whole school.
- » Invite parents to support and encourage their children's ideas, activities, or campaigns in the community, to increase their impact.



2

Intermediate lesson plan 2: Cities vs. natural phenomena

General objectives

- » Understand how natural phenomena can affect cities.
- » Understand the importance of resource management and risk management.

Class activity 1: Game—“Vulnerability, adaptation, and prevention”

Objectives	Time	Place
<ul style="list-style-type: none"> » Understand why some home designs and building materials resist natural phenomena better than others. » Make risk planning part of our lives. 	2 hours	Outdoors

Materials

- » 40 infrastructure model cards (figure 12); large die (figure 13).

Class preparation

Print four copies of the infrastructure model cards (figure 12).
Make a 40 cm x 40 cm (16" x 16") giant dice from a box or foam (16 inches on all sides), as below.

Step by step

- » Organize students into four groups. Give each group 10 cards and ask them to shuffle the cards.
- » Explain that each card shows an image of a different type of building used for housing. Each has different characteristics in terms of its materials, design, and environment, and is assigned points based on its “vulnerability” or susceptibility to three natural phenomena: earthquakes, floods, and landslides. Low point values mean relatively low vulnerability, greater resistance, and more security for inhabitants.
- » Each card also has points for “adaptability,” referring to its potential use in a variety of locations with various designs and materials. The higher the point value, the more adaptable the construction.
- » Show students the die. Explain that it has images representing the three natural phenomena, plus the words “adaptation” and “prevention and evacuation.”
- » The object of the game is to earn the most cards from opponents. In each round, one team takes a turn rolling the die.
- » If one of the three natural phenomena appears, each team must read the point value associated with the vulnerability to this phenomenon on their first card. The team with the lowest vulnerability to this phenomenon wins.

- » If “Adaptation” appears, each team must read the point value for “adaptability” on their first card. The team with the greatest capacity (most points) for adaptation wins.
- » If “Prevention and evacuation” appears, the team that rolled the die automatically wins the cards of their opponents.
- » Then, the next team takes a turn until one team holds all the cards or time runs out. In case of a tie during any round, the teams involved should have a tiebreaker in which the teacher rolls the dice and each team plays its next card. The winning team in this round wins only the cards in the tie, not those from the tiebreaker. If the teacher rolls “Prevention and evacuation,” s/he must roll again until a phenomenon or “adaptation” appears.
- » At the end, compare the 10 cards and discuss why each has different values for adaptations and vulnerabilities. Analyze which building types are best, the pros and cons of each, which buildings students would choose for themselves, and why.
- » Finally, read the following text and talk about prevention—not just of natural disasters, but at any time and in any situation.

Box 2. Healthier buildings

The construction boom of recent years has prioritized the bottom line, to the detriment of people’s health. As cities continue to grow, it is time to reflect on how we can build in a more sustainable manner.

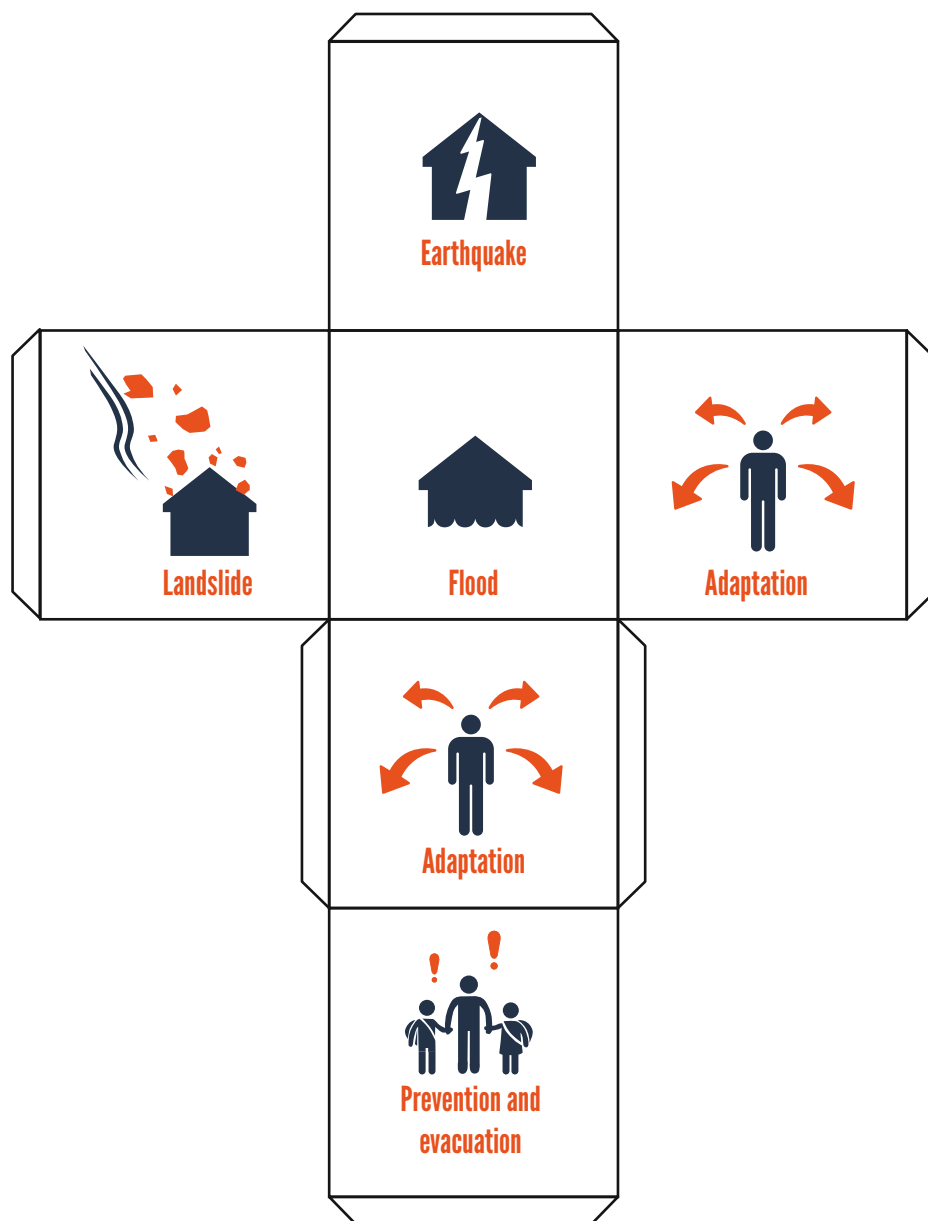
According to the World Health Organization (WHO), 20 percent of the population of the Western Hemisphere is affected by the “sick building syndrome”—a set of problems caused by pollutants in the interior of modern buildings. The influence of most materials around us has yet to be analyzed. Many of the substances involved are not easy to detect, and new ones are being created all the time, with unknown effects. Lists of the components of construction materials, as regulated by law, are not required to warn when toxins are below certain levels. A typical example is a “green” paint that declares that 5 percent of its ingredients are “organic.” The word “organic” is misleading in this case, as it refers to adhesive oil-based components that are organic only in “organic chemistry” terms. Over 50,000 toxic substances are known to be used in construction and decoration; they are still marketed despite their harmful effects. These effects include diseases such as chemical intolerance (SQM), “electrosensitivity,” and many types of allergies. We need to ask for more transparency. City residents need everyday living spaces that support their physical and mental well-being.

Source: www.ecohabitar.com

Figure 12. Infrastructure model cards



Figure 13. Making a large die for your game



Class activity 2: We're prepared for natural risks!

Objective	Time	Place
Understand the importance of risk management.	1 hour	Classroom

Materials

» Cups, water, seeds, waste (used oil, cement, food scraps, toothpaste, powdered soap)

Class preparation

Explain that drills are simulations of emergency situations; they let us prepare, practice, and improve our response to real-life emergencies.

Step by step

- » Tell students that they are going to conduct an earthquake drill. Pretend that the school and classroom are on the verge of collapse and the entire class must evacuate.
- » Ask everyone to use their common sense to save their own lives and those of their classmates.
- » Once outside the room, ask if they are prepared to act suitably in the event of a natural phenomenon. How? Next ask:
 - What did they do? Which actions were the most appropriate? Why?
 - Which actions could put others at risk?
 - What information was crucial to taking appropriate action?
 - What would they do differently in future events of this kind?

- » In groups of four, ask them to identify the following in the school:
 - Risk sites and safe areas
 - Evacuation routes
 - Items they may need in the event of a natural phenomenon (first-aid kit and knowledge of how to use it, stretchers, alarms, whistles, lanterns, fire extinguishers, etc.)
 - Emergency numbers and a plan for how to care for injured people
- » Conclude by saying that the most important steps in preparing for a natural phenomenon are to be informed and take preventive measures in advance, including:
 - Identifying exits or emergency routes
 - Agreeing on identified meeting points
 - Knowing the evacuation route
 - Following instructions from teachers, parents, or authorities
 - Avoiding panic (screaming, running, collective hysteria)

Formative assessment

Before proceeding to the next topic, make sure your students:

- Understand why some home designs and building materials resist natural phenomena better than others.
- Recognize the importance of risk prevention and management.
- Have students pair up and discuss or write down at least two construction features that reduce the impact of an earthquake, a flood, and a landslide.
- Ask students to write down why it's important to prepare for natural phenomena and other possible occurrences.
- Divide students into groups and stage a contest. Each group must write and explain five actions that may be taken in an emergency situation. The first group to hand in five solid responses wins.

Integration with other subjects

- » **Science:** Research how earthquakes, tsunamis, floods, landslides, and hurricanes begin. Distinguish between natural phenomena and disasters.
- » **Language:** Write a story about risk prevention.
- » **Social studies:** Research natural disasters that have affected your region and analyze measures taken at that time. Which were useful? Which revealed room for improvement?
- » **Civics:** Investigate preventive actions that your region needs to undertake to prepare for emergency situations, and share them with your neighbors.

Remember

Good adaptation plans include four components:

- » Information for effective planning
- » Resistant infrastructure
- » Insurance against social risks and poverty
- » Institutions for risk management

Tips for the teacher

Put on a play showing how some buildings are more vulnerable than others to natural events. Adapt the story of the “Three Little Pigs” and present it to the student body.



Lesson Plans at the

Advanced Level

Advanced lesson plan 1: Are we on a heat island?

General objective

- » Understand how “heat islands” affect air quality and public health in urban areas.
- » Recognize their effects on climate change and regional warming and discuss possible solutions to these problems.

Class activity 1: Measuring differences

Objective	Time	Place
Understand the concept “heat island.”	About 2 hours	Outside, preferably in a tree-shaded area

Materials

- » Map of the city or municipality, thermometer.

Preparation

- » Read the text for this activity or watch “Heat island, what’s that?” a video you can find at www.iadb.org/riseup.
- » Choose two sites: one in the city’s heat island and the other in a well-wooded area.
- » Determine the fastest and safest route to get to and from both sites.
- » Take a camera to record the activity, if possible.
- » Request permission to take students off school property; divide the class into two groups if you have an assistant.
- » Do the experiment yourself first.
- » Note: If the school is located in a densely populated area, it’s possible to do the activity without taking a field trip by comparing different areas at or near the school (a football field and an area with many buildings).

Step by step

- » Invite your students to watch the video “Heat island, what’s that?” at www.iadb.org/riseup.
- » Lead the class to a paved site that is surrounded by walls, has no plants or trees nearby, and is well lit by the sun. A treeless sidewalk or street would also work.
- » Use a thermometer to take the local temperature in the sun and in the shade, if possible.
- » Have students touch the concrete or asphalt to feel its temperature. Stay there for a moment, breathing quietly and sensing the air quality.
- » Immediately afterwards, take students to an area with mature trees, vegetation and, if possible, a body of water (pond or lake). Stand under the trees.
- » Ask students to touch tree trunks, branches, leaves, and earth—comparing those that are exposed to the sun with those that are in the shade.
- » Ask them to breathe, taking note of the humidity and air temperature.
- » Measure the temperature in the shade and in the sun.
- » Return to the classroom and compare the data. Ask students what they felt at each site.
- » Optional: If any students go to a nearby rural area over the weekend, have them quickly measure the air temperature in front of their houses before leaving, and then again in the rural area. Which is higher? How do the differences they observe in temperature and air quality compare with those observed during the class outing?

Class activity 2:

Understanding heat islands

Objective	Time	Place
Understand the relationship between population density and heat islands	About 1 hour	Classroom

Materials

» Copies of the images below; or computer and projector.

Preparation

» Arrange the class into groups.

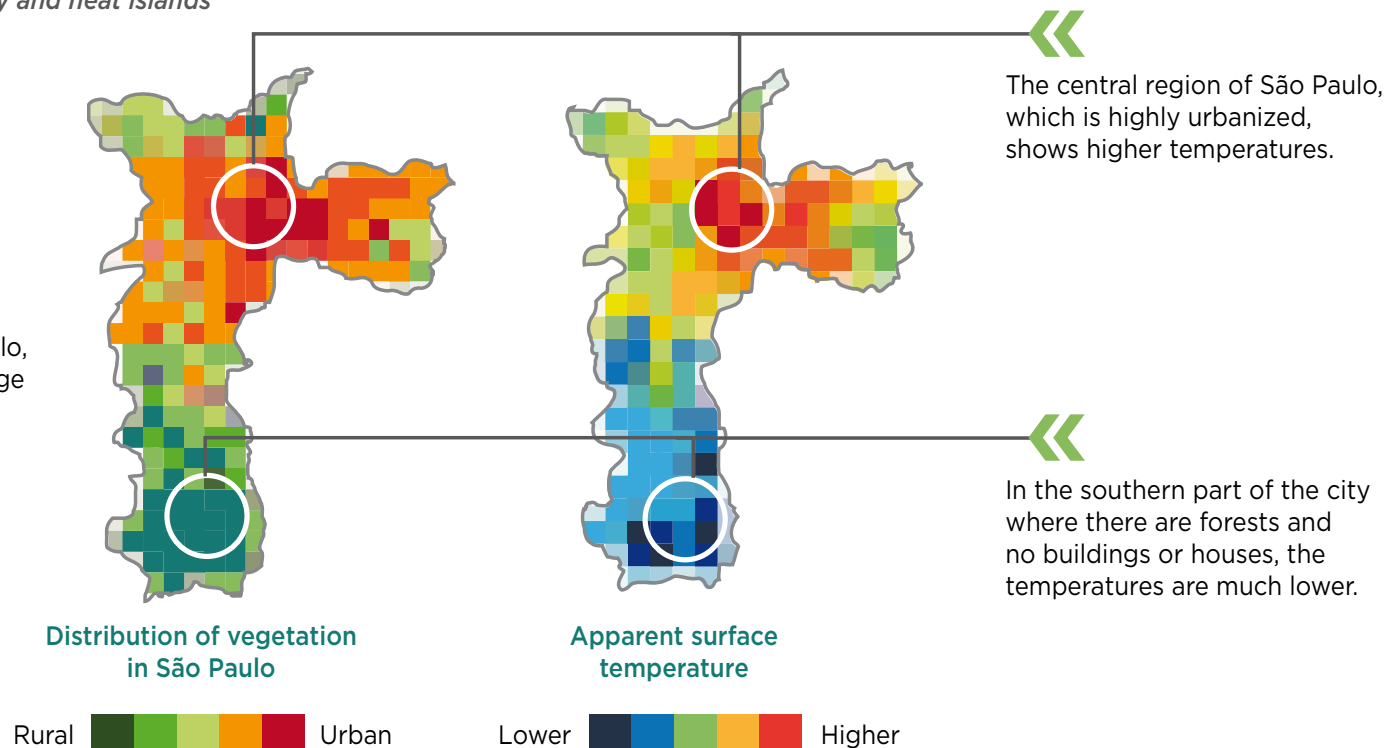
Step by step

- » Show your class the map in figure 14.
- » Divide the class into groups of five or six and ask them to carefully observe the two maps in their groups; discuss what they see for five minutes.
- » Ask them what the four circles mean and why they are paired.
- » Remind students of the experiment in which they compared the temperatures of a paved and a wooded area. Ask them to discuss the possible causes of the temperature differences among themselves and record group members' responses.

Figure 14. Population density and heat islands

Population density and heat islands

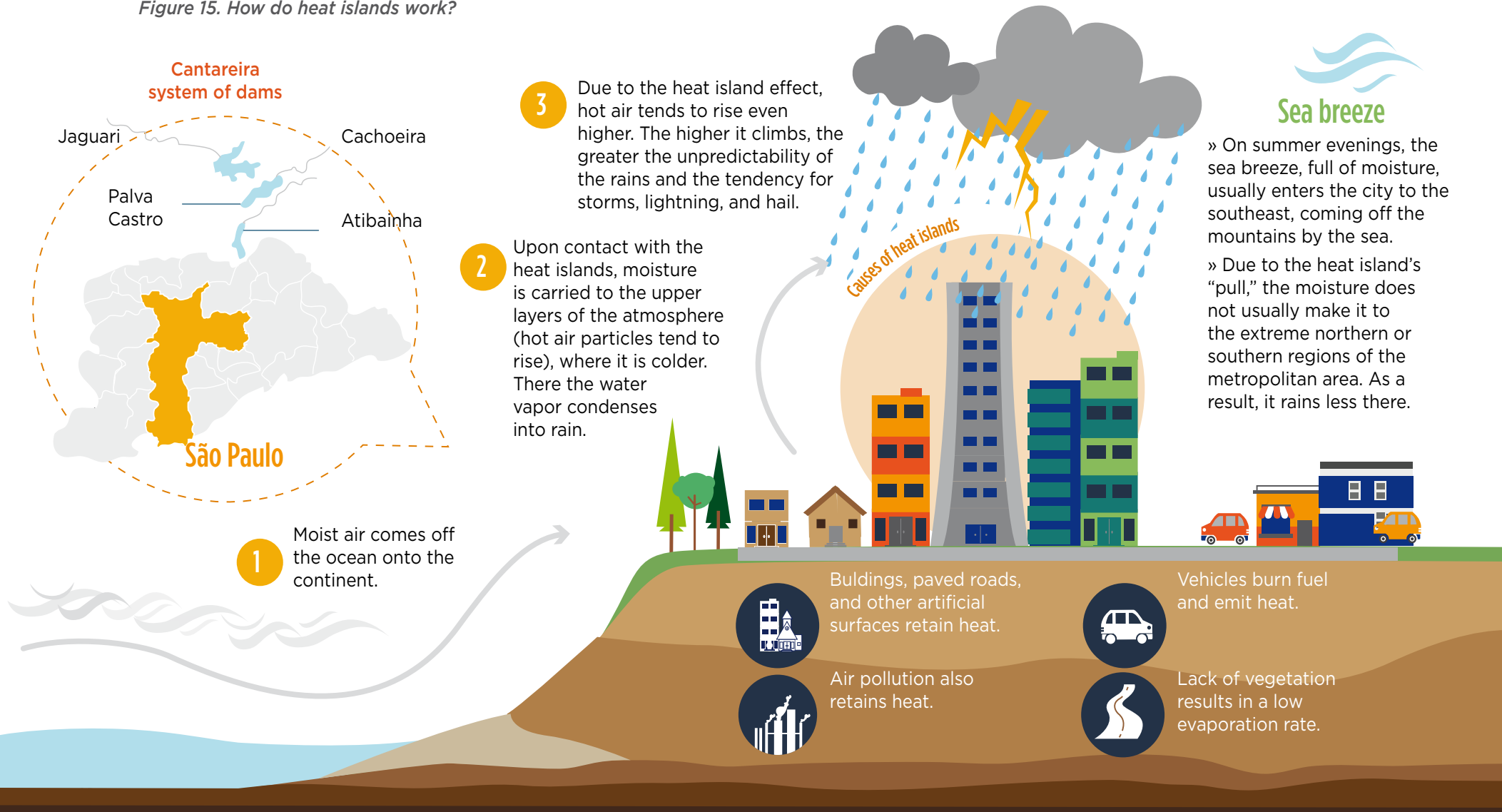
Municipality of São Paulo, where temperature range from 24°C to 32°C.



- » Have each group present their conclusions to the class and discuss them together.
- » Ask students if this situation is similar to the area around the school.
- » Discuss their responses, using the list of causes in the introduction to this unit as a reference.

- » Show figure 15 to the class and discuss why it rains more on buildings than on dams in heavily populated cities such as São Paulo. Discuss the consequences and risks of heat islands.

Figure 15. How do heat islands work?



- » Tell students that surface temperatures in eastern São Paulo and wooded areas of the city can differ by as much as 10°C.⁷
- » Ask what consequences the difference in temperatures may have and mention those outlined in the text.
- » Discuss similarities between your region and the city of São Paulo and what may have caused them. Which areas of your city are the hottest? If you live in a town or small city, ask students if they have been to a big city such as São Paulo, and what they remember about its air temperature and quality.

Class activity 3: Finding solutions

Objective	Time	Place
Understand solutions to reduce heat islands	About 1 hour	Classroom

Materials

- » Paper, markers, crayons, wax tape.

Preparation

- » Before the activity, research initiatives to reduce heat islands in the world's cities.
- » Research cities such as Stuttgart (Germany) and Mexico City (Mexico) as well as the U.S. Environmental Protection Agency's (EPA's) Heat Island Reduction Initiative's pilot cities of Baton Rouge, Chicago, Houston, Sacramento, and Salt Lake City.
- » Project or print figure 16, or look for examples in magazines or encyclopedias.

Step by step

- » Taking into account the causes for heat islands (review these if students do not remember), have students suggest and write down solutions to reduce the heat island effect.
- » Show pictures of green roofs, roofs and facades painted in light colors, shaded areas, vegetation islands, and other initiatives to give students some ideas.
- » After 10 minutes, talk about how trees reduce temperatures, pollution, and rapid evaporation.
- » Talk about the city of Stuttgart, Germany—60 percent of which is covered with vegetation, including green roofs, tree-lined streets, parks, and grass in between train tracks. Mention that Mexico City is investing in green projects such as vertical gardens to reduce pollution. Discuss any other examples you have found.
- » Distinguish heat islands from climate change. Heat islands have local causes and effects, while climate change stems from the rising average atmospheric temperature and has global consequences. Both affect urban areas.

Formative assessment

- » Encourage students to visit the Latin American Network for Just, Democratic, and Sustainable Cities website (www.cidadessustentaveis.org.br) and find the most innovative “best practices.” Ask two or three students to share the results of their research.
- » After completing this lesson, students should comprehend the following concepts:
 - Urban heat island
 - Population density
 - City planning

Integration with other subjects

- » **Physics:** Explore the relationship between Fahrenheit and Celsius using heat island data.
- » **Biology:** Research the thermal comfort zone and heat islands' influence on human health.

⁷ Study of the Municipal Secretariat for Environment of São Paulo with the Oceanographic Institute of the University of São Paulo (USP, 1993).

Tip for the teacher

Ask the local city government, botanical garden, or an environmental organization to provide native trees and distribute them among your students. Develop a plan to plant and care for the trees at school. Invite an experienced botanist or gardener to speak to your students, and ask students to make signs listing the names of identified species.

Remember

- » Highly urbanized areas tend to have heat islands, characterized by the simultaneous heating of the atmosphere and surfaces. Average air temperatures in urban areas are 0.5–0.8°C higher than in surrounding nonurban areas. In regions with four seasons, temperature differences may exceed 1.5°C.
- » Initiatives such as green roofs, planting trees, and caring for wetlands can reduce the heat island effect.

Suggested reading and viewing

- » James A. Voogt's 2004 article "Urban Heat Islands: Hotter Cities" on the bilingual Action Bioscience website explains the science behind heat islands and explores solutions such as green roofs. www.actionbioscience.org.
- » The Heat Island Group at Lawrence Berkeley National Laboratory in the United States tracks heat islands and suggests solutions. Instructive images are available on the site. <https://heatislands.lbl.gov/>.

Figure 16. Green areas to reduce heat islands



General objective

- » Understand how climate change affects cities and their inhabitants, especially the poor, and how cities can become more sustainable.

Class activity 1: Urban challenges on stage

Objective	Time	Place
Understand problems faced by cities with high population density and density's repercussions on sustainability	1.5 hours	» Classroom

Materials

- » Props to support the activity.

Preparation

- » Arrange space in the classroom for the stage.
- » Take photos, if possible.
- » Have students publish a story and photos in the school's blog or newspaper.

Step by step

- » Remind your class of the game "musical chairs," in which participants rush to find a seat each time the music stops, only to find there is one chair too few.

- » Discuss population pressure on major cities, and how it can be represented by the game "musical chairs."
- » Divide the class into two groups: the first represents a population with few resources and the second represents a population with many resources. Ask students to imagine living in each situation and to act out how they get around, where they work, what their homes and neighborhoods are like, what they do for fun, what they eat, what they have, what they do with their waste, and so on. Before beginning, read the text in box 3 out loud.
- » After reading the text, one student in each population group should describe his/her life, saying something like: "I have one (or two or three) cars," "My house is big; it has five bedrooms," "I buy a lot of prepared foods," and so on.
- » After the presentations, encourage students to consider the following questions:
 - How can we change the situations that were presented?
 - Do you know of examples of cities with less contrast?
 - What can be done to reduce lifestyle discrepancies between the rich and the poor and to achieve a fairer environment in cities?
- » Ask students to imagine living in a fair environment and to make a second presentation—this time of life in an ideal city. How would life be different?

Box 3. Two urban challenges

The waste challenge

Cities face a major sustainability challenge in waste management. In general, cities consume materials and energy that come from other regions and produce a lot of waste. Incentives to consume and the perception that items are disposable (that is, that they quickly become “old” and must be replaced) perpetuate cities’ wasteful tendencies.

Tons of solid waste accumulates in landfills; only collectors, who are exposed to unhealthy conditions and are at risk for accidents, separate a very small portion.

Using garbage responsibly, and reusing, recycling, and reducing waste are essential to ensuring the quality of life in cities.



The mobility challenge

Sustainable urban mobility depends on transportation and traffic policies that provide all citizens equal access to urban spaces, where socially inclusive, ecologically sustainable public and nonmotorized transportation is prioritized.

Many cities are still far from achieving this vision. In many cities, the fleet of personal vehicles is increasing, public transportation is inefficient and time consuming, and illnesses and deaths from vehicle exhaust are increasing.

Governments, businesses, and individuals must work together on socioeconomic, sociopolitical, and environmental activities to make urban mobility sustainable.



Class activity 2: Ongoing initiatives

Objective	Time	Place
Understand the principles of sustainable development	1.5 hours	Classroom

Materials

- » Cardboard, various colored markers, tape.

Preparation

- » Identify space for groups to meet.
- » Gather photos or news illustrating the main problems facing communities near the school.

Step by step

- » Use the Adopting Principles for Sustainability section in the general introduction text for this chapter to tell the class about initiatives to make cities healthier, happier, and fairer.
- » Divide the class into 10 groups and assign one principle to each group.
- » Ask each group to assess how well their city follows or doesn't follow their assigned principle and list reasons justifying their opinion.
- » Have students rate their city from 1 to 10, based on how closely it adheres to the principle. For example, for the Zero Waste principle, a very clean city with an effective recycling and waste collection program would be rated a 10, while a dirty city with garbage everywhere and no recycling programs would be rated a 1.
- » Ask students to propose solutions in cases where the rating is below a 6.

- » After the groups present their analyses, ask them to attach the paper with the principle and rating to a box, making a sustainability thermometer for the city.
- » Optional: Talk about the "Transition Towns" movement created by Rob Hopkins to make sustainable model cities that are less dependent on oil, more integrated with nature, and resistant to external economic and ecological crises.
- » Remind students that we need to make changes at home as well as collectively, through laws and public policies.

Tip for the teacher

Invite students' families to see the sustainability thermometer and discuss solutions.

Class activity 3: Field trip—Totem to a clean city

Objective	Time	Place
Reflect about sustainable cities	1 school day	Outside (park, river bank, forest)

Materials

- » Garbage bags, gloves, glue, tape, stapler, scissors.

Preparation

- » Find a green area in your city or town that is full of trash or debris, and organize a field trip to clean it up.
- » Contact the owners or managers and ask permission, if necessary.
- » Ask colleagues, assistants, or volunteers to help chaperone the group (there should be one adult for every seven students).

Step by step

- » The day before the activity, ask students to bring in nonorganic waste products from home (such as cardboard, paper, plastic bottles, tetra-paks, and so on) and put them in a large bag in the classroom.
- » Also ask students to bring kitchen gloves and garbage bags from home (or provide them, if possible) to collect the waste they find on the field trip.
- » When you arrive at the site, ask students to work in pairs and tell them to stay close to the group. Have them collect as much nonorganic waste as they can.
- » Back in the classroom, create a totem pole out of the collected waste, pressing, trimming, pasting, and/or stapling it together. Add the trash that students brought from home as well as trash from the classroom. The taller and thicker the totem pole, the better.
- » Once completed, give the structure a name that represents the students' desire for a clean, friendly, and sustainable city. Display the sculpture in the school's main hall with a sign explaining the place and date of the field trip and crediting the class.
- » Optional: If several classes create sculptures, organize an exhibit at school or the city hall and invite the students' families to attend.

Class activity 4: What do my neighbors know about urban sustainability?

Time	Place
4 hours	Classroom, an outside space (city center, a place where there is a lot of foot traffic)

Materials

- » Voice recorders or video cameras, notebook, pens.

Preparation

- » Read the text in box 4 and, in the general introduction to this unit, research the concepts underlined.
- » Organize a field trip to a crowded place, such as a market, mall, square, or park.
- » Make sure the place is safe and ask colleagues or volunteers to accompany you (there should be one adult for every seven students).

Step by step

- » Make copies of the article in box 4 for the class and read it aloud together
- » Ask students what they think about the text.
- » Ask them to describe and explain the highlighted concepts.
- » Take your students to a crowded place in the city or town and ask them to work in pairs and pretend to be reporters. While one films, records, or takes notes, the other will interview people. Have them explain that they are doing a survey for school and would like to ask a few questions. The questions should be about the concepts in the text, to find out what people do and don't understand. Each group should interview two to four people of various ages, genders, and origins.

- » Back in the classroom, have students assess their interviews and draw conclusions about what their community does and does not know about sustainable cities. Ask them what they learned about their community.
- » Optional: Create a radio or television program using these interviews. Students can also record “commercial breaks” defining the various concepts.

Box 4. *The relationship of cities to the environment*

Twenty years after the first Earth Summit in Rio de Janeiro, it is obvious that there is greater awareness about the relationship between cities and the environment. Many cities have implemented initiatives to protect the environment, reduce greenhouse gas emissions, restore rivers and coastal areas, create ecological corridors, and prevent and cope with disasters.

Today, Latin America and the Caribbean can leave behind the cycles of underdevelopment, inequality, and environmental unsustainability in which they have been immersed for decades. The region is about to undergo a new urban transition that will fundamentally improve the quality of life in cities, bringing more equity and sustainability.

Latin America and the Caribbean, which have been the testing ground for many city planning and management innovations, have the resources and capacity to become 21st century models of urban development. Founded on ensuring people’s well-being and inclusion in society, these models would emphasize local employment, social and cultural diversity, environmental sustainability, and the reaffirmation of public spaces.

Source: “State of Latin American and Caribbean Cities 2012,” United Nations Program for Human Settlements (UN-Habitat).

Tips for the teacher

The 24th session of the Governing Council of the UN-Habitat was held on April 15–19, 2013, in Nairobi, Kenya. The topic of the meeting was “Sustainable Urban Development” and the role of cities in creating economic opportunities for all, with special emphasis on youth and gender issues.

- » As a follow-up to this meeting, research national priorities for urban sustainability and proposals involving youth.
- » Review the meeting agenda and propose topics for future meetings involving opportunities for young people.
- » Have one or more students act as virtual correspondents at the meeting and present the results to their classmates.
- » Discuss meeting expectations and results in groups.
- » Study how UN-Habitat and its Board of Directors operate.

Formative assessment

After this lesson, students should comprehend the following concepts and ideas:

- » Sustainability and its three components
- » Inequity
- » Underdevelopment and developing countries
- » Planning
- » Urban development
- » Mobility
- » Local jobs
- » Social and cultural diversity
- » The 10 principles of a living planet

Integration with other subjects

- » **Biology:** Explore the interrelationships and interdependencies between plant and animal species.
- » **Geography:** Study maps showing the population density of your country, region, or town and compare them to physical maps showing topography and green areas such as parks or forests, cultivated areas, and so on.

- » **Social studies:** Analyze the composition of your city or town using poverty and wealth indexes. Discuss the concept of social inequality. Explore the gender issue.
- » **History and art:** Research sculptures from past civilizations and explain what a “totem” is.

Remember

- » Some water bodies (rivers, ponds, wetlands, etc.) pass through or are in cities. Diverting, drying them out, or polluting them does great damage. Caring for urban water bodies is caring for life.
- » Protecting the countryside and promoting the consumption of local products and the fair value of field labor is a fundamental role of city and regional governments.
- » The city should develop a culture of responsibility in the use of resources and energy for transportation, housing, and production.
- » Responsible consumption extends from managing demand to reducing and properly managing waste.
- » The sustainability of cities depends on governments and citizens, who must be informed and feel involved in the common good.

Suggested reading and viewing

- » One Planet Living offers examples of sustainability initiatives in communities around the world. <http://www.bioregional.com/oneplanetliving/>.
- » C40 is a network of the world's megacities committed to addressing climate change. C40's Climate Leadership Group links more than 80 of the world's great cities, home to more than half a billion people. On the C40 website, you can find information about each city, such as population, greenhouse gas emissions, and ongoing efforts to tackle climate change. www.c40cities.org.
- » Alex Steffen explains how to fight climate change by making cities more sustainable in his Ted Talk entitled “The Shareable Future of Cities.” www.ted.com.



2016

Sustainable Cities for Smart Urban Growth

Lesson Plans for Children and Youth

Emma Näslund-Hadley, María Clara Ramos, Juan Paredes,
Ángela Bolívar, and Gustavo Wilches-Chaux



Rise Up Against Climate Change!

A school-centered educational initiative
of the Inter-American Development Bank