

Building with LEGO bricks: The Ecocities of Tomorrow



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Preface: About the Project

«Building with Lego Bricks: The Eco-cities of the Future» (Youngsters4EcoCities) aims to bring the UN's Sustainable Development Goals, particularly SDG 11 into the consciousness of young people aged 6-14. It endeavours to improve the competences of teachers and educational staff by developing a curriculum and a training manual on SDG 11, inspired by the theories of landscape architect and city planner, Ian McHarg. In his book, Design with Nature, McHarg puts the environment first in planning the development of a city. By teaching young people about ecological city planning, the project will help instil in them the value of sustainable development early in life.

The project develops and provides teachers and educational staff with tools to develop young people's understanding of natural systems, urban landscapes, and ecological planning concepts, and has involved the LEGO® Group by using Lego bricks in the training curriculum. The objectives of Youngsters4EcoCities is:

- To advocate for an ecological approach to urban planning which focuses on social and ecological priorities;
- To foster awareness raising and capacity building around sustainable development and particularly Sustainable Development Goal 11 (Sustainable Cities and Communities);
- To provide teachers and educational staff with tools to develop young peoples' understanding of natural systems, urban landscapes and ecological city planning;
- To support and enhance the knowledge of young people within the fields of natural systems and urban landscapes, as well as ecological planning processes for them to acquire social, civic, and environmental competencies;
- To develop integrated non-formal learning material and innovative tools which will prioritize the need for a holistic understanding to resilient urban development;
- To strengthen teachers, educational staff, and young people's abilities to think critically on urban development issues; and
- To develop transversal skills and competencies to support quality education.

The primary target group is teachers and educational staff, and the ultimate targets are the pupils themselves. A secondary target are school principals and politicians who have the power to implement the concepts of the project on a larger scale.

Youngsters4EcoCities is a two-year Erasmus+ project, that started in September 2020 and ends in November 2022.

Partners

FO-Aarhus – Denmark (Coordinator)
Synthesis Center for Research & Education – Cyprus
Wisamar Bildungsgesellschaft GmbH - Germany
Eco-Logic – Republic of North Macedonia
Lousada Municipality - Portugal



Sustainable Development Goal 11: Make Cities and Human Settlements Inclusive, Safe, Resilient & Sustainable

The United Nations' [Sustainable Development Goal](#) (SDG) provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. SDG 11 is dedicated to «make cities inclusive, safe, resilient and sustainable». The targets of SDG 11 include investment in sustainable transport systems, safe and affordable housing, creating green public spaces, reducing the adverse effects of natural disasters, and improving urban planning and management in participatory and inclusive ways.

In 2018, 4.2 billion people, or 55 percent of the world's population, lived in cities. By 2050, the urban population is expected to reach 6.5 billion. Sustainable development cannot be achieved without significantly transforming the way we build and manage our urban spaces. The world's cities occupy just 3 per cent of the Earth's land, but account for 60–80 per cent of energy consumption and 75 per cent of carbon emissions. Thus cities are both an important cause for and solution to climate change.

Before the pandemic, cities had rising numbers of slum dwellers, worsening air pollution, minimal open public spaces and limited convenient access to public transport. The direct and indirect impacts of the COVID-19 pandemic are making it even more challenging to achieve this Goal, with more people forced to live in slums, where quality of life is deteriorating and vulnerability increasing. The number of slum dwellers has continued to grow over the years, exceeding 1 billion in 2018. Slum dwellers are most prevalent in the three regions of Eastern and South-Eastern Asia (370 million), sub-Saharan Africa (238 million) and Central and Southern Asia (226 million).

Data collected for a sample of 911 cities from 114 countries and territories in 2020 indicate that between 1990 and 2019, spatial urbanization occurred at a much faster rate than population growth, and smaller cities were being urbanized more quickly than their larger counterparts. On average, all regions except sub-Saharan Africa and Eastern and South-Eastern Asia recorded a consistent increase in built-up area per capita, with the highest values in Australia and New Zealand.

Data on a sample of 911 cities from 114 countries and territories indicate that the share of urban area allocated to streets and open public spaces averaged only about 16 per cent globally in 2020, well below the allocation recommended by United Nations Human Settlements Programme (UN-Habitat) of 30 per cent for streets and an additional 10 to 15 per cent for open public spaces.

As of March 2021, 156 countries and territories have developed national urban policies, almost half of which are already at the implementation stage. Of these countries and territories, 38 per cent are in the early stages of plan development, while 13 per cent are monitoring and evaluating the performance of their plans.



**MAKE CITIES AND HUMAN SETTLEMENTS INCLUSIVE,
SAFE, RESILIENT AND SUSTAINABLE**

Learning with LEGO bricks



For over six decades now, LEGO ® has been accepted in the field of education to help and enhance learning of children. It helps them to be creative. It has become a part of popular consciousness, and a part of childhood memories of many across the world. It has become a generic symbol for creativity. In fact the LEGO brick has been named the “Toy of the Century.” The LEGO brick has become synonymous with creativity.

Studies show that LEGO bricks can enhance the relationship between learning and creativity.

A study of LEGO Kids Inner Circle members parents in the USA showed that 90% of parents believed that LEGO play has had positive impact on numerous developmental skills:

- Creativity
- Problem Solving
- Coordination
- Thinking
- Learning
- Engineering
- Reasoning

Intelligence, learning and creativity are intertwined: LEGO bricks encourages children to make something (build/create), making things up (imagine/fantasise), play make believe (doing as if/pretense). Storytelling, construction play and fantasy play can continuously feed one another, enabling children to become familiar with inventive problem-solving through the act of play (playful learning).

Godtfred Kirk Christiansen, the founding father of the LEGO® System of Play, believed that children should not be offered ready-made solutions, instead they needed something different that would strengthen their imagination and creativity. He devised the notion that a range of toys should be put together to form a system, in order to create a toy with value for life as well as bring order to the sprawling toy sector of the time. A patent application was made for the LEGO® brick in 1958.

“Our idea has been to create a toy with a value for life – a toy that appeals to children’s imagination and develops the urge to create and the joy of creation which are the driving forces in every human being.”¹

¹ Godtfred Kirk Christiansen, 1955. <https://www.lego.com/en-us/history/articles/lego-system-in-play/>

For further reading, teachers can read the following literature:

[Parker, Rachel and Thomsen, Bo Stjerne. "Learning Through Play at School," The Lego Foundation, 2019.](#)

[Ackerman, Edith; Gauntlett, David and Weckstrom, Cecilia, "Defining Systemic Creativity : Explaining the nature of creativity and how the LEGO© System of Play relates to it, Lego Learning Institute, 2009.](#)

[Building Blocks for Developing Spatial Skills: Evidence From a Large, Representative U.S. Sample, Jamie J. Jirout, Nora S. Newcombe](#)

[Top 10 Ways Legos Are Educational for Your Child: Learning with LEGO](#)

[10 Incredible Benefits of Playing with Lego](#)

[How Playing with LEGO can make your kid smarter](#)

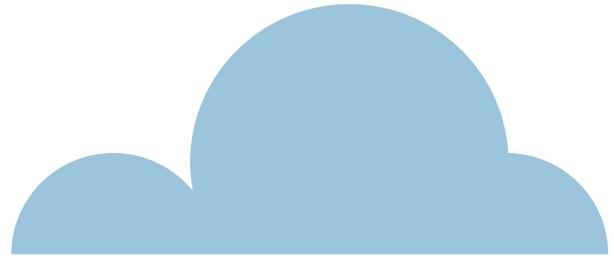
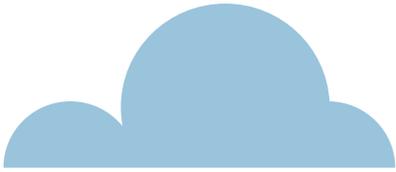
[4 WAYS BUILDING TOYS CAN GROW YOUR CHILD'S MIND](#)





MODULE 1

**The Theory of Ian McHarg on
Environmental Planning**



Introduction

Today the consequences of climate change and global warming have become more distinct than ever. The sea levels are rising, extreme weather conditions are causing natural disasters, wildlife are in danger and due to human consumption, the planet's natural resources are running dry. It has become more evident than ever that we need to change our way of life, if we want our children to have a future on this planet.

As many people live in cities, ensuring a sustainable urban environment is vital. How does Man, nature, architecture, history and culture interact with one another? How do we shape the landscape and it us? And how can we build with nature instead of destroying the existing environmental systems when building cities?

These were some of the thoughts behind landscape architect Ian Lennox McHarg's ecological city planning method developed in the late 1960's, and the questions are still relevant today more than ever due to the challenges of the twenty-first century.

«Let us green the earth, restore the earth, heal the earth¹...» Ian McHarg

The following module talks about the life of McHarg, what led to his ideas on landscape planning, his methods and how we can use this legacy today to build sustainable cities where nature and Man are considered part of the same ecological system.



¹ Ian McHarg, Design with Nature (25th edition 1992)



1.1 The Legacy of Ian McHarg

“

We must see nature as a process within which man exists, splendidly equipped to become the manager of the biosphere.

”

Ian Lennox McHarg, Scottish landscape architect and author of the book, *Design with Nature*, on landscape planning based on natural systems.

Learning outcomes

the teachers/youth workers should be able to:

- understand who Ian McHarg was and what difference he made in landscape architecture and city planning

Ian Lennox McHarg.

Ian Lennox McHarg (20 November 1920 – 5 March 2001) was a Scottish landscape architect, author, tv-host and founder of the department of landscape architecture at the University of Pennsylvania in the United States. With his book, *Design with Nature* (1969), McHarg developed a new theory and philosophy on landscape planning which was centered around the use of natural systems. At the time, this was a rather unfamiliar approach to landscape planning, and Ian McHarg was one of the first to bring environmental concerns and ecological planning methods into landscape architecture and city planning. His ideas in *Design with Nature* started a public and political awareness on the environment and ecological

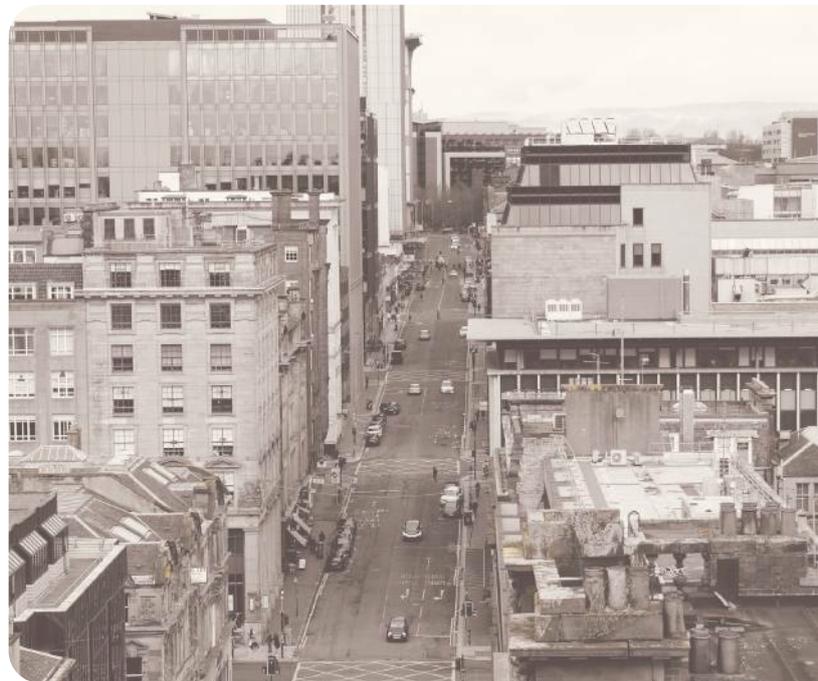
planning and established the basic concepts which were later developed in geographic information systems.

Ian McHarg grew up in industrial Glasgow during the Great Depression. Already as a child, Ian McHarg showed great drawing skills and was encouraged to consider a career in landscape architecture. McHarg loved nature and he would often go hiking in the Scottish landscape. His childhood and adolescence, however, took an abrupt turn when he entered the Second World War as a teenage private.

Ian McHarg was one of the first to bring environmental concerns and ecological planning methods into landscape architecture and city planning.

McHarg left the military service after the war as a major and later graduated in landscape architecture and planning at Harvard. He was encouraged to establish a new graduate program in landscape architecture at the University of Pennsylvania. In the beginning McHarg's practice and teaching was grounded in the modernist principles he had learned at Harvard, but he later began to move away from the stylistic idea of modernism: 'one-size-fits-all'. McHarg still remained true to the ideals of modernism and believed that knowledge should guide action. Knowledge about the environmental systems and the respect for the balance between people, society and nature would result in better, safer and healthier housing and communities, better transportation systems and more open space.

Through the 1960s and into the 1970s, Ian McHarg became more and more popular, both at university and in public. His academic course, «Man and Environment», was the most popular course on campus, and the theory in *Design*



For in-depth explanation of the highlighted terms, go to the glossary on page 118 or click on the terms in the text.

with Nature was presented in the CBS television show «The House We Live In». McHarg later hosted his own TV show, inviting prominent theologians and scientists to discuss the human place in the world, and his ideas and activism inspired faculties and students across the nation.

McHarg's planning method proposed an approach where information about the physical oceanography, geology, geomorphology, physiography, hydrology, soils, vegetation, limnology (lakes, streams etc.), marine biology, wildlife, and land use be studied before starting a building project. Most important was to understand how all these elements are connected and integrated in one another.

Ian McHarg represented a holistic view of man and nature: As human beings, we relate with one another as well as with our physical and biological environments. Like other organisms, we are part of the web of life. The challenge, according to McHarg, was to see ourselves as part of that web. He recognized the need for us to understand the landscape we inhabit as well as how we shape it, and it shapes us. As early as 1968, McHarg wrote: «We must see nature as a process within which man exists, splendidly equipped to become the manager of the [biosphere](#).» McHarg called this global responsibility our «greatest role.” He strongly believed that this approach to landscape and city planning could and should be expanded to the planet.



² Steiner, F. (2004). «Healing the earth: the relevance of McHarg's work for the future.» Philosophy & Geography



1.2 Designing with Nature: An Ecological Approach

“

We must come to know this world, to understand how it works, and to regulate our behaviour to maintain and enhance the biosphere. ”

Landscape architect Ian Lennox McHarg

Learning outcomes

the teachers/youth workers should be able to:

- Understand and apply the ecological model of Ian McHarg (Design with Nature)

As mentioned earlier, Ian McHarg hosted a CBS television show, *The House We Live In*, in the early 1960s, where his theory in *Design with Nature* emerged from. For a series of 26 Sundays, McHarg invited the leading theologians and scientists of the day to discuss our place in the world, and leading scholars were invited to discuss values, ethics, the universe, evolution etc. In 1969, he finally published «*Design with Nature*» - a book with step-by-step instructions on how to break down a region into its appropriate uses, based on its environmental characteristics.

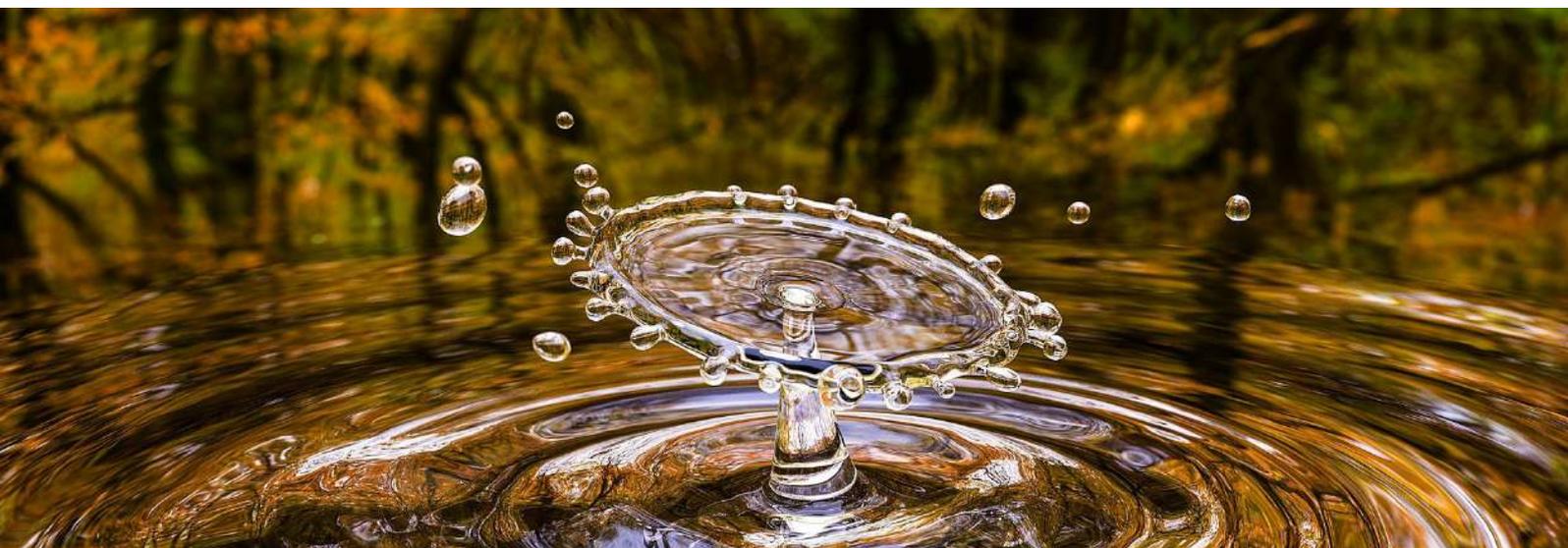
Design With Nature was the first work of its kind to present a methodology on how to approach landscape planning. McHarg's notion of ecological planning comes from two fundamental characteristics of natural processes: creativity (the dynamics that govern the universe) and fitness (how organisms adapt and survive). This philosophy became known as the ecological planning method - a practical method for planners and designers in a two-step process:

First, natural resources and physical features are analysed and visualized as mapped layers: "The Layer Cake Model." Each layer represents a component of the natural and physical environment. These include, among others, the mapping of bedrock geology, surficial geology, groundwater [hydrology](#), [geomorphology](#), [limnology](#), surficial hydrology, soils, vegetation, wildlife, land use, and climate. Each layer in the model is placed on each other to show how the

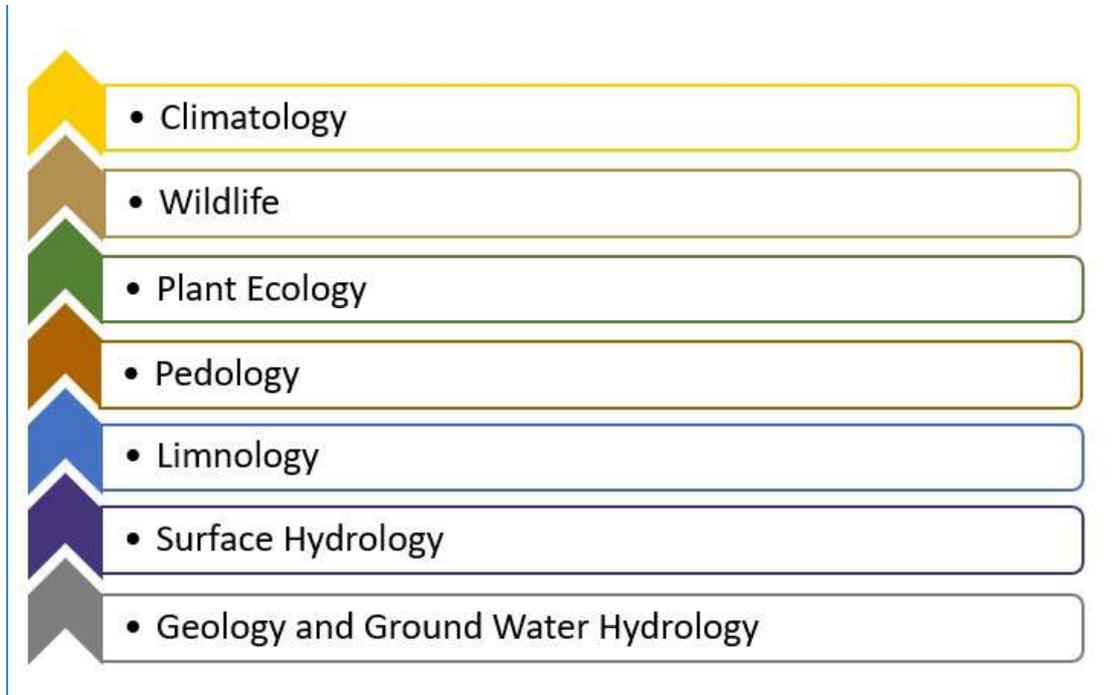
different data relates to each other. McHarg was less concerned with each individual layer than with how they interact to form the natural landscape pattern. The model on page 16 depicts the different layers in the layer cake model used for ecological planning.

Second, it needs to be determined which areas in any given site are suitable for specific kinds of building and development. The locations most suitable for development are the ones that require less human intervention and thereby cause least possible damage to the environment.

McHarg makes an important distinction between ecological planning and ecological design: Ecological planning is the study of a region, its biophysical and social processes, opportunities and constraints for any human use. Ecological design comes after the planning and requires a designer with a visual imagination as well as graphic and creative skills to find the best suited form with the materials at hand.



The legacy of Ian McHarg and Design with Nature continue to inspire and challenge landscape planners and designers today. With the global climate changes, it is more relevant than ever to understand the ecological processes and our responsibility for the problems we are facing. Design with Nature offers a hope to change our way of using the landscape, moving towards a way of collaborating with as well as protecting nature. It is no longer enough to focus on planning and designing just for community and regional sustainability. Instead, we need to focus on the following ways of planning³:



³ Source: Layer Cake Model adapted from: Ian McHarg, Design with Nature, 1969



1.3 Demonstrating Ecological City-Building Ideas with LEGO bricks

“

Our idea has been to create a toy with a value for life - a toy that appeals to children’s imagination and develops the urge to create and the joy of creation which are the driving forces in every human being.

”

Godtfred Kirk Christiansen, the founding father of the LEGO® System of Play

Learning outcomes

the teachers/youth workers should be able to:

- understand the value of using LEGO bricks when teaching pupils about ecological city-building concepts
- apply Lego bricks when demonstrating how to build a sustainable city

The theory and philosophy of Ian McHarg can be taught to young children in a fun and engaging way by using LEGO bricks to build ecological city models.

First, the learners need to understand the method of mapping. A city with healthy ecosystem functions requires landscape planners to analyse and map the existing natural landscapes and systems. The process begins with mapping foundational geological formations, topography, and soil types.

Next, water systems such as lakes, oceans, rivers, and creeks need to be mapped. It is important to include underground water resources such as pockets of groundwater close to the surface, and the deep aquifers far

beneath the ground. Tides and flood plains also need to be understood.

Next, vegetation needs to be analysed, including pristine wild forests, open scrubland and meadows, wetlands, forest patches, plantations, and agricultural fields.

Finally, human settlements, cultural landscapes, and important historic sites should be identified and protected.

Only after these systems are identified would new services for urban development be designed (future building) to minimize destruction of natural systems, and to enhance landscapes.

A simplified version of Ian McHarg's Layer Cake Model



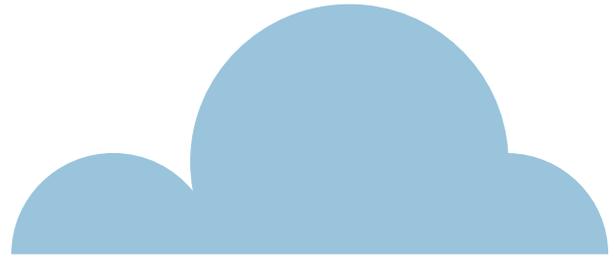
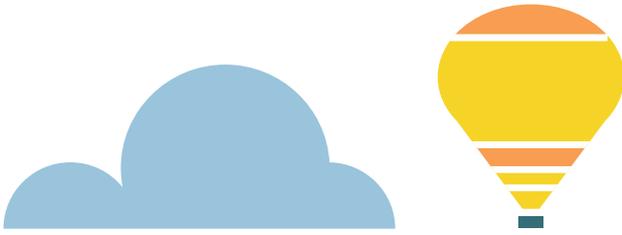
Source: A simplified version based on the Layer Cake Model adapted from: Ian McHarg, Design with Nature, 1969

The simplified model is very suitable for teaching children and young people about ecological city planning which can be done in a fun and creative way with the use of LEGO bricks. Here, the learners can visualize the different layers underneath the surface of the ground and afterwards start building their city on top of these layers, taking wildlife habitats, natural water systems etc. in consideration. Train tracks, bridges, roads and sidewalks would be placed only after the best sites for urban development are identified.



MODULE 2

Trees and Forests



Introduction

Which thoughts and feelings appear when you see a tree? When you walk in a forest, in a park or in a garden? What role do trees play in our everyday life?

Trees have always had a great significance for man. They produce oxygen, provide us with food, give us shade, give us warmth and surround us with beauty. In all times, trees have been a source of artistic inspiration and recreation, and we are more dependent on trees than many are aware of.

On an emotional level, trees can help modern people reduce stress, recover during mental challenges and increase the quality of our everyday life.

On an economical level, trees provide timber for building construction, furniture manufacture, paper industries and many household items.

And most importantly, on an environmental level, trees help the environment by improving the quality of the air, conserving water, preserving soil, and supporting wildlife. With the global climate

changes, trees play an important role since they can help moderating the effects of the sun, rain and wind.

However, many of the world's forests are at risk for deforestation due to the increasing population, farming and industries.

In module 2 you will learn about the role which trees and forests play in the eco-system, how the eco-systems work, how forests are managed and used in industries, and how we can use tree for recreation.





2.1 Natural Forests beyond Urban Boundaries

“

Forests are so much more than a collection of trees. Forests are home to more than three-quarters of the world's life on land.

”

World Wildlife Fund (WWF)

Learning outcomes

the teachers/youth workers should be able to:

- define the concepts of the forest ecosystem, biodiversity and climate change
- understand the different types of forest management, their products and impacts
- identify and understand different types of ecosystem service

Forests are complex places, being much more than just a collection of trees. Forests have a structure full of communication networks, interactions and dependencies, with thousands of inhabitants. As in urban human communities, forests function as large 'green cities' with food and energy production factories. Mechanisms that promote its balance contribute to the health and stability of this «city» through the established food networks, where, for example, predation of sick and more fragile individuals occurs, and the fittest and most resistant prevail as a result of natural selection! This «green city» is one of the main allies in maintaining the environment as we know it and is one of the major responsible for life on the planet.

About 30% of the Planet's land cover is occupied by forest, which is equivalent to about 39 million hectares. Despite the magnitude of these numbers, this figure has been steadily decreasing over the last millennia, estimating that in the last 5,000 years an area similar to 50% of today's forest has been lost due to population growth, the demand for land for agriculture and grazing and the unsustainable exploitation of forest resources. Currently, it is estimated that an area equivalent to a football pitch is lost every second.

Forests can be defined and valued in different ways, depending on the vision and perspective of the person characterising them. A forest can be, for example, a source of raw materials such as timber, a nature conservation area, an ecosystem full of biological diversity, a carbon sink, a source of multiple ecosystem services or, more correctly, a combination of all these and other views.

The definition of a forest may not be simple, but we can consider it to be an ecosystem made up of various dynamic strata, from the ground we walk on to the tops of the trees, typically with great biological diversity, and there may (or may not) be water lines or stretches of water or other natural structures that encourage biodiversity.



For in-depth explanation of the highlighted terms, go to the glossary on page 118 or click on the terms in the text.

What is an Ecosystem?

An [ecosystem](#) consists of the combination and relationship that exists between different living organisms and the physical environment where they live and with which they interact. The biotic components - corresponding to living organisms such as animals and plants - are directly related to the abiotic components - water, light, radiation, temperature, humidity, atmosphere and soil - corresponding to everything that is not alive.



Native forest in central Portugal.

Forest ecosystems have changed over time, even when man did not yet inhabit the Earth. The composition of forests has changed over millions of years. Many forest species, both plant and animal, have already become extinct, giving way to others that have adapted to the changing structure of the Earth and the climate itself. Recent data shows that forest ecosystems are home to about 80% of terrestrial biodiversity, with, for example, some 60,000 known tree species.

Ecological Succession

How have the forests changed, even without human intervention? The answer lies in [ecological succession](#)! An ecological succession corresponds to the sequence of biological communities occupying a given space, from their colonisation to the climax state.

Thus, the formation of a forest can take thousands of years! For example, after a major natural disaster completely alters the ecology and eliminates life from a particular landscape, the ecosystem will try to recover from that loss. This process is called primary ecological

What is a Species?

The biological concept of [species](#), defined since the 1930s, refers to a group of organisms that can reproduce and produce fertile offspring. While *Amanita muscaria* is a species of mushroom, the fox (*Vulpes vulpes*), a mammal, corresponds to another species, and these species can never reproduce among themselves. The individuals of a species that inhabit the same habitat constitute a population, which may share its habitat with populations of other species, constituting communities. The set of several communities is what constitutes the ecosystems, which as a whole represent the biosphere.

succession. During this process, organisms slowly begin to populate and colonise for the first time a space that, having been disturbed, is now a completely new space. However, this type of succession does not happen exclusively in situations of large-scale disturbance; this type of ecological succession can happen all the time, on a much smaller scale! The collapse of a cliff, the formation of a new waterhole, or the formation of a new dune are also examples of this kind of ecological recovery, without, for example, major natural disasters.

Despite the natural evolution within forest ecosystems, the arrival of man has led to changes in the dynamics of the various species of animals and plants, both inside and around them, in order to meet their needs for food or to support their quality of life. If at the dawn of humanity, man was a hunter-gatherer and highly dependent on natural resources, with the development of farming and livestock raising techniques we have witnessed a drastic modification of the landscape and biodiversity itself!

What is Biodiversity?

Biodiversity is the term given to the fabulous diversity of life forms that exist in nature and all the interactions between them. Diversity can range from the smallest gene (genetic diversity), which is responsible for each individual within the same species being different from its sibling or cousin, to the diversity of large living systems such as forests, soils or oceans, and including all species from bacteria and other single-celled creatures to fungi, animals and plants. It is biodiversity that makes life on Earth possible and it is thanks to it that we, too, exist today!



Forest management, lumber and pulp industry, silviculture and agroforestry

In recent decades, there has been an increase in forests planted with a single species - monocultures -, usually fast-growing, making them exclusive for the production of a certain raw material, such as wood, paper pulp or oil. Examples of this type of forest exploitation are monocultures producing eucalyptus, pine or palm, respectively. These intensive productions require huge extensions of open land, have thousands of individuals in very small bars, and are generally cultivated using aggressive techniques that resort to soil disturbance, with consecutive mobilisation of the soil using heavy machinery, resulting in the subsequent need for intense artificial fertilisation, with negative impacts on the entire system. Taken together, and by the very over-simplification of what would be the forest structure, monocultures lead to drastic reductions in levels of biodiversity.

Thus, the benefit of monoculture forests is essentially economic and sometimes they even represent a great threat to the survival of the animal and plant species that previously lived there, and a balanced and conscious management should be carried out.

Forest management has evolved over time and if, initially, Man's main purpose was the production of wood, nowadays this management is increasingly oriented towards the multiple uses of the forest, combining the production of wood with the extraction of forest by-products, such as mushrooms or fruit, as well as recreational activities.

In order to make the different uses of the forest compatible, it is important to apply sustainable forest management.

Sustainable Forest Management involves applying methods and practices whose aim is to maintain and enhance the social, ecological and economic values of the forest today, while safeguarding the same conditions for future generations. A well-managed forest, by representing a balanced and functional ecosystem, will not only be more profitable, by aggregating various values, but also more resistant to all kinds of threats, such as fires, droughts, pests and other phenomena, for example caused by climate change.

The synergies created between agricultural and forestry systems have developed ever more complete and organised activities, such as agroforestry systems, in which, for example, the grazing of animals under the cover of tree species can be combined, and in which the fruits or other products resulting from these trees can also be used.

Thus, there is an increasing interest and need to practise sustainable forest management, where it is possible to obtain economic income without jeopardising the natural values that must be conserved.

Forestry, or silviculture, is a form of forest management and involves different processes aimed at producing goods in the forests that have an associated economic value and direct income. We can divide these goods into two categories:

- **Woody goods:** all products produced from tree trunks and/or timber, such as solid wood and veneer for the construction industry; paneling, plywood, particleboard, pulp and paper, among others;



Ecosystem services provided by forests

Even if many thousands of people have never visited a forest, walked under a century-old oak tree or spotted an otter on the bank of a water line, every day, these people benefit from the forest and what it produces.

From the forests we are able to extract various products on which we depend daily, from raw materials such as wood and resin, to the water we drink, the energy we derive from burning fossil fuels and wood, but also food and substances used in cosmetics and the pharmaceutical industry, among many others.

It is easy to understand that not everything the forest produces is tangible and visible to the naked eye! Forests also contribute to the quality of the water we drink, by filtering pollutants and controlling pathogens. They are also important in controlling soil erosion, infiltrating rainwater into the ground and are essential in absorbing greenhouse gases and, consequently, in producing oxygen.

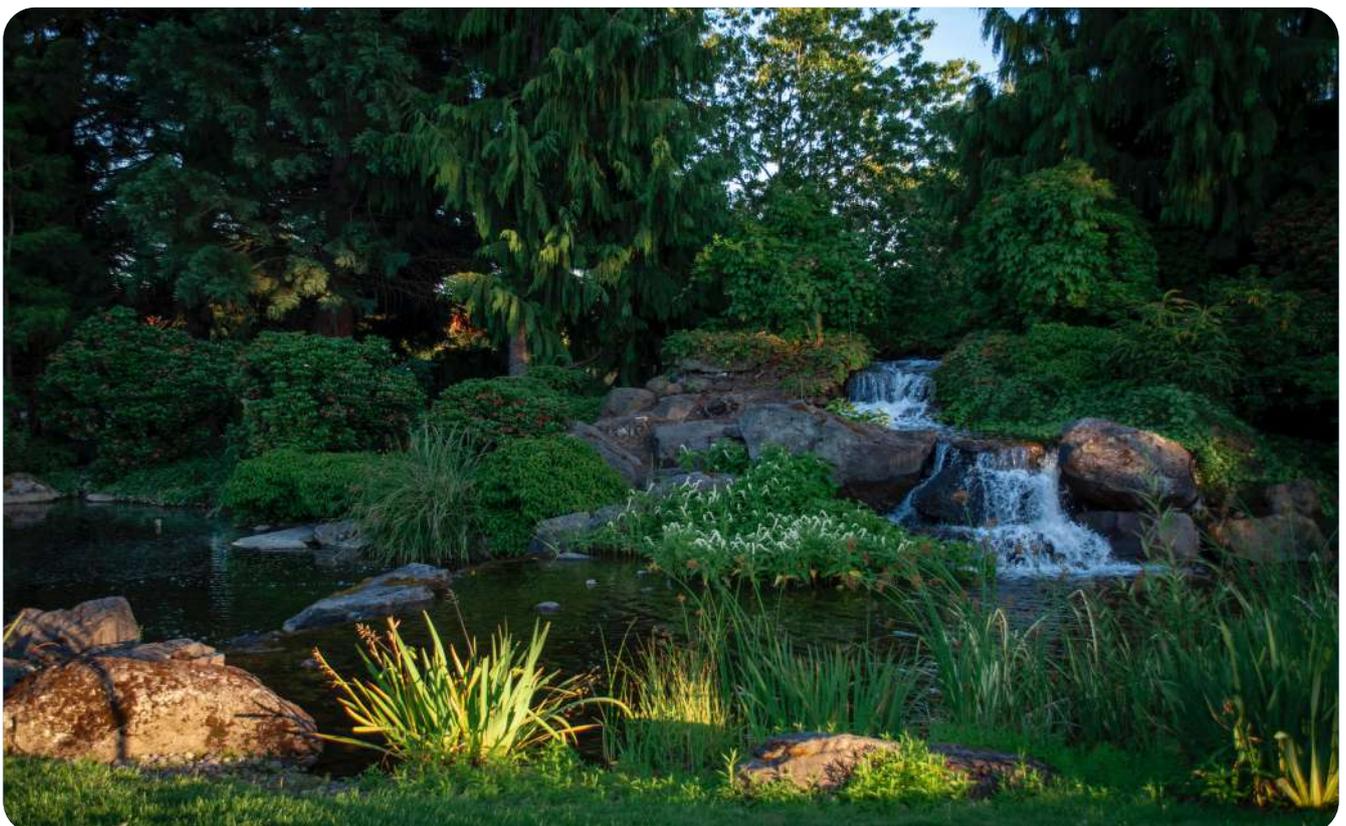
What is the greenhouse effect and how do plants help reduce its impacts?

The [greenhouse effect](#), in the context of climate change, as the name suggests, is a phenomenon similar to what happens in a glass or plastic greenhouse, in which the coating will prevent the sun's heat from escaping into the atmosphere and will concentrate inside the greenhouse, causing the atmosphere to heat up. In the case of the Planet, the heating happens on the surface of the Earth. This process has always happened and it's a good thing, because otherwise the Earth would be too cold to live on! However, the problem is the high concentration and rapid increase in the proportion of these gases (carbon dioxide, methane, nitrous

oxide and chlorofluorocarbons) in the Earth's atmosphere, causing a very high warming rate. Although atmospheric warming phenomena have been cyclical for millions of years, since the 18th century, with the industrial revolution and the burning of fossil fuels such as coal and oil, which were releasing carbon dioxide into the atmosphere at rates never before observed, this process for the first time was very accelerated and did not allow life on Earth to gradually get used to changes in climate and temperature. In order to stop global warming it is therefore necessary to decarbonise the atmosphere!

All these goods and services, we call [ecosystem services](#). They are services provided by all terrestrial and aquatic ecosystems. Every year, ecosystems as a whole provide \$125 billion worth of services to the global economy, whether through the provision of fresh water, food, clean air, heat absorption, fertile soil and the absorption of carbon dioxide not only by forests but also by oceans. However, we must understand that monetary value will always be insufficient to mention the importance of ecosystem services, as you cannot «buy» them and life itself on Earth depends on them.

Ecosystem services can be divided into four categories, as summarised in the table on page 27.



Ecosystem Services

Type of ecosystem services	What are they?	Some examples!
Support services	They are the ones that enable the existence of sites for biodiversity. They enable all other services to exist and function.	<ul style="list-style-type: none"> • Habitat for biodiversity • Maintenance of complex links between other services • Genetic diversity (enable resilience and adaptation to ecosystem change)
Regulatory services	They are responsible for maintaining the quality of air, water and soil.	<ul style="list-style-type: none"> • Air quality • Carbon sequestration • Mitigation of extreme natural phenomena • Treatment of polluted water (through the biological activity of micro-organisms) • Prevention of soil erosion and maintenance of fertility • Pollination • Pest control • Regulations of water flow
Provisioning services	They are responsible for the production of material goods and food products.	<ul style="list-style-type: none"> • Food (e.g. fruit, meat animal production, fishing, non-wood products) • Raw materials (e.g. wood, fibres, biofuel) • Water • Medicinal products (e.g. plants, fungi, algae)
Cultural services	They are all those «non-material» goods. They also relate to the services and goods that we can enjoy thanks to support and provisioning services.	<ul style="list-style-type: none"> • Mental and physical well-being (e.g. walks in urban parks, forests, mountains) • Tourism (includes benefits for the tourist and functions simultaneously as a service provision) • Cultural, artistic and design inspiration • Spiritual experiences and sense of belonging and connection.

Forest recreation and access

The forest is an important sector of activity that employs thousands of people and is one of the places of excellence for promoting the mental, psychological, social, recreational and educational quality of life of societies. Trees and forests also bring other, less obvious benefits. Different areas of research in psychology and environmental medicine have shown that the exposure of children to natural spaces and environments, whether gardens or other forested areas, even in urban areas, contributes to an improvement in their cognitive development and can also mitigate the effects of hyperactivity and other disorders in young people and adolescents. Numerous studies show that the use of these green spaces in a didactic context has positive impacts on the learning capacity, attention and concentration of pupils, managing to produce effects similar to those of ritalin peaks (chemical substance used to stimulate the nervous system and enhance attention).

There is also evidence that contact with green spaces promotes a reduction in aggressive behaviour, chronic stress in adolescents, crime rates, the frequency of diseases in prison environments and increases the improvement of living conditions in Alzheimer's patients and children with autism, confirming that nature is essential for our physical and psychological balance, even if we don't realise it.

Recreational nature tourism activities are an essential economic pillar for many countries. Many of the activities that take place in these environments, such as hiking, climbing, birdwatching, camping, among others, contribute in Europe to the economy and rural development, with the generation of numerous jobs.



Green areas and renewable energy in a city.



2.2 Urban Forest Patches

“
Trees should be an essential, rather than merely a desirable part of our cities.
”

Martin Ely, PhD candidate
University of Adelaide, School of Architecture, Landscape Architecture and Urban Design

Learning outcomes

the teachers/youth workers should be able to:

- Define the concept of urban forest
- Understand the concept of ecological corridor
- Understand the concept of urban sprawl and the importance of urban planning
- Recognise the importance of single trees in an urban context
- Identify different types of protection that can be applied to monumental urban trees.

Concept of Curbing Urban Sprawl

Just as forests represent diverse and widely variable ecosystems, so human cities can take on very different characteristics, but always inflicting a high degree of change in relation to the natural conditions that previously occurred in that space. In ecological terms, since the construction of a city, and throughout its «life», nutrients are mobilised to the detriment of others, the distribution patterns of species communities are extinguished and altered, the composition of the landscape and the atmosphere itself is changed and, cumulatively, a large part of the characteristic biodiversity of that place is massively extinguished. However, despite the profound landscape and ecological changes caused by the installation of a human urban community, there are always organisms that have the ability to subsist in these new environments, either by adapting to the resources resulting from human action or by, even with so many pressures, being able to take advantage of the natural structures that remain.

The urban environment is a highly fragmented and artificial environment, which generally includes wooded green plots of various sizes, whose origin may be natural, as remnants of

previous ground cover, or planted, for example in the form of groves and gardens, street alignments or isolated trees.

In recent decades there has been an intense rural exodus, which has led to a great occupation of urban environments. The European Commission even estimates that around 85% of Europeans live in cities. This anthropogenic pressure on cities results in the enlargement of their areas, with the associated ecological and social impact. Often this enlargement is done without much attention to sustainable planning, to the ecosystem services that could mitigate impacts and to the real needs of extension, occurring very fragmented areas with low population density. As resources (including space available for urbanisation) are not infinite, it is very important that planning and urbanism reflect on the reduction of this unstructured enlargement, on the optimisation and functionality of the urban matrix and on the ecological preservation of its surroundings.

Preservation of forested areas for biodiversity within city limits

Urban ecology largely depends on the preservation of tree vegetation, which, in an urban context, gains even more relevance from a public health perspective. In terms of biodiversity, urban trees provide shelter for many species of insects, birds and even mammals, as well as other plants that will subsequently colonise the trees, thus increasing urban biodiversity.

Urban forest spaces can take different forms, ranging from simple private courtyards or gardens to larger urban parks, riverbanks or central or peripheral wooded corridors, and the structural diversity itself can influence the biodiversity that can occur in an urban environment.

However, it should be noted that this increase

in the diversity of life forms occurs mainly in species with a high degree of mobility, such as birds, or are commensals, i.e. have behaviours and habits associated with Man, such as some species of granivorous birds, to the detriment of species with more specific ecological requirements, which do not adapt to the urban environment.

Nevertheless, all these spaces have a relevant role in the conservation of biodiversity in an urban context. Contrary to what one might imagine, when talking about conservation biology, one cannot only consider the great wild biomes, such as the great forests, jungles, savannas and other places so far away for most urban dwellers, one should also think and assimilate urban biodiversity as a value to be fostered, more and more.

Forest patches and connectivity

From an ecological perspective, urbanisation contributes to the alteration of previously existing natural fragments in terms of shape, size, composition and connectivity between vegetation patches. Physical changes in the landscape, with the construction of a city, alter the functions of the ecosystems that were there before.

Most cities do not have enough space to have several large green spaces or forests to ensure ecosystem services and to host viable populations of various wild species. It is therefore necessary to establish several «stepping stones», possibly smaller natural areas that allow connectivity, contact

between wild populations and their dispersal, ensuring a green continuum throughout the city. The set of stepping stones or a continuous green area constitute what is called an [ecological corridor](#).

Ecological Corridors

The concept of ecological corridor is associated with a green space that may or may not have human intervention, which allows the movement of fauna and connectivity between wild populations. Examples are forest areas, riparian galleries and riverbanks, patches of scrub and undergrowth that form a continuum, among others.



For in-depth explanation of the highlighted terms, go to the glossary on page 118 or click on the terms in the text.

Recognition and preservation of significant trees or stands of trees

The preservation of trees through their recognition as public heritage properties has already occurred in a wide range of countries, in some of them for a long time (e.g. Portugal, since 1914). This mechanism makes it possible to preserve unique trees or groups of trees of particular value, mainly due to their size, age or associated cultural services, namely those related to history or local identity, ethnography or even religion. This type of classification gives this natural heritage a protected status which means that any urban intervention also on its periphery is controlled, reducing the direct impact on the trees and also helping to enhance the value of the place where they are located.

In addition to the protection of singular trees (or groups of trees) due to their monumentality or manifest public interest, there are legal protection mechanisms at local or national level that may extend to all individuals of a given species, either due to the economic value of the products that may be extracted from the adult tree (e.g. the cork of the cork oaks *Quercus suber*, a protected species in Portugal), or for their ecological value, determining the prohibition of felling (e.g. in Germany, the EcotopTrees are obligatorily maintained in forest production areas, in order to reduce the impact on biodiversity).

The preservation of certain trees or groves is a fundamental step towards ensuring the safeguarding of cultural, economic and ecological values of certain regions, and also represents excellent teaching resources for environmental awareness and education.



[Monumental Tree](#)



2.3 Street Trees

“

The more trees we plant, the less environmental damage there is to repair, with fewer severe heat waves and less intense urban heat islands.

”

Doug Kelbaugh, FAIA FCNU, is Dean Emeritus of the Taubman College of Architecture & Urban Planning at the University of Michigan.

Learning outcomes

the teachers/youth workers should be able to:

- Understand the importance of regulatory services in cities
- Recognise how well cared for trees can help to enhance the space where they are located



Climate mitigation - shade and cooling, atmospheric moisture

Outside of urban forests, isolated trees - such as those found in squares or streetscapes - are also important in helping to support the biodiversity of urban space by facilitating connectivity between wider green patches. Each tree, even in isolation from the others, is capable of providing almost, if not all, of the ecosystem services that forests or larger green patches provide, despite their smaller scale. In fact, a large part of the regulating services that are provided in forests originate from each individual tree, with a cumulative effect of all these natural structures occurring in the forest space.

A single tree is thus also of high importance for our lives, being able, for example, to cool the temperature of urban spaces we use daily by between 2 and 8°C compared to similar areas without trees. On a larger scale, green

patches in urban spaces can help reduce the temperature inside them and around them by up to 200-400 metres, provided they are larger than 10 hectares. Differences of only 10% in afforestation make possible thermal differences of more than 1°C on extreme temperature days.

The cooling of the atmosphere near trees results from the combination of their presence and their ecological functioning. On the one hand, tree canopies create shade in their surroundings, reducing the incidence of sunrays on buildings and streets; on the other, through the natural process of transpiration, they release water vapour into the atmosphere, humidifying it and thus helping to reduce air temperature.

The provision of these services is directly proportional to the available leaf area on the tree, i.e. the amount of leaves a tree has. The more leaves there are, the larger the canopy and the greater the leaf area available for transpiration. It is easy to see then that, in order to maintain this ecological service, we should take particular care with the management and maintenance of these trees and their crowns, especially with regard to pruning. If these interventions are done in an excessive manner, they reduce the canopy and make it impossible to provide the services described, as well as compromising the health of the tree and a number of additional services.



Storm water absorption, shelter from wind

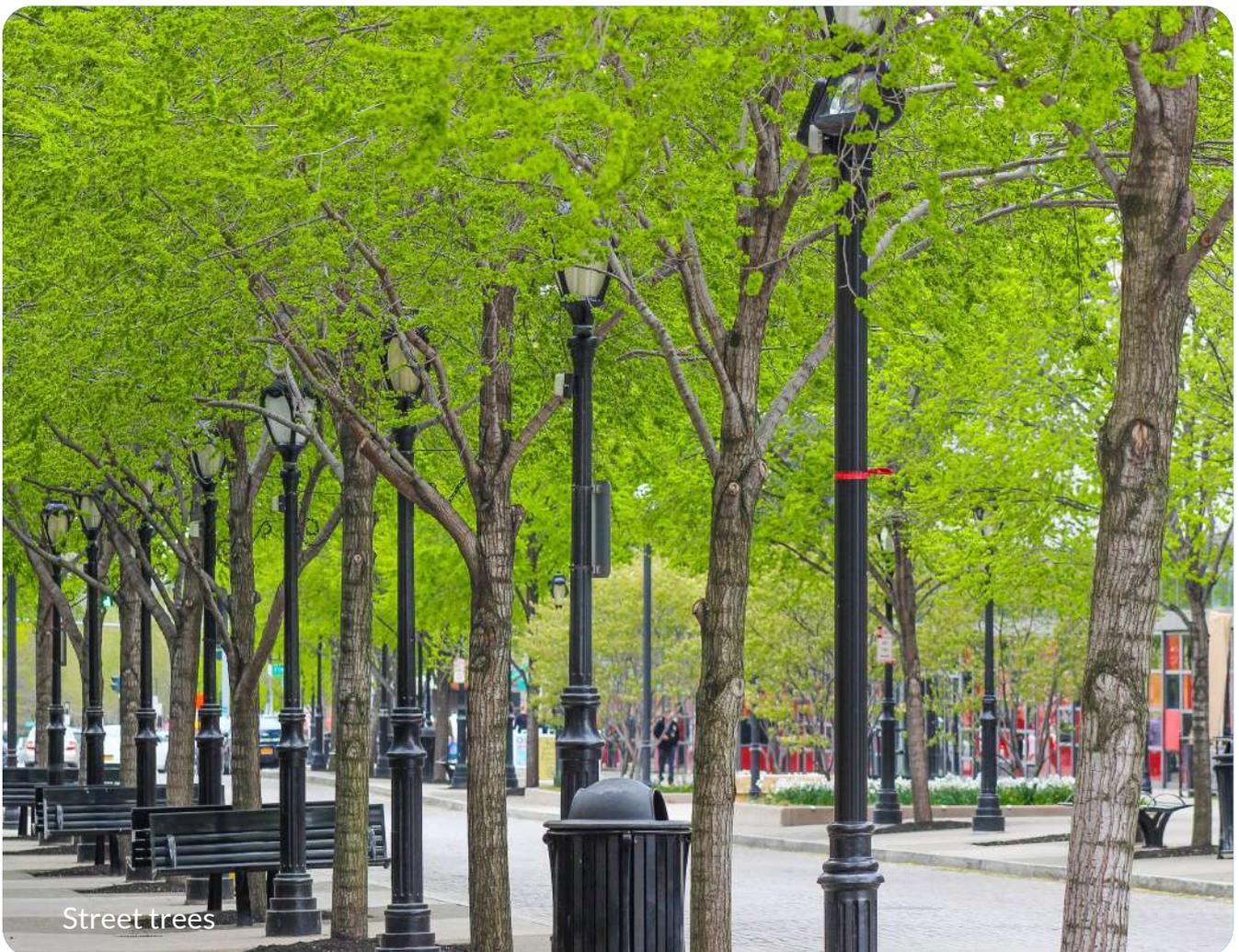
Single trees, if well managed, can grow to a large size and provide many other services like those that occur in forests, such as: support of biodiversity, removal of pollutants, water infiltration and carbon sequestration. In urban settings, trees provide additional services that are very difficult to replicate with artificial constructions. For example, urban trees promote a so-called barrier effect, which occurs in different situations. For example, they constitute a noise barrier, when the canopies intersect noise, reflecting and refracting it in different directions, and thus mitigating the urban noise level. Tree canopies are very effective barriers against wind, heavy rainfall and other extreme weather events, helping to protect people and property. Trees also regulate the hydrology of urban areas through two complementary processes: on the one hand, when the raindrops intercept the canopy, they lose speed until they reach the ground, facilitating infiltration; with the water already on the ground, the roots of the trees absorb it and aerate the soil, creating spaces where the water infiltrates, preventing uncontrolled surface run-off from the streets, which - without infiltration - can cause floods. Infiltration thus reduces direct erosion caused by rainwater. Also at ground level, the evapotranspiration of the tree also increases the air humidity of the urban space, so it is important to keep the soil bare and not waterproofed.

For all these services to function and for trees to help us mitigate the problems described, it is necessary that they are correctly installed and that the species are the most suitable for the space and climate, thinking about the size that they will reach when adult. The planning of tree plantations and interventions is fundamental to the correct management of urban space!

Resident enjoyment and monetary value of well-treed streets

The importance of trees in urban environments has been increasingly reflected in resident satisfaction, which is reflected in property values. Properly wooded urban areas can have a real estate value up to 20% higher than equivalent areas without vegetation. In addition to emotional well-being, afforestation also generates long-term economic savings in household electricity consumption for heating/cooling. Thus, it is understandable that the economic and social value of cities is related to the existence of trees or vegetation of particular landscape or ecological relevance.

The preservation of certain trees in urban environments can also lead to the enhancement of tourism and visitation, bringing benefits to other commercial sectors, such as commerce, restaurants and hotels. In countries with tree classification systems, it is also noticeable that in areas of high tourism visitation, there is a greater valorisation of unique trees through the declaration of their public interest, recognising the importance and values of more trees in these areas than in others. On the other hand, in areas where tourism is not so significant, there is a lower number of classified trees, although there are also specimens with characteristics that would allow such classification.



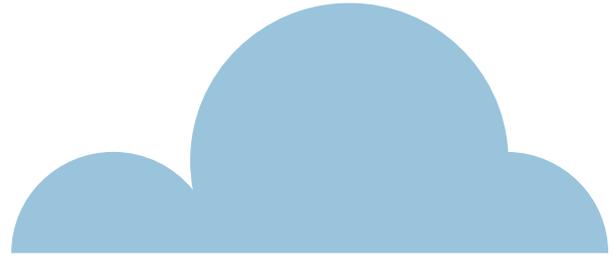
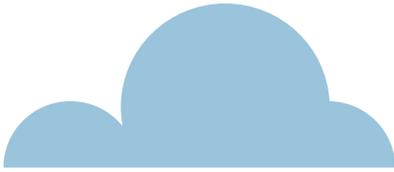
Street trees



Ajuntament de Barcelona

MODULE 3

**Urban Mobility, Health Benefits of
Urban Ecology and Human-Nature
Connection**



Introduction

What images come to your mind, when you think about the future city, say in the not too far future of the year 2100? Do you see glass skyscrapers with elevators shooting up into the sky? Drones? Flying cars? Massive multistory intersections? Transportation tubes spanning through the cityscape? You are not alone. Richard Louv, journalist and author of the book «The Last Child in the Wood» states that grown-ups fall notoriously for the same predominant dystopian images, that we lend from the science fiction of popular culture.

Louv criticises that even if sustainability comes up, it is usually merely equated with energy efficiency. He encourages us to design an alternative urban phantasy:

Martin Luther King said and demonstrated in many ways: “Any movement, any culture will fail, if it cannot paint a picture of a world that people will want to go to.” One of the

most important things that we can do for our children’s mental health and our mental health and truly the future of our civilisation is to begin to think in larger ways; to begin to reclaim the courage to be idealistic.

So I talk a lot less now about sustainability and a lot more about a nature-rich future, nature-rich cities, nature-rich schools, nature-rich workplaces, nature-rich homes and yards and nature-rich lives for future generations and for our children and ourselves right now. That’s a very different way to frame the future. ¹

He is calling upon our idealism to shift away from this reiterated post-apocalyptic future and rather turn to an urban future we would wish the next generation to experience.



¹ Louv (2014).

Challenges of the Future City

In Europe 70% of the population live in urban areas, with numbers continue to increase. World-wide, the share of the urban population would have risen from 55% to 70% by the year 2050. With 55% of the current world population, cities are already responsible for 70% of greenhouse gas emissions and two thirds of global energy consumption through urban transport, industry, impractical waste management and harmful building practices. With the ongoing urbanization trend, cities will accelerate climate change, if policy makers and the urban population do not take a turn for a more sustainable urban development. But

cities are not only catalysts for the effects of climate change, but are also victims to those. Cities in coastal areas are vulnerable to extreme weather events like storm surges and sea level rise and city residents in general experience **urban heat island** effects that result in temperatures being 4 - 10°C higher than in its rural surroundings with direct negative consequences of its citizens' health and mortality, but also biodiversity.

For in-depth explanation of the highlighted terms, go to the glossary on page 118 or click on the terms in the text.

Cities can be an effective lever in slowing down climate change and can make a great impact, provided that legislators, public actors and individuals alike take immediate action. The United Nations have included this objective into their list of 17 **sustainable development goals**:



MAKE CITIES AND HUMAN SETTLEMENTS INCLUSIVE, SAFE, RESILIENT AND SUSTAINABLE

As cities are growing in every given moment to accommodate the increasing demand, concepts for how to expand sustainably are indispensable and cannot be entrusted to investors only. The public needs to be aware of the necessary measures, and policy-makers need to direct the growth towards sustainability.

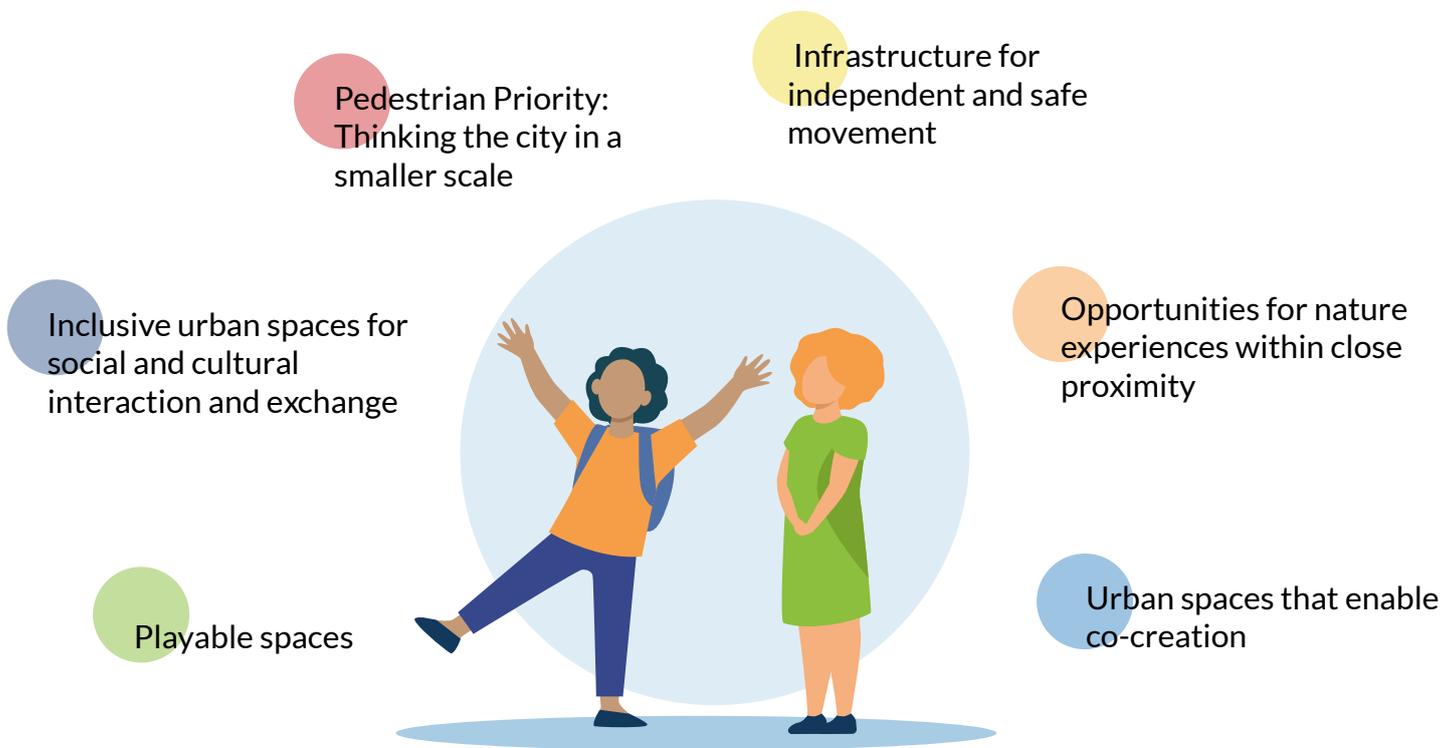


Child-Friendly Cities Are Human-Friendly Cities

As sustainability more and more functions like a buzzword in the global context, we need guidance to determine what this term really means. As a matter of fact, creating a better urban environment for the next generation not only serves as a motivation in this endeavour, but it also is a great indicator

of how to design the city of the future in a sustainable way. Thinking about a [child-friendly city](#) can direct us when drafting an agenda for an optimistic urban future for ALL residents.

Below are some indicators of child-friendly cities:



Co-creation opportunities range from planning and designing to the management and even the construction of urban spaces. This involvement not only improves the outcomes of urban planning towards more sustainable ways, but it equips children with competences of ownership and self-efficacy that are indispensable if we are to avoid the dystopian visions of future cities.

In recent years, city planning professionals take children extremely serious as agents of change and allow for participatory processes that involve children in shaping urban spaces. With their drive to explore, out-of-the-box thinking and creative abundance, children can become the designers of their own future.



3.1 Urban Mobility

“

A city can be friendly to people or it can be friendly to cars, but it can't be both.

”

Enrique Peñalosa, former Mayor of Bogotá

Learning outcomes

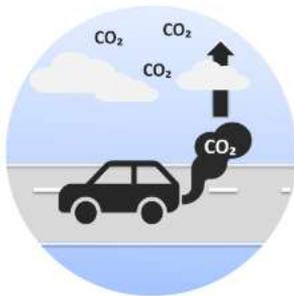
the teachers/youth workers should be able to:

- Identify how urban mobility has to be reshaped to improve sustainability.
- Identify the importance of sustainable mobility for more equity.

As we understand by revisiting the existing images of the urban future in our heads, this new vision has a lot to do with reframing the word mobility. Over the last decades we have come to accept a car-dependent design of our cities. Congestion of the urban traffic routes in the rhythm of commuting rush hours are a familiar appearance that seem inevitable, even though the numerous negative effects that private motorized transportation brings about are well known. Apart from the negative impacts on mental and physical health, the environmental damage the centeredness around the automobile causes is massive.

While the rise in popularity of the private automobile in the second half of the 20th century was associated with the promise of individual freedom and wealth especially for the middle class, it has shaped all resident's city. The more popular driving got, the more did the urban system accommodate private driving. As driving reciprocally got more comfortable through more elaborate car infrastructure, more people got encouraged to drive. In an endless feedback loop, city planners reacted with more roads to the increasing congestion resulting in more traffic with even more road rage, accidents, air pollutions and carbon emissions.

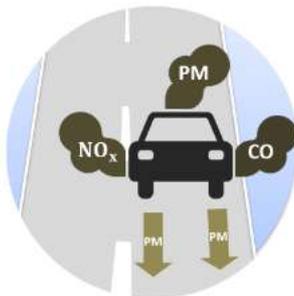
Four externalities of road traffic:



Climate change
Road traffic generates one fifth of carbon emissions in the European Union.



Congestion
Loss of time, planning uncertainties, and increased fuel consumption.



Air pollution
Health impacts due to nitrogen oxide, particulate matter, and carbon monoxide.



Accidents
25,000 deaths, 135,000 severely injured persons annually in the EU.



The departure from fossil fuels and growing orientation towards electro mobility solves some of the environmental and health issues but not all of them. When cars get smarter, more connected and eventually might drive automatically, the threshold of using individual motorized transport might even sink due to the fact that users can then spend their time other than with driving. All the more, new concepts are needed that

reward collectively more efficient forms of transport. An often neglected side-effect of a car-friendly city is inequality. After all, many households cannot afford a car (whether it is powered by petrol or renewable energy), while others have more than one. A great share of our public realm is reserved for driving and parking cars, even though this only serves the car-owning part of society.

Making urban mobility inclusive and accessible for all, unavoidably means shifting planning effort, urban space, resources, technology, investments, tax money and incentives from the car to alternative low carbon transportation systems. Charles Montgomery, the author of the book «Happy City: Transforming our Lives through Urban Design» breaks the good news: There is a wide array of measures that can be taken, and in fact are already in action in many places worldwide, to advocate for shared transport and reveal the existing positive effects: from better and more flexible timetable management including on-demand

mobility to real-time displays of timetables and better design of stopping points, maps and apps. Montgomery also points out that the disadvantages of car transport are often overlooked, for instance waiting time is perceived much differently at a bus or train stop as opposed to in a traffic jam: “A minute waiting subjectively takes much longer than a minute moving forward, no matter how slow this is.”² Montgomery also points out that car owners often underestimate the real costs of owning a car. Add to costs for driving licence, insurance, parking, fuel, maintenance and repair costs, the hours you have to work to afford a car and you end up



Justicia Urbana by Fabian Todorovic

with a transportation device that is much less efficient than you thought it is in the first place.

Therefore a new direction for urban mobility infrastructure could not only release city residents from car-related mental and physical health issues and provide relief for the environment, but could also foster inclusion and social equity by making place

for pedestrians, cyclists and transportation systems that serve all residents regardless their socio-economic background or physical abilities for an intergenerational, diverse and multifunctional public realm.



² Montgomery (2013), p. 201.



3.2 The Walkable City

“

Freedom is about being able to go anywhere without having to use a car.

”

Janette Sadik-Khan, former transportation commissioner of New York City

Learning outcomes

the teachers/youth workers should be able to:

- Identify how a pedestrian experience can foster a city's child-friendliness.



Ajuntament de Barcelona

Infrastructure for Independent Movement

For today's children, independent movement is a rare experience. Paradoxically, in the digital age, parents urge their children to go and play outside, but open opportunity space for children to do just that is shrinking. The 2007 article "How children lost the right to roam in four generations" stated the obvious by showing the radius of movement of four eight-year-olds from four generations of the same family. From the great-grandfather who walked up to nine kilometres without an accompanying adult to go fishing, to Ed, who was 8 years old in 2007 and was allowed to walk 300 meters to the end of the street. While this shrinking range to roam has various reasons, and most of them do not allow for a glorification of the past, it can

serve as an impulse to reflect on how our urban design induces this lack of children's mobility and independence. As the WHO stated recently, road traffic injuries are the leading cause of death of children and youths aged 5-29. While for a long time this has been addressed with road safety education for children, urban planning endeavours become more frequent that aim for changing the car-centred infrastructure altogether.



Especially in the light of child-friendliness, there is a lot to be gained when shifting priorities from the car to alternative ways of moving in the city. Over the decades, the car has imposed its scale on the city and it is high time to zoom in again to a human scale.

Sociologist and landscape architect Randolph Hester analyses how urban design can foster connection with our fellow citizens but also with our natural environment. In his book *Design for Ecological Democracy* he maps out the importance of cities to accommodate a full range of tempos “from the cinematic light speed to the snail’s pace”³. By creating an urban infrastructure that provides routes for all tempos, equality in our society is strengthened, as this not only affects children, but also the elderly and people who are physically impaired. If paradigms shift from car-friendly to human-friendly urban design, there will be room for inclusive public space, that gives back the freedom of mobility to all residents.

Transforming Cities

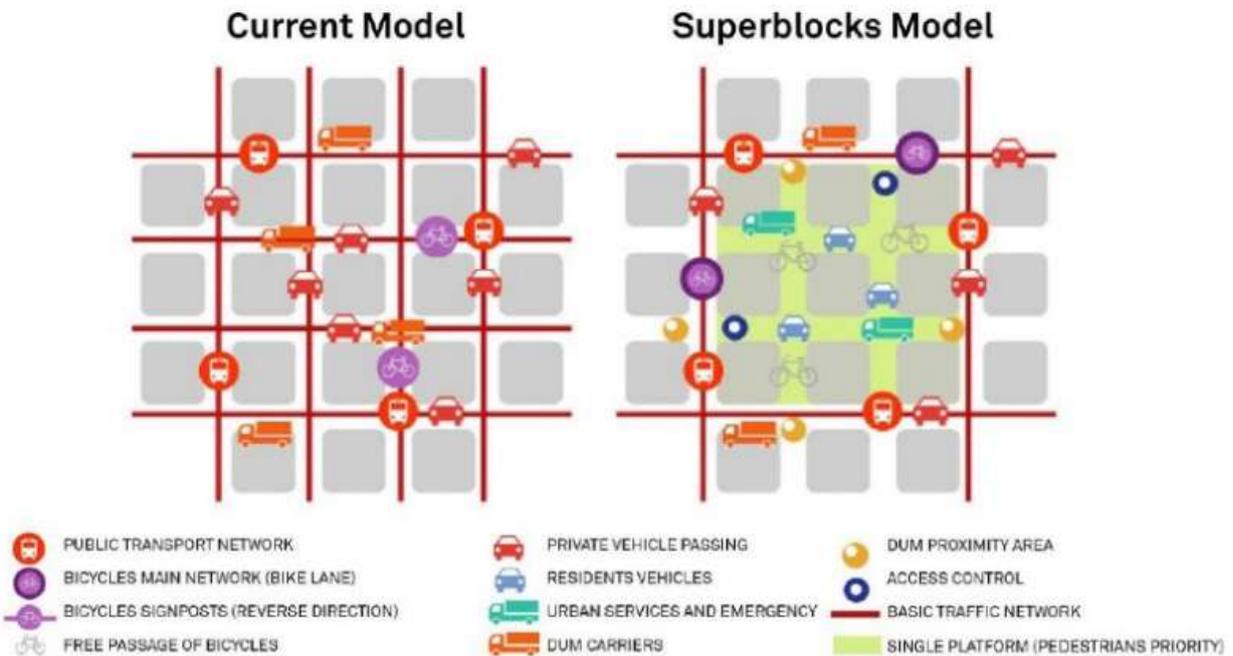
Guiding stars for this development are the city of Barcelona’s SUPERILLES - superblocs. With the slogan “Let’s fill the streets with life”, in 2015 the municipality started to transform street networks into car-free zones allowing for cyclists, public transport and pedestrians to reclaim the streets. This came at a time when the municipality of Barcelona had constantly failed to meet the EU’s air quality targets. As cars are diverted around those superblocs, a network of streets is released to the free use of the residents. While essential traffic of motor vehicles is still allowed (public transport, residents, delivery), but hampered to 10 km/h, all transit traffic is eliminated and makes room for picnic tables, street markets, playing grounds and also planters and trees, that transform the streets into a vibrant, green, mixed-use (almost) car-free zone. The change of infrastructure delivers new urgently needed incentives to cyclist and pedestrians in order to reduce transport-related carbon emissions and air pollution. For children and families who are inhabiting those streets, this transformation provides a safe, walkable and playable surrounding and therefore significantly improves their actual quality of life.



³ Hester (2006), p. 360.



SUPERBLOCKS MODEL



Enrique Peñalosa, former mayor of Bogotá (1998 – 2000 and 2016 – 2019) is the figurehead of city policy-makers pushing this transformation forward. His advocacy for reinventing urban life is based on the conviction that equality and equal participation needs common civic space. According to Peñalosa, public space has been sacrificed for too long to automobiles and privatization under the pretext of increasing economic wealth. While only few profited from this, the majority of the population was pushed to the margin, left with the externalities of those set priorities. Peñalosa committed to redesigning the experience of city living for Bogotá's inhabitants by replacing intersections with plazas, car lanes with bicycle highways and establishing a chain of parks spanning through the city. Regularly, the roads are closed for cars altogether, allowing for a new pedestrian experience in a city that was notoriously known for its street

Pedestrian Experience

Sociologist and landscape architect Randolph Hester calls for civic loitering demanding that we all should spend more of our time in the streets as an act of community building and to bond with our environment. But he also stresses, that the pedestrian experience has to be directed by deliberate planning decisions in order to accommodate this. As policy-makers in Barcelona and Bogotá proved, there are a lot of measures that can be taken to make streets safer by giving priority to pedestrians and thereby improving the quality of the walking environment and at the same time making the public space more inclusive by decelerating its pace. According to Hester however, more needs to be done regarding city planning. Walkable routes have to be provided that link residential areas with the city center as well as with the open space beyond the city providing car-free linkages from the center to wild landscapes. Hester elaborates that walking "teaches



us about the habitat [...] and extends the boundaries of territory that we care about.”⁴ He is calling for creating “living Symphonic Sequences”⁵ or routes that touch people’s heart. While this sounds quite emphatic for a city planning effort, it helps again to take a child’s perspective here. How can the public space provide a pedestrian experience for children? Children’s everyday journeys should include features that inspire to interact. While playing grounds are the standard answer to that demand, there are other valuable ways that allow playful encounters while making walking more attractive. Apart from their environmental benefits, natural elements in the cityscape can provide glimpses of wild space that offer ever-changing sensual experiences for children. In Copenhagen, a variety of measures that improve the city’s climate resilience serve simultaneously as green and adventure space for children and are situated right within the neighbourhoods

like Tåsinge Plads or Østerbro. **Green urban infrastructure** like this helps to absorb and manage stormwater excess and has a cooling down effect while providing wild vegetation and animal life to be experienced and explored on people’s everyday walking routes. Those multifunctional interventions create synergies that make walking in the city more attractive, and can even advance to an impelling aesthetic experience embedded in people’s everyday routines. If this is implemented in a near-natural way it might also give opportunity for children to encounter biodiversity in their close environment and even transform adults’ viewing habits, who expect neatly cut lawn and hedgerows when they hear urban green.

⁴Hester (2006), p. 393.

⁵Hester (2006), p. 399 ff.

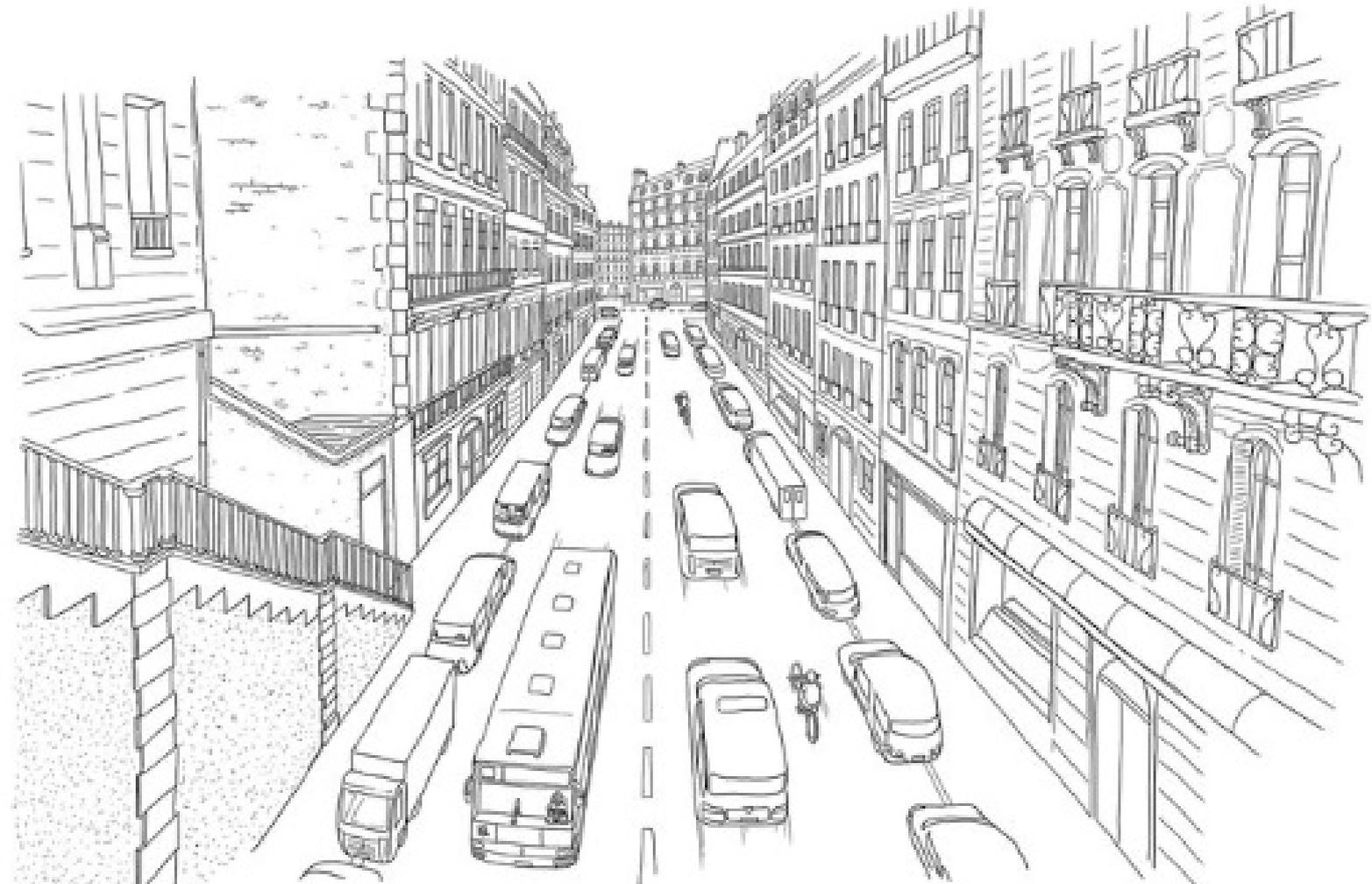
The 15-Minute-City

Another aspect of prioritizing walking is to provide all needed services within walking distance of residential areas. [New Urbanism](#) wants to shift paradigms in city planning by defocusing on automobility and focusing on access. For decades, massive investments in cities were dedicated to move automobiles further and faster and thereby endowing a car-dependent system.

The 15-minute-city-movement wants to bring back the services into residents' arm length that were outsourced into shopping centers and designated commercial zones: "Good access comes from having a diversity of services intermingled within your own neighborhood, so you don't have to go all the way across town – or outside of town – to get to what you need."⁶ In his TED-Talk Carlos Moreno claims that the dysfunctionality and

indignity of the city and our acceptance of noise and pollution reached a peak. We have come to accept the domination of the car as if it was God-given. In order to change that, we have to design mixed-use cities that provide living space, but also commercial, health, cultural and leisure services. To rethink the city in this light, he presents four principles that are the building blocks of the 15-minute city:

- **ECOLOGY:** for a green and sustainable city.
- **PROXIMITY:** to live with reduced distance to key services
- **SOLIDARITY:** to create links between people
- **PARTICIPATION:** to actively involve citizens



Paris en Commun - Rue avant après by Nicolas Bascop

⁶ Moreno (2020).

Under these parameters, neighbourhoods can evolve to allow residents to reach all needed services within a walk of 15-minutes (or bike ride of 10 minutes). Anne Hidalgo, the Mayor of Paris is implementing this scheme to transform the French capital into a sustainable city. She is implementing Moreno's recommendations for making the 15-minute city happen. By reorganizing and topping up local services, assigning multiple purposes to the common space and adapting the rhythm of the neighbourhoods to humans not cars, Hidalgo is making the most of Paris' already existing density. Nicolas Bascop's illustrations for Paris en commun give a vivid impression of Paris streets before and after the transformations in progress.

This transformation minimizes the need for motorized transport and thereby turns the city as significant perpetrator of environmental harm into a part of the solution. Moreover, social space is created that can connect people and create community. This is also an essential reorientation for urban space that has long been centered around commercial services. As a lot of these move into the digital realm through the possibilities of online order, it is time to give new purpose to the vacant public realm.





3.3 Health Benefits of A Sustainable City

“

Time in nature is not leisure time; it's an essential investment in our children's health (and also, by the way, in our own).

”

Richard Louv, Last Child in the Woods

Learning outcomes

the teachers/youth workers should be able to:

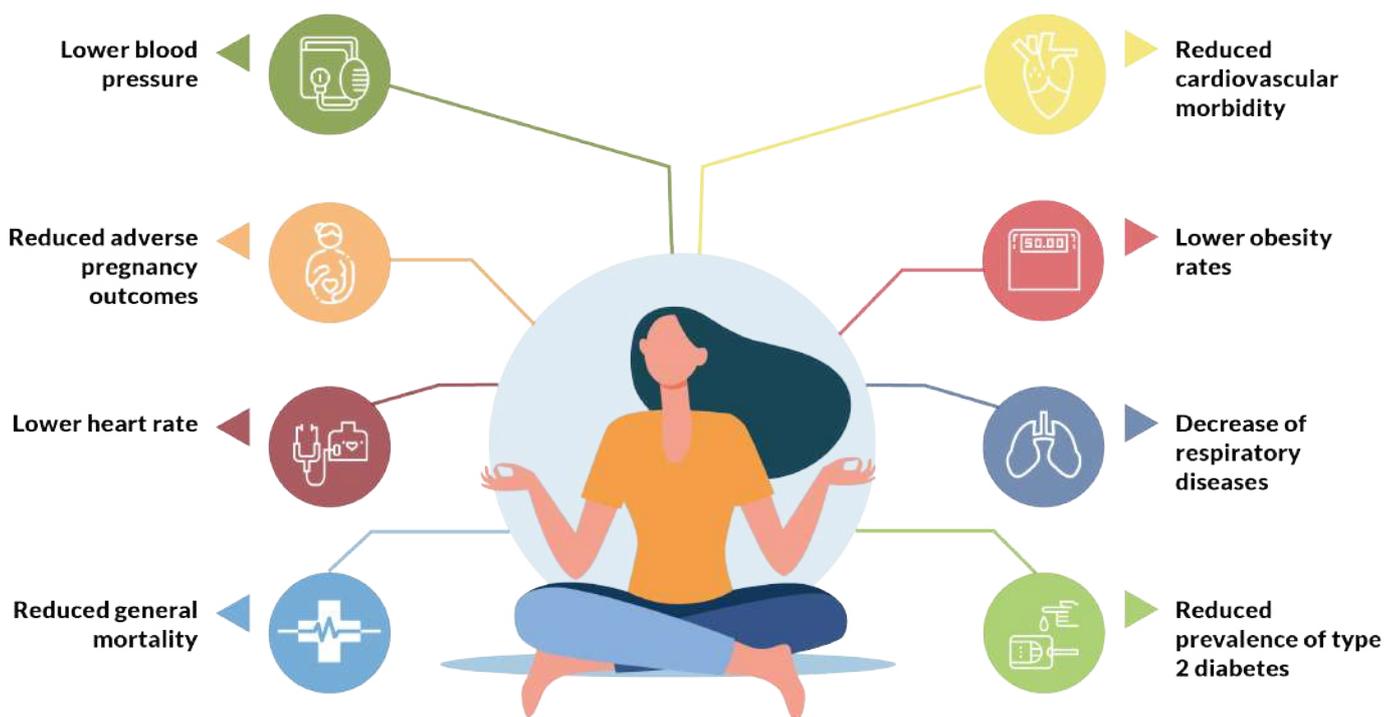
- Identify the interconnection between health of the ecosystem and human health.

An essential tool for making cities more sustainable is to integrate nature into the urban fabric. The benefits of a green urban infrastructure are obvious if it comes to the environmental dimension of making cities more resilient to climate change. But how can green spaces improve the human living condition?

Benefits of A Sustainable City for Physical Health

There are two dimensions to the impact of nature on health: On the one hand, urban green infrastructure can mitigate health stressors like heat, noise and air pollution; on the other hand, access to natural environments and a thoughtful city layout can encourage physical activity and thus enhance an overall fitness.

Those two factors demonstrably result in the following benefits for physical health⁷:



Additional health value can be detected with children. Physical activity is one of the measures that counteract child obesity. With the Covid-19-pandemic school closures and lockdowns are expected to have a strong impact on childhood obesity levels. Early exposure to plant and animal diversity has a strengthening effect on the immune system and prevents the development of allergies. For children’s eye health, it is essential to spend time outdoors, for the eye to develop its full potential through different stimuli as opposed to excessive screen time exposure.

⁷ European Environment Agency (2020), p. 43ff.

Benefits of A Sustainable City for Mental Health and Well-Being

The Covid19-pandemic caused for millions of people worldwide a serious threat to their lives or physical health. At the same time, the societal crises around the pandemic brought about a worsening of people's mental state and well-being with depression, anxiety, chronic stress, fatigue and loneliness on the rise. Recent studies show, that nature access formed a significant relief to people and nature experience turned out to be a balancing force for stressed minds. Those who were lucky enough to be allowed to leave their house and had green infrastructure around the corner were decidedly better off

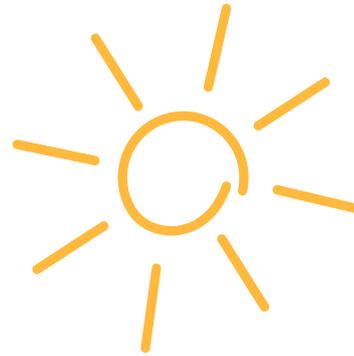
in terms of their psychological constitution. What the pandemic revealed is consensus in the research done by nature, health and social sciences: nature experiences have a positive impact on cognitive functioning, psychological well-being and other dimensions of mental health.



Cheonggyecheon, formerly covered river basin in Seoul, South Korea that got transformed into a public recreation and nature space

In the 1980s studies started to emerge that proved the interconnectedness of the presence of nature and human health. A 1984 study by R.S. Ulrich, researcher in healthcare design, found out that recovery is significantly quicker with hospital patients that have a view on green from their hospital beds. In the 1990s, several experiments conducted with people living in large developments showed that health and well-being was subjectively perceived higher by people overlooking greenery from their homes. Further impacts on the psychological health can be detected with children. For ADHS patients nature experiences have a positive effect on their emotions, evoking joy, carefreeness and boosts of self-confidence. Children who suffer psychological strain can also buffer the detrimental impact of negative experiences

better through access to nature. The flip side of those positive effects that nature experiences can have on children is best described by Richard Louv. He detects a nature-deficit disorder in our society caused by a lack of experiences with the natural world.



Louv refers to general attention deficit, loss of sensory perception and an increase in physical and psychological illnesses, but he also stresses the positive potential if we decide to address and change this “Deficit is one side, the other one is abundance that awaits us, if we find ways to connect children and nature again”.⁸



⁸ Louv (2005), p. 56.

In her work Louise Chawla, professor for environmental design, inquires how exactly exposure to natural environment increases well-being and cognitive competences in children. She mentions several principles that are inherent to design of nature and influence children's emotions, abilities and competencies in a positive way:



Nature is dynamic

There is always something new to discover and to adapt to.



Nature is multisensorial

It challenges all senses through different scales, textures, colours, sounds and scents.



Nature has loose parts

It encourages children to interact and to create.



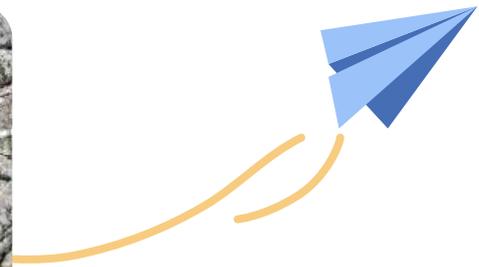
Nature is diverse

It does not prescribe social roles like other environments for play.



Nature is adventurous

It challenges coordination and risk assessment by allowing for climbing, jumping, balancing.



By comparison to the standard playing ground set up, the benefits of play in nature become apparent. They foster significantly the development of coordination, teamwork, self-efficacy, risk-assessment skills and self-confidence.



3.4 Building Bonds between People and Nature

“No one will protect what they don't care about, and no one will care about what they have never experienced.”

Sir David Attenborough, broadcaster and naturalist

Learning outcomes

the teachers/youth workers should be able to:

- Identify how urban nature experiences can raise awareness and agency for the natural world within children.

As science proves, nature is a fix to a lot of our civilization diseases. As a matter of fact, this might be reason enough, to design nature intentionally into our lives and start working on providing access to nature for everyone on a daily basis. But the biosphere is not merely an [ecosystem service](#) or a dwindling resource, that we need to manage, we also are inherently part of it. Human health is interdependent with the health of our environment.

Child-Nature Connection to Build Competences

This connection needs to be experienced to be understood, so educational scientists urge practitioners to give opportunities to children to make „pivotal experiences in childhood and youth (that) prepare people to actively care for the natural world and environmental justice“⁹. Chawla claims that those interactions with the natural world on the one hand help build an ecological identity, that provides a sense of belonging and purpose that can nurture well-being across a person’s life span. Connection to nature can endow children with the capability of social affiliation, but also affiliation with other species, while widening their sensuality, imagination, bodily integrity, capacity for free play, self-efficacy and cognitive performance. To develop those skills to the fullest, children need opportunity and space for free-range exploration. It is crucial to allow for interaction as opposed to experiences that objectify nature like zoos or manicured parks with fenced lawns. Nature is multi-sensorial and reactive and this quality can best be experienced in an immersive setting that encourages interaction.

From Nature Connection to Nature Conservation Behaviour

On the other hand, experiencing connection with nature is the starting point for children’s commitment to its protection. To ignite this much needed agency, that will be crucial for future generations, children must experience natural habitats and biodiversity. The more this is part of their environment, the more likely it is that they evolve from objectifying nature to identifying with it. Research shows that the foundation of an ecological identity even if laid in childhood runs through biographies. When asked for the origin of their engagement, a lot of environmental activists refer to nature experiences in their childhood or adolescence. The ambition to provide such experiences for a great share of today’s youth, can be game-changing. We have to take every design opportunity to foster [biophilia](#) in the children’s direct environment.



⁹Chawla (2020), p. 634.

[E]very practice to increase children's access to nature is important, from naturalizing private yards and multi-family housing sites, to mosaics of parks and gardens, to greening the grounds of schools and child care centers, to making nature centers, camping and field trips to natural areas available for all children. Finding ways to bring nature to children, even in densely populated and low resourced parts of the world, appears essential to foster connection. Doing this can simultaneously create networks of green spaces for biodiversity and offer many opportunities for children to become involved in nature protection and restoration.



Flower-filled meadow in the school yard of Gemeinschaftsschule Kerspleben in Germany (by Daria Junggeburth/DUH)

From Biophobia to Biophilia

Practitioners in environmental education report about steep learning curves once children get in touch with the biosphere. First encounters with insects especially reveal the alienation from nature when growing up without access to green and wild spaces. Some children are even disgusted by spiders or worms and think contact can be dangerous. To approach this lack of connection with and misconceptions of the natural world, researchers recommend several strategies to involve children sustainably:

- **Promote empathy** and respect for living creatures
- **Show appreciation** of children's accomplishments and discoveries in nature and support their curiosity
- **Allow children** freedom to engage with nature autonomously
- **Practice risk-benefit-assessment** instead of just risk assessment.

Coping with Environmental Fear

In the light of rapid climate change, worry, anxiety and anger can be expressions of a felt connection to nature. While these emotions can lead to environmental activism, they can also cause frustration and paralysis. As the ecological identity is strengthened, recognition of shared vulnerability can make it stressful to deal with climate change and biodiversity loss. Instead of fatalism, which a lot of adults are stuck with, it is necessary to establish an attitude of constructive hope. This requires:



A vision for a possible future

Awareness of pathways to reach the goal

Belief in agency to achieve it

Furthermore, if environmental action is experienced collectively, may it be in the family, classroom or community, individual helplessness can be replaced by social stewardship. Some educators refrain from confronting children of a young age with the hazards of climate change and researchers recommend to always „combine the science of environmental change with information about how to make a difference“.¹⁰



¹⁰ Chawla (2020), p. 632.

Inspiration for the future

For more information on child-friendly cities, read Arup's guide to the child-friendly approach: *Cities Alive. Designing for Urban Childhood*. It is available online and provides 40 global practices of child-friendly interventions.

Arup (2017). *Cities Alive. Designing for urban childhoods.* <https://www.arup.com/perspectives/publications/research/section/cities-alive-designing-for-urban-childhoods>

An account of how the COVID-19-pandemic could potentially accelerate sustainable city planning, read Carlos Moreno's article on Post-Pandemic Cities. Moreno is the pioneer of the 15-minute-city-concept.

Moreno et al (2021). *Introducing the "15-minute-city": Sustainability, Resilience and Place Identity in Future Post-Pandemic Cities.* *Smart Cities* 2021/4. <https://www.mdpi.com/2624-6511/4/1/6>

The ultimate guide to involving children into placemaking is Victoria Derr's and Louise Chawla's book *Placemaking with Children and Youth*. It provides a framework for how to implement participatory practices with children and provides inspirational case studies from all over the world.

Derr, V. and Chawla, L. (2018). *Placemaking with Children and Youth: Participatory Practices for Planning Sustainable Communities.* New Village Press, New York.

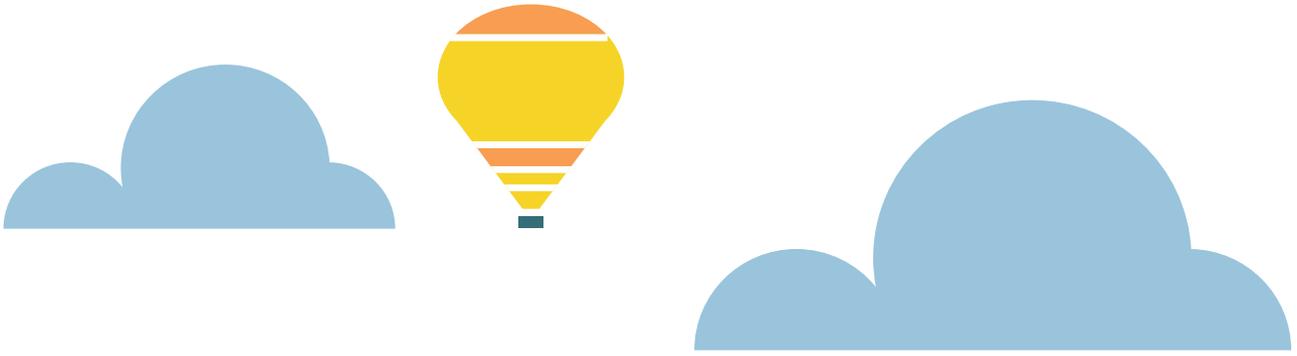




Children playing in water fountain

MODULE 4

Caring for Water



Introduction

73% of the surface of the Earth is covered with water. Water is the main condition for life as human, animal and plant life are deeply dependent on it.

Imagine you are on a hiking tour in the hot summer and your water bottle only has a few drops left. You will immediately notice in your body and mind how indispensable water is and how deeply we rely on water access.

Although the quantity of water on Earth has remained fairly constant over time, today's climate change has affected the water cycle of the planet. Higher temperatures cause glaciers to melt and many areas are affected by drought. Water scarcity and pollution threaten human health, food security and quality of life. The change of rainfall and river flow patterns lead to frequent flooding which increase the risk of damage to homes, infrastructure and energy supply.

Not only is water a crucial resource for human life but it also regulates climate and weather and keeps our planet functioning. Thus, it is important to manage and protect our water as it is a vital natural resource for future generations. Without water, no life can survive.





4.1 Access to Clean Water

“

The right to water entitles everyone to have access to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic use.

The United Nations,
Human rights

”

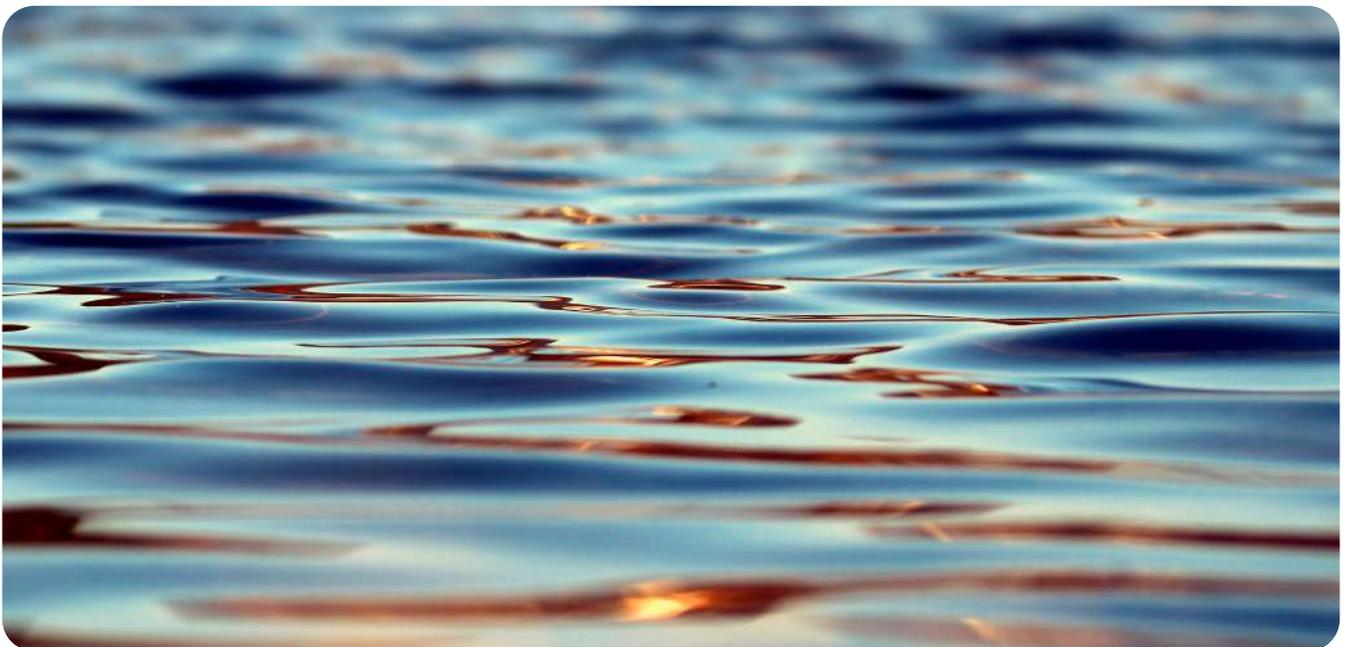
Learning outcomes

the teachers/youth workers should be able to:

- Understand the importance of water as a crucial resource for life for on earth

Water is a crucial resource for humanity. Every one of the cells, organs, and tissues of the human body use water to help with temperature regulation, keeping hydrated and maintaining bodily functions. Access to water and sanitation are recognized by the United Nations as human rights and it «entitles everyone to have access to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic use»¹. Nevertheless, 2.2 billion people do not have access to clean water.

Extreme weather events and changes in water cycle patterns caused by climate change are making it more difficult to access and ensure safe drinking water. The rising sea levels are causing the fresh water to become salty, which affects the quality of the water resources that millions of people rely on, the raising temperatures foster pathogenic bacteria in freshwater resources, making the water dangerous for people to drink, and natural disasters, like flooding, earthquakes, wildfires, tornadoes and hurricanes, can destroy and contaminate water supplies.



Absent, inadequate, or inappropriately managed water and sanitation services pose a great risk for the health of the world's citizens. Contaminated water and poor sanitation can lead to the transmission of diseases such as cholera, diarrhea, dysentery, hepatitis A, typhoid, and polio. Globally, 2,2 billion people do not have access to clean drinking water in their own home. This is primarily people living in the world's poorest slum areas and rural districts.

¹ [United Nations, UN Water](#)

What is Drought?

Drought is characterized as a period of time when an area or region experiences a lack of precipitation which can cause reduced groundwater, diminished stream flow, crop damage, and a general water shortage.

What is Water Scarcity?

Water Scarcity results from water demand exceeding available water resources and is defined as «scarcity in availability due to physical shortage, or scarcity in access due to the failure of institutions to ensure a regular supply or due to a lack of adequate infrastructure»².



The water demand grows along with the population of the planet and higher living standards, as well as the food and energy demand that require large amounts of water. According to data from 2019, 17 countries are characterized as water-stressed, and twelve of them are located in the Middle East and North Africa. Water scarcity and climate change are factors that can lead to conflict and migration, as communities and populations compete for shrinking water resources. Families may be forced to leave their homes to find dependable water supplies and livelihood opportunities. In these situations, people often move to urban areas, putting even more pressure on already strained services.

For in-depth explanation of the highlighted terms, go to the glossary on page 118 or click on the terms in the text.

² [United Nations, UN Water](#)



4.2 Drought and Water Scarcity

“

(...) according to our estimates about one third of the EU territory is exposed to water stress in which the demand exceeds the available supply for a certain period.

Hans Bruyninckx, EEA Executive Director

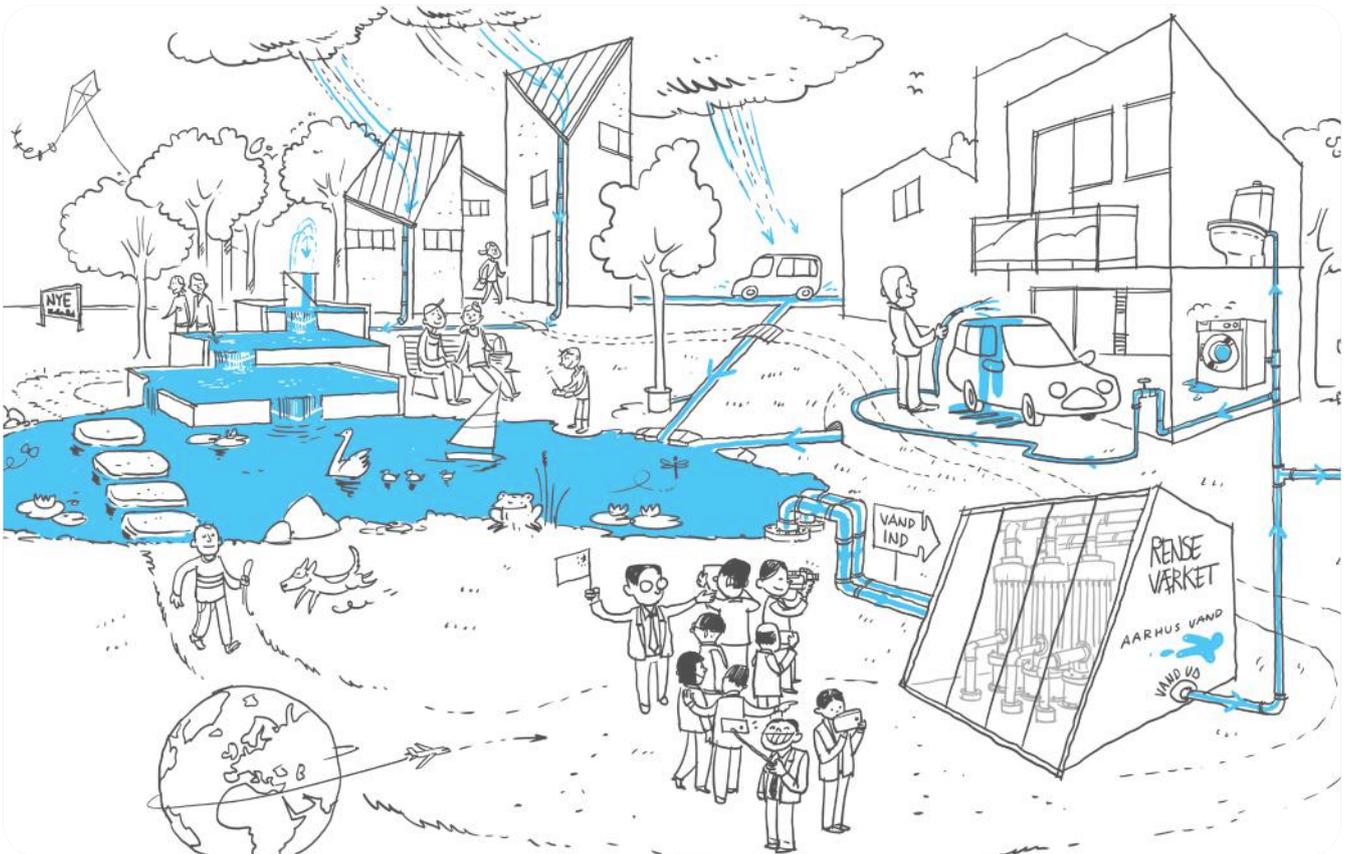
”

Learning outcomes

the teachers/youth workers should be able to:

- Understand and define drought and water scarcity
- identify the consequences that result from the two phenomena

Water scarcity events are becoming increasingly severe and prevalent in Southern Europe, with Portugal experiencing long periods of severe drought in recent years. Given that 75% of Lisbon's water consumption is for street washing, irrigation and other non-drinking water uses, Portugal's capital has devised a strategy to optimize the use of recycled wastewater for non-drinking uses, which has had the effect of contributing less than half the greenhouse gas emissions of drinking water. The strategic plan for water reuse is part of a wider Water Efficiency Strategy, anchored in a vision of a city filled with green infrastructure managed with minimum water needs. Greenspaces are planted using rain-fed native species which limits the need for irrigation. Where irrigation is needed, a system is used to rapidly detect and fix water leaks and increase efficiency.



The water system in Nye, Denmark.

Another city that exploits wastewater as a viable resource is the Danish city Nye. Nye, located north of Aarhus, is a city based on a green and sustainable vision with the purpose of creating a better life for its inhabitants. The city is built on sustainable principles considering the residents, nature, and the surroundings of the city. As the first city in Denmark, Nye uses surface water for toilets and washing clothes to limit the consumption of groundwater resources. Rain and surface water from roofs, roads and the surround green areas is led through drains and canals and into a rainwater lake. From there the water is led into a wastewater treatment plant which purifies the water and then distributes clean water to the toilets and washing machines in the city through a separate water pipe system. With this method 40 % of the area's water consumption is covered by purified rainwater.



4.3 Flooding

“

With climate change we do expect all hydro-meteorological extremes to become more extreme.

”

Carlo Buontempo, the director of the Copernicus Climate Change Service at the European Centre for Medium-Range Weather Forecasts.

Learning outcomes

the teachers/youth workers should be able to:

- Understand and identify the different types of flooding

Flooding occurs when an overflow of water submerges land that is usually dry. Floods can be caused by heavy precipitation, rapid melting of snow or ice or by large storms or tsunamis. They can be extremely damaging and have severe social, economic and environmental consequences. Floods can be categorized as one of the following 3 types: river floods, pluvial floods and coastal flood.

River Floods

River floods (also called fluvial floods) occur when the water level in a river, lake or stream rises and overflows, the surroundings, shores and neighbouring land. This can be caused by excessive rainfall or rapid snowmelt. These floods can take hours or even days to develop.



Pluvial Floods

Pluvial floods occur when extreme rainfall creates a flood that is not linked to an overflowing water body. They take form in two ways:

- **Surface Water Floods** are caused by an overwhelmed urban drainage system where water flows out into the streets. The water level is usually shallow and does not create an immediate threat to lives, but they may cause economic damage.
- **Flash Floods** are characterized as intense torrents of water with high velocity emerged from heavy rainfall in a short amount of time. Flash floods generate quickly and can be extremely dangerous, as they do not give residents time to prepare or evacuate.



Coastal Floods

Coastal floods occur when land areas along the coast are inundated by seawater. These floods are caused by intense windstorm events occurring at the same time as storm surge (when wind forces water onshore) and tsunamis.



Water Management and Flood Protection

Over the decades, the Dutch have mastered the art of flood protection as the Netherlands have been - and still are - on the front lines in dealing with flooding and sea level rise. One third of the Netherlands is below sea level, and two thirds are vulnerable to flooding. As one of the worlds leading countries in water management they now consult other exposed countries.

Nature and water go hand in hand. This is the thought behind the Dutch «Room for the River programme». This working-with-nature approach now serves as a global model in terms of water management and protection against increased risks of flooding linked to climate change.

In 2005 the Dutch Government started the «Room for the River Programme» which main goal is to increase the capacity of rivers to cope with high water levels at 30 locations in the country. This is done by lowering the levels of flood plains, creating water buffers, relocating levees, increasing the depth of side channels, and the construction of flood bypasses. The floodplains that have been lowered will be inundated during periods of high-water levels, thus temporarily giving the river more room and easing the pressure on the dykes.

«The risk is out there, so our challenge is to stay resilient, and adaptation is key.³»

«If you keep your floodplains and protect them as they are, you can still maintain your economic development while being flexible and resilient in dealing with the risks.⁴»

**Willem Jan Goossen,
Senior Policy Adviser on climate adaptation
and water at the Ministry of Infrastructure
and Water Management, The Netherlands**



Oosterscheldekering, The Netherlands

³ [Willem Jan Gossen, Senior Policy Advisor, 2018](#)

⁴ [Willem Jan Gossen, Senior Policy Advisor, 2018](#)

Water Management and Re-naturalization



The municipality of Lousada, Portugal works with water management as part of its environmental strategy and its different sustainable development initiatives. In 2019 the municipality established «the Forest and Watermills Park of Pias» consisting of 7 hectares of natural area along the Sousa River. The watermill complex holds an environmental education center promoting traditional agriculture, power systems moved by water, and ecological awareness regarding rivers.

The watermill complex is located in an area which has been ecologically degraded due to an abusive land use. In periods of heavy rain, the river overflows and erodes the surrounding fields.

In order to regulate the water flow and mitigate the impacts of heavy rain and periods of drought, three ecological interventions were made:

- a) the construction of a large pond that provides water in drier periods,
- b) the re-naturalization of the river margins and the recreation of the natural river profile and
- c) forestation of the riverbank and the surrounding areas to control water infiltration and flow.

This initiative restored the natural profile of the river and created sustainable ways of regulating water flow that benefits both the community and the biodiversity.



4.4 Europe's Challenges

“

There is need for a stronger focus on urban nature, for example by building up networks of blue-green infrastructure to adapt to a changing climate.

”

Professor Dr Beate Jessel, President of the German Federal Agency for Nature Conservation

Learning outcomes

the teachers/youth workers should be able to:

- Understand the water-related challenges experienced in Europe in general,
- Understand the challenges experienced in Cyprus, Portugal, Germany, The Republic of North Macedonia and Denmark

Climate Change

Like the rest of the world, Europe is facing the consequences of climate change and the gravity of the situation can be denied. Many European regions are experiencing more frequent, extreme, and longer lasting droughts and the damage they cause is mounting. Most of the roughly EUR 9 billion annual losses caused by drought affect agriculture, the energy sector and the public water supply.

Water scarcity is no longer an uncommon phenomenon in Europe, as it affects at least 11 % of Europeans. Studies show that the largest increase in drought conditions is projected for southern Europe, where the competition for water between agriculture, industry, tourism and households most likely will increase.

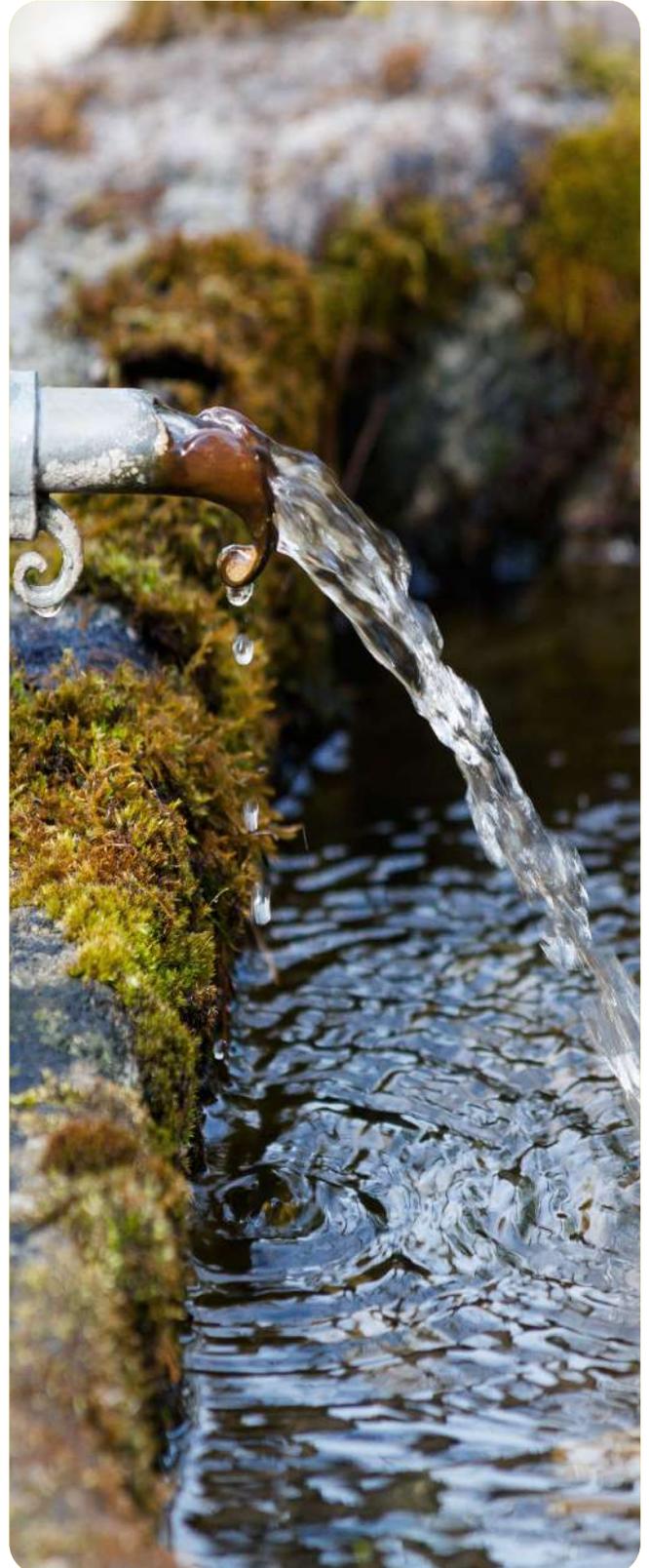
The severe droughts and a rise in temperatures can cause a decrease in water quality as these conditions foster the growth of toxic bacteria. This also affects the water availability and hereby worsen the problem of water scarcity.

Most European rivers originate in mountainous areas, and 40% of Europe's fresh water comes from the Alps. However, the changes in snow and glacier dynamics and rainfall patterns can lead to temporary water shortages across Europe.

Across the European Region, 16 million people still lack access to basic drinking-water services, of which over 3 million rely on surface water for direct consumption. River flooding is one of the most common natural disasters, which has resulted in fatal accidents affecting millions of people and causing massive economic losses in the last three decades. In addition, heavy rainstorms and flash floods are also expected to become more frequent across Europe.

Experts have predicted that Europe will experience an average of 60-80 cm rise in the sea level by the end of the century, depending on the rate at which the Antarctic ice sheet

melts. This will affect European citizens living near the coast, which make up a third of the EU population¹⁶. A sea level rise will contribute to increase in coastal flooding events along the European coast.





Flooding in Venice 2010

Since 2000, damaging floods in Europe have caused at least 700 deaths, the displacement of about half a million people and at least EUR 25 billion in insured economic losses. Venice, Italy is one of the European cities that are severely exposed to flooding. During the years Venice has experienced various flooding events, and in 2019 the city suffered its worst flooding since 1966, as an exceptional high tide rose and submerged three quarters of the city.

With sewage systems, wastewater treatment facilities and the regulation of pollutants from

industry and agriculture, Europe has come a long way in reducing emissions to water bodies.

Nevertheless, water pollution continues to be a problem with over-exploitation, physical alterations and climate change continuing to affect the quality and the availability of water.

As for the European seas, 75-96% of the assessed areas have a contamination problem caused by chemical pollution, nutrient enrichment and eutrophication, climate change or pressures from coastal and maritime activities.



Denmark

The access to water in Denmark is generally good. 99,9 % of the Danish drinking water comes from groundwater and can be accessed straight from the tap. The water is pumped up from the underground, oxidized, filtrated and lastly quality assured by the waterworks before being sent directly out to the taps of the consumers. Unlike in many other countries, it is not necessary to disinfect the water with chlorin or other chemicals. However, the biggest threats to Danish drinking water are pesticides and fertilizers used for farming as they contaminate the groundwater and jeopardizes the quality of the drinking water. Even though legislation on pesticides is extensive with many requirements for both the professional user, importer and distributor, the discovery of residue from pesticides has increased during the last few years. Water management has also been challenged as extreme weather events, such as heavy rainfall and flash floods, are becoming more frequent, putting pressure on the sewer systems and adding damage to properties. Additionally, 14 areas in Denmark have been categorised as risk zones of flooding from sea and streams, underlining the need for preventive measures.



Germany

Germany used to be considered a country rich in water. But climate change is turning into a huge challenge for water management and water users. Due to climate change, Germany experiences a string of drought years that result in extreme weather events such as heavy rainfall and flash floods are becoming more frequent. In cities, water masses from heavy rainfall must be able to drain off better. Falling groundwater levels and decreasing soil moisture is threatening crops and forests. Waterways are increasingly impassable. In addition, many lakes, rivers and groundwater are contaminated. Drugs and pesticide residues due to fertilization in intensive agriculture have a detrimental effect on the diversity of plants and animals in and around the waters. These inputs endanger the ecological condition of water bodies and will make the production and supply of drinking water complex, expensive and subject to future conflict of use.



The specific challenges of the partner countries

Cyprus

Cyprus is the third largest island in the Mediterranean Sea, with an area of 9,251 sq. km. Like other countries in the Mediterranean region, Cyprus has a semi-arid climate and limited water resources. Cyprus suffers from the highest water stress level in Europe, particularly in years of excessive drought. Thus, the issue of water shortage is a key aspect of life in Cyprus where limited supply, urban spread and population growth are all relevant producing an urgent need to control its dependence on precipitation.

The two main water-consuming sectors in Cyprus are irrigated agriculture and domestic use. Agriculture accounts for about 70% total water use, while the domestic sector accounts for 20% of water use. Other sectors include tourism (5% of water demand), industry (1%), and amenities (5%). Due to the limited supply of surface runoff in Cyprus, groundwater has traditionally provided the resource needed for domestic use and irrigation. Throughout the years, the groundwater resources of the island have been heavily over-pumped, especially during periods of drought. It is estimated that

groundwater resources are overexploited by about 40% of the sustainable extraction level. The existing conditions have resulted in saline water intrusion and consequent quality deterioration in coastal aquifers and depletion of inland aquifers. Seawater intrusion in aquifers has also resulted in spoiling valuable underground water storage room. Furthermore, intensive agriculture and excessive use of fertilizers have resulted in nitrate pollution of many aquifers. Similar nitrate pollution problems appear in aquifers in inhabited areas because of direct sewage disposal in adsorption pits. Cyprus has been faced with the increased frequency and intensity of droughts during the last 30 years. Due to the over-utilization of existing water resources, the environmental and social impacts of droughts also intensified. In the years 1990-1991 and 1996- 2000 Cyprus faced a water crisis as a result of drought, forcing the Government to impose restrictions on water supply both for domestic and irrigation purposes, with adverse effects on the economy and social life.



Portugal

Portugal faces several water management issues. There is a need to regenerate the forests. The forests in the country's central and northern is populated primarily by a monoculture industrial stands of eucalyptus (*Eucalyptus globulus*), which causes erosion of the soil and the absence of regenerative understory. Altogether, this poor forest management affects water quality and the river's ecological functioning, which is also jeopardized with the accumulation of sediments originated in lixiviation. In urban areas, water quality is affected by pollution and the decharacterization of the water streams' natural features. Many rivers see their margins artificialized, degraded, walled or deprived from vegetation, with serious consequences on the water flow and associated biodiversity. Furthermore, in some urban areas, littering is an issue, and many campaigns and volunteers end up cleaning the river banks from plastic bottles, bags and other daily items. Additionally, as a European and worldwide phenomenon, in Portugal there is also intensive agriculture that poses a growing threat to the water quality and aquatic ecosystems. For example, chemicals such as pesticides and fertilizers are massively used. They are not deperated and end up contaminating superficial and underground water systems with negative consequences on wildlife and public health.



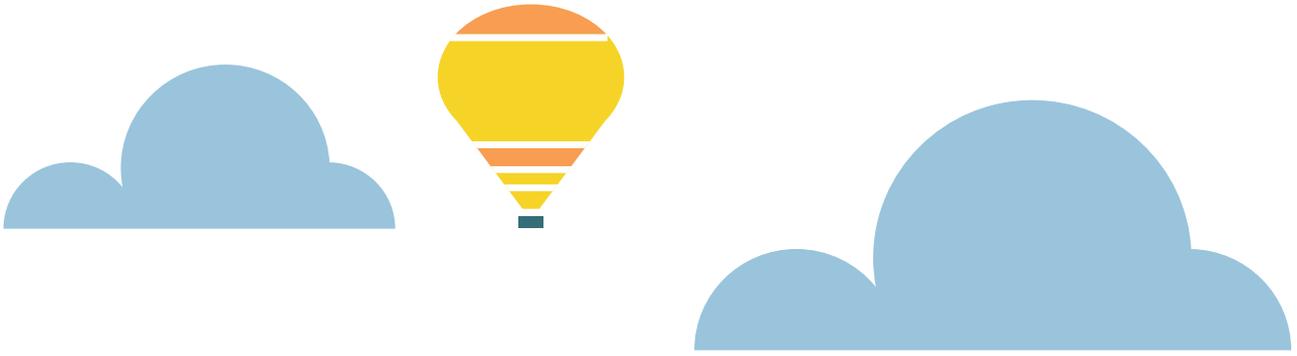
The North of Macedonia

11,1 % of individual households in Macedonia do not have access to drinking water. These household are mainly concentrated in sparsely populated rural areas. In some municipalities, due to the lack of drinking water, there are backward or newly drilled wells used for drinking, especially in the areas of unurbanized settlements. These water resources are not controlled and there are no data on safety and quality criteria. 88,9 % of the individual households in Macedonia are supplied with drinking water from public water supply. However, some people still have access to water which is not being tested chemically nor microbiologically. The biggest water pollutants in Macedonia are the citizens (42%), the processing industry (33%) and the mining facilities (10%). As for extreme weather event, Macedonia is currently not experiencing overflow of watercourses or potential flooding. However, in recent years the state has witnessed some of the biggest floods that have occurred since its existence in 1962 and 2016. Additionally, drought has become a serious issue in Macedonia as it has emptied Lakes Ohrid and Prespa. The consequences are being felt in the rivers and water levels have not stopped falling. The level of Lake Ohrid is at elevation 693.09 meters above sea level, which is 1 centimetre below the natural water level and 8 centimetres below the allowed elevation set in the Bilateral Agreement concluded with the Republic of Albania (693.17 meters above sea level). In addition to the long dry period, inadequate management of water resources are pointed out as part of the reason for this situation.



MODULE 5

Connectivity and Animal Migration



Introduction

Wildebeest running over large areas, salmon jumping up the river, whales traveling for weeks between summer feeding grounds and winter breeding grounds...

Many of us have seen these phenomena in television and some of us perhaps in real life. Animal migration fascinates us and pique our curiosity to find out why and how migrations take place.

Some of the most amazing feats of endurance can be witnessed in the long-distance migration of many species, such as the caribou (reindeers), the hump back whales and the arctic terns which have been found to have some of the longest migrations in the world.

Since one of the main trickers for migration is the change in seasons, the increasing climate changes all over the world represent a threat to the natural behaviour and migration of many species. Declines in populations for migratory species have been observed worldwide.

Since one of the main trickers for migration is the change in seasons, the increasing climate changes all over the world represent a threat to the natural behaviour and migration of many species. Declines in populations for migratory species have been observed worldwide.

As humans we benefit both economically, nutritionally and emotionally from animal migration and the seasonal bounty of distant ecosystems. We have a great role and responsibility in protecting our eco-systems and incorporate our knowledge on animal migration and connectivity in our landscape- and city planning. Without recognizing the natural patterns, we are less equipped to manage them effectively across jurisdictional boundaries.



5.1 Animal Migration

“

Migratory animals are essential components of the ecosystems that support all life on Earth.

”

Conservation of Migratory Species (CMS)

Learning outcomes

the teachers/youth workers should be able to:

- Understand and define the concept of animal migration and connectivity
- Identify the different types of animal migration
- Understand the connection between animal migration and humans, and how important their connection is.



Animal Migration

[Animal migration](#) is the relatively long-distance movement of individual animals, usually on a seasonal basis. It is the most common form of migration in ecology. It is found in all major animal groups, including birds, mammals, fish, reptiles, amphibians, insects, and crustaceans. The trigger for the migration may be local climate, local availability of food, the season of the year or for mating reasons.

While most migratory movements occur on an annual cycle, some daily movements are also referred to as migration. Many aquatic animals make a [diel vertical migration](#), travelling a few hundred meters up and down the water column, while some jellyfish make daily horizontal migrations, traveling a few hundred meters across a lake.

[Seasonal migration](#) is the movement of various species from one habitat to another during the year. Resource availability changes depending on seasonal fluctuations, which influence migration patterns. Some species such as Pacific salmon migrate to reproduce: every year they swim upstream to mate and then return to the ocean. Temperature is a driving factor of migration that is dependent on the time of year. Many species, especially birds, migrate to warmer locations during the winter to escape poor environmental conditions.

[Circadian migration](#) is where birds utilize circadian rhythm (CR) to regulate migration in both the fall and the spring. In circadian migration, clocks of both circadian (daily) and circannual (annual) patterns are utilized to determine the birds' orientation in both time and space as they migrate from one destination to the next. This type of migration is advantageous in birds that during the winter remain close to the equator, and allows the monitoring of the auditory and spatial memory of the birds' brain to remember an optimal site of migration.

[Tidal migration](#) is the use of tides by organisms to move periodically from one habitat to another. This type of migration is often used to find food or mates. Tides can carry organisms horizontally and vertically for as little as a few nanometers to even thousands of kilometers.



Jellyfish migration across the Atlantic



Salmon migration up the river



Bird migration



For in-depth explanation of the highlighted terms, go to the glossary on page 118 or click on the terms in the text.

Animal migration occurs because it allows animals to exploit resources where and when they are most abundant by moving seasonally between habitats. Where humans have come to exploit, enjoy or otherwise benefit from migratory species, we too are capitalizing on the seasonal bounty of distant ecosystems.

The benefits we derive from migratory species are:

- economically and culturally important,
- feed millions of people,
- agricultural pests are regulated,
- enables pollination,
- provides recreation (wildlife viewing, hunting),
- facilitates seed dispersal, and many more.



Without explicitly recognizing the benefits provided by migratory species or the places upon which they depend, we are less well equipped to manage them effectively across jurisdictional boundaries. Indeed, population declines have been observed for migratory species worldwide.

Connectivity

The primary thesis is that landscape patterns that promote connectivity for species, communities and ecological processes are a key element of nature conservation in environments modified by human impacts. The concept of connectivity is used to describe how the spatial arrangement and the quality of elements in the landscape affect the movement of organisms among habitat patches and the landscape scale. Connectivity has been defined as ‘the degree to which the landscape facilitates or impedes movement among resource patches.

It is critical to recognize that a landscape is perceived differently by different species and so the level of connectivity varies between species and between communities. A landscape or local area with high connectivity is one in which individuals of a particular species can move freely between suitable habitats, such as favoured types of vegetation for foraging, or different habitats required for foraging and shelter. Alternatively, a landscape with low connectivity is one in which individuals are severely constrained from moving between selected habitats (Fig. 1-2). A particular landscape or region may, at the same time, provide high connectivity for some organisms, such as mobile wide-ranging birds, and low connectivity for others such as snails or small sedentary reptiles.

There are two main components that influence potential connectivity for a particular species, community or ecological process – a structural component and a behavioural component.

The structural component of connectivity is determined by the spatial arrangement of different types of habitats in the landscape. It is influenced by factors such as the continuity of suitable habitat, the extent and length of gaps, the distance to be traversed, and the presence of alternative pathways or network properties. It refers to the mappable, spatial arrangement of habitats for which a number of quantitative indices have been proposed (e.g. measures of circuitry, mesh size, fractal dimension).



The behavioural component of connectivity relates to the behavioural response of individuals and species to the physical structure of the landscape. It is influenced by factors such as the scale at which a species perceives and moves within the environment, its habitat requirements and degree of habitat specialization, its tolerance of disturbed habitats, the life stage and timing of dispersal movements, and the species response to predators and competitors. Consequently, even though living in the same landscape, species with contrasting behavioural responses (to habitat disturbance for example) will experience differing levels of connectivity.



5.2 Linkages to Support Migrating Species

“

Barriers to migration (...) may limit the ability of some species or populations to shift their distribution. In extreme cases, these isolated populations may decline or go extinct.

”

The Land Trust Alliance

Learning outcomes

the teachers/youth workers should be able to:

- Understand the importance of connecting conserved areas with the global land and seascape
- Understand the importance of green infrastructure

Achieving global sustainable human development will depend on how well Earth's ecosystems are managed and maintained. Ecosystems are complex open systems, interweaving biological diversity with ecological processes to produce a host of services for the planetary biosphere and human society. Yet few of the Earth's ecosystems are being effectively managed or maintained. Global fisheries are depleted, forests undervalued and clear-cut, soils eroded, biodiversity threatened and vital ecosystem processes disrupted. Protected areas play an important role in countering these processes. Although they are the cornerstone of biodiversity conservation efforts, they are insufficient in scale and number – either on the land or in the sea – to significantly address this gap in human management of landscapes and the processes

and life they contain. Linkages are the vehicle for benefits to be provided beyond park boundaries.

Fifty years ago, protected areas were almost entirely a national responsibility. Today many are seen as a concern at many levels of jurisdiction, from local to international. Historically, protected areas were only concerned with protection; now there is also a need to focus on conservation, sustainable use and ecological restoration. And where previously most protected areas were strictly and legally protected as national parks or nature reserves, now park planners argue that they should be complemented by other kinds of protected areas or managed land/seascapes in which people live, biodiversity flourishes, and natural and cultural resources are used sustainably.





Protected area in Denmark, Thy National Park

Whether on land, at the coastal edge, or on the high seas, if the concept of protected area as fortress conservation was acceptable in the 20th century, we can see now that it is ecologically, and even logically unviable. Protected areas cannot be “untouchable islands”, isolated from the rest of the world. Like every other part of the biosphere, protected areas as part of a global matrix, depend on a wide variety of factors for their survival. Protected areas must be connected with the global land and seascape, and interact with it, so as to ensure correct ecosystem functioning, as well as species distribution and survival.

It would be foolish to think that a national park (as the most well-known type of protected area) won't be affected by impacts in its surrounding landscape or, vice versa, that the presence of a protected area won't affect or influence the surrounding ecosystems. Protected areas need to be connected – or reconnected – to the surrounding landscape. It is said that protected areas are a key part of achieving sustainable development. But sustainable development means harnessing ecosystem services, and managing and maintaining ecosystems to produce those services for the biosphere. This intrinsic definition of sustainable development implies a partnership between development and conservation, and not a protection of conservation against development.

Critical to an understanding of linkages is a good science basis, coupled with an understanding of the bio-cultural nature of Earth systems. Talking about [linkages in the landscape](#) and seascape will bring to a wider public the need to set protected areas in context, and make sure that everyone

clearly understands that protection alone is not enough. The critical link that will help us to survive is the simple understanding that protected areas, as they have been designed, are part of the solution to human and other species survival, but certainly not THE (only) solution.

Closely coupled with the issue of broadscale loss of natural habitats is the challenge of maintaining and conserving biodiversity in landscapes now dominated by human land use. In many such landscapes, large natural tracts are becoming scarce or no longer exist.

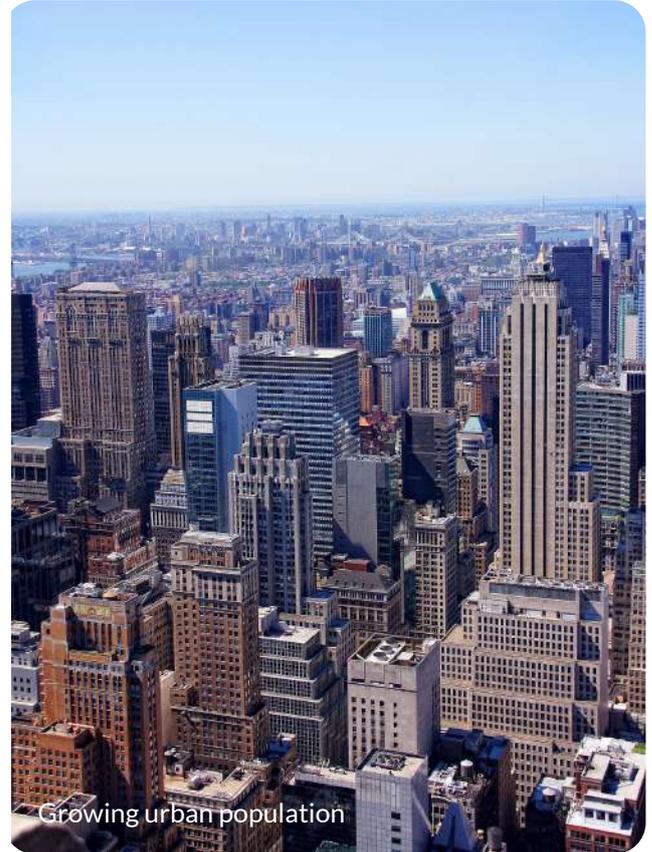


Protected area on Cyprus, Konnos, Cape Greco National Forest Park.

Remnants of the natural environment increasingly occur as a mosaic of large and small patches, survivors of environments that have been carved up to develop new forms of productive land use for humans. These natural fragments range from large blocks that may be set aside as nature reserves, to tiny remnants surrounded by intensive land use. Together they provide the habitats upon which the conservation of much of the flora and fauna in developed landscapes ultimately depends.

Throughout the world, reserved areas dedicated to conservation are relatively few in number and scattered in location. Success in conserving Earth's biodiversity will largely depend on the capacity of plants and animals to survive in fragmented landscapes dominated by humans. Understanding the consequences of habitat change and developing effective strategies to maintain biodiversity in developed and disturbed landscapes, is a major challenge to both scientists and land managers. In the scientific community there has been strong growth in the relatively new discipline of conservation biology.

Although there is substantial overlap with other areas such as wildlife management, forestry, landscape ecology, population genetics and much of traditional population and community ecology, a key element in conservation biology is its fundamental focus on reversing the decline in biodiversity and extinction of species on Earth. To be effective it must integrate scientific skills with applied management and policy in order to achieve practical outcomes that have long-term benefits for species and biological communities. Issues addressed in conservation biology encompass broad themes such as the status, management and recovery of threatened species, the viability of small populations, the impacts of habitat loss and disturbance on plants and animals, the design of protected area systems, and the dynamics of threatening processes on populations and communities.



The concept of corridors as a conservation measure has been highly successful in catching the attention of planners, land managers and the community and a wide range of ‘wildlife 4 Linkages in the Landscape corridors’, ‘landscape linkages’, ‘dispersal corridors’, ‘[green belts](#)’, ‘[greenways](#)’ and other forms of connecting features have been proposed, drawn into conservation plans, or are now under active construction or management. These encompass a range of spatial scales and a variety of levels of sophistication – from artificial tunnels and underpasses that assist animals to move across local barriers such as roads and railway lines, to major tracts of undisturbed natural forest that link reserves at high and low elevations.

Cities can be great hubs for ideas, culture, science, productivity, commerce and social development, offering citizens diverse opportunities for employment, education and lifestyle. The potential of cities is under threat, however, from unprecedented urban growth and an exponential increase in the global urban population. Many city administrations are struggling to respond to the demands of

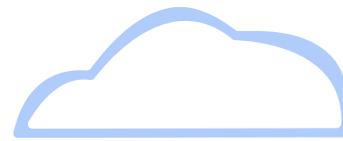
their rapidly growing populations, especially in lower- and middle-income countries, where urban population growth has often not gone hand in hand with socio-economic development. A lack of capacity to deal with the challenges posed by uncontrolled urban population growth is leading to poverty and hunger, exacerbating social exclusion, and increasing the gap between poor and rich. This challenge was also recognized by the United Nations General Assembly, which, in Sustainable Development Goal 11, calls for “making cities and human settlements inclusive, safe, resilient and sustainable”. Indeed, urban planners and city administrators face daily challenges in maintaining sufficient healthy and safe food, clean water, clean air, energy, housing, and green spaces and addressing conflicts of interest related to land use.

In recent decades, some cities have started to change towards a greener, more sustainable, and more resilient model of urban development. They are investing in forests, wetlands, and other green spaces – “green infrastructure” – to tackle urban issues previously addressed with engineered solutions that often involve concrete, asphalt and steel. Properly planned, green infrastructure can be cheaper to establish and maintain than engineered solutions while performing similar functions, generating income and employment and increasing the quality of the urban environment. When fully integrated into local urban planning and management, trees and forests can help transform cities into more sustainable,

resilient, healthy, equitable and pleasant places to live.

Although every tree contributes to the quality of city life, the integration of trees and forests into networks of green spaces will maximize the benefits. For example, properly planned and managed urban and peri-urban forests:

- help regulate water flows in cities by intercepting and absorbing rainfall
- create a favourable environment for animals and plants
- contribute to biodiversity conservation



Well-managed forests in city hinterlands ensure the supply of good-quality water to urban dwellers and prevent erosion and [land degradation](#).





5.3 Blue and Green Wedges

“

A multifunctional landscape design solution must embrace the various ecosystem services that have already been bequeathed to a land area.

”

Bo Yang m.fl, Associate Professor in the Department of Landscape Architecture and Environmental Planning at Utah State University

Learning outcomes

the teachers/youth workers should be able to:

- Identify the benefits of using green and blue spaces to connect rural ecosystems with urban spaces.

Urban and rural populations ultimately depend both directly and indirectly on ecosystems for their well-being. However, the environmental, economic, and social changes associated with urbanization can alter people's relationship with nature and the well-being benefits people obtain from ecosystems—that is, ecosystem services. Urban and rural environments differ in people's lifestyle, economic activities, and ecosystem services supply. These differences may influence the human-nature relationship and the perceptions of ecosystem services.

The most heavily affected ecosystem services are often those that have a close relationship to land cover, including regulating ecosystem

services (e.g., water filtration and regulation, soil retention, and climate regulation) and provisioning ecosystem services (e.g., food and material production). Rural areas are also affected by urban areas and urbanization. Urban areas often expand into natural areas and agricultural land. Furthermore, to meet the needs of urban populations for food and materials, the production of provisioning ecosystem services (e.g., food, fiber, and fuel) may increase in rural areas. Increases in provisioning ecosystem services can lead to a decrease in regulating ecosystem services related to the functioning of ecosystems, potentially causing environmental degradation.

The green ecological corridor plays a significant role in the overall security and stability of the landscape because it is the intermediate for energy flows between different ecological source patches and a bridge between humans and nature and between urban and rural areas. The objectives and characteristics of such corridors differ by locale due to differences in cultural background, social structure, development stage, and urban characteristics.

Roads are associated with the most frequent human activities and the most potent interference. In recent years, urbanization and additional automobiles have resulted in many large and wide main roads. The density of the road network has gradually increased, which has enhanced the communication between cities and has improved the convenience of travel.



Wildlife corridor connecting areas of natural habitat to Karawatha Forest Park.



However, it has also caused fragmentation of forests and other natural landscapes. Thus, it is worth exploring the connectivity of the roadside landscape and integrating them to create a greenway system. Some studies have shown that roadside green spaces can purify rainwater, can reduce surface runoff, and can also remove air pollutants from vehicles. The construction of a greenway network combining roadways and adjacent green landscapes can provide more public spaces for the leisure and recreation activities of urban residents and more ecological spaces for wildlife habitat and migration and can also play an essential role in the overall ecological security of a region and the development of sustainability.

The river is an essential urban landscape factor with natural, linear, and flowing features. In the last few decades, due to rapid urbanization, a large number of natural rivers have become artificial channels, and massive wetland loss has taken place. Natural features of rivers have been lost, and the purifying functions of rivers have declined, among other issues. Watershed management and river ecological restoration are important for the sustainable development of human settlements. Increasing river connectivity and integrating watershed resources to construct a blue-green ecosystem can help restore watersheds and urban-rural environments.

Green spaces also play an active role in regulating the climate, such as by ventilation, cooling, and air purification.



5.4 Pollinator Habitat

“

A world without pollinators would be a world without food diversity - and in the long run, without food security.

”

José Graziano da Silva, FAO Director-General

Learning outcomes

the teachers/youth workers should be able to:

- Understand and identify the important role of the pollinators
- identify how to create and sustain healthy pollinator habitats

Pollinators

Pollinators are animals that move from plant to plant while searching for protein-rich pollen or high-energy nectar to eat. As they go, they are dusted by pollen and move to the next flower, fertilizing the plant and allowing it to reproduce and form seeds, berries, fruits and other plant foods that form the foundation of the food chain for other species-including humans.

Pollinators are themselves important food sources for other wildlife. Countless birds, mammals, reptiles, and amphibians eat

More than 85% of flowering plants require insect pollination which results in fruits, nuts, and seeds that 25% of birds rely on for food. One example says that the native bees pollinate 15% of U.S. fruit, nut, vegetable, and field crops

Pollinator species are responsible for approximately 1/3 of the food we consume each day. Yet pollinators are at a critical point in species survival. There are many reasons for this steep decline, but experts agree that planting more native nectar and pollen sources will positively impact their health and survival rate.

The plight of honeybees, monarch butterflies, birds, bats, and other native pollinators have placed a renewed sense of urgency on the development and conservation of local pollinator habitats.

When planting a native pollinator habitat, each species should be carefully considered for bee and pollinator health to help restoration efforts and combat declining pollinator populations with sustainability in mind.

Bee populations are under severe stress. Since the Second World War, we've lost 97% of our wildflower meadows, a vital habitat which pollinators depend on food and shelter.

protein and fat-rich eggs, larvae, or adult forms of pollinators, or feed them to their young. Pollinators play a critical role in the food supply for wildlife and people. Bees are well-known pollinators, but over 100,000 invertebrates-including butterflies, moths, wasps, flies, and beetles-and over 1,000 mammals, birds, reptiles and amphibians, act as pollinators.



Bee collecting nectar from flowers.

For in-depth explanation of the highlighted terms, go to the glossary on page 118 or click on the terms in the text.

Protecting pollinators - a role for everyone

Habitat protection

First and most important is to protect existing natural habitats. This is key because once we destroy a complex, established ecosystem, it can be difficult or impossible to recreate what was there before.

«Imagine if every garden, park and school grounds had bee-friendly, flowers, and we grew wild flowers on our roundabouts and road verges; our towns and cities could become huge nature reserves for pollinators.»

Bee expert, Prof Dave Goulson



Grass is often cut too hard and lose value for bees and other insects.

Habitat creation

For the creation of new habitats, every little does help, and the more we scale up our action, the more bees and other pollinating insects will benefit. And not only insects. Higher quality green spaces bring us closer to nature. We know that our mental and physical health and well-being improve the more we are exposed to nature in our everyday lives-it's a win-win.

Please find out what easy things you can do to make a difference today.

Next comes restoration of existing areas to encourage plants to re-establish themselves. If grassland or hedges are cut too often or too hard, they lose their value for bees (and countless other valuable bugs too). Trees and shrubs, verges and parks need to be allowed to flower and fruit. Bees need pollen and nectar that flowers provide, while birds need the seeds. But more than that, bees need to survive the winter and safe spaces to rear the next generation. Leaving rough, uncut areas in parks or around hedgerow bottoms may not appeal to the tidy-minded, but the bees would prefer us to leave well alone.



Planting wild flowers and letting grass grow can help attract bees and other insects.

Plant and Create Pollinator Habitat Gardens

Every individual can help by providing the following:

Food:

Provide native flowering plants and trees that sustain pollinators with nutrient rich nectar and pollen. Learn more about the plants in your region that pollinators evolve with and rely upon.

Clean water:

Provide water for pollinators by filling a shallow birdbath with gravel or creating a muddy patch in a corner of your yard.

Cover: Cluster plantings close together to provide pollinators' shelter and camouflage from predators.

Places to raise young: Butterflies need special host plants as food for their caterpillars. Planting host plants attracts more butterflies and allows them to successfully produce the next generation.



'Bug hotels' or 'insect hotels' are created to provide shelter for insects during winter.

Most native bees are solitary and lay eggs in tiny tunnels in dead trees, fallen branches, hollow stems, or in sandy soil. Leave standing dead trees, fallen logs, and bare patches of sandy soil. Attract hummingbirds by planting dense shrubs for nesting.

Sustaining Healthy Pollinator Habitat

Attract ladybugs, predatory wasps, and other natural enemies of garden pests. Native plants attract these beneficial pest predators. These insects are a sign of a healthy garden, and an important food source for birds.

Avoid pesticides. No need to spray pesticides! Hand-pick pests if you have an infestation or wash them off with a stream of water from a hose.

If you must spray:

- Use only organic or natural pest deterrents such as soap, garlic and chili pepper.
- Spray only at night, when flowers are not blooming, and when it's dry and windless.
- Use products that target specific pests rather than broad-spectrum ones. Avoid anything labeled as toxic to bees or that kills the "weedy" flowers pollinators visit. Specifically, avoid garden products that include neonicotinoids.
- Carefully read and follow application instructions on any spray, using them sparingly.



5.5 Ecotopes and Borders

“

Worldwide, wildlife habitats are being transformed and fragmented by human activities, and the behavior of several species has changed as a result of human activities.

”

Carme Rosell, Wildlife consultant and Managing Director, Minuartia

Learning outcomes

the teachers/youth workers should be able to:

- understand the potential of human/wildlife interaction at the borderline between two or more ecosystems.

The nature of wildlife management throughout the world is changing. The increase in the world's human population has been accompanied by a rapid expansion of agricultural and urban areas and infrastructures, especially road and railway networks. Worldwide, wildlife habitats are being transformed and fragmented by human activities, and the behavior of several species has changed as a result of human activities. Some species have adapted easily to urban or peri-urban habitats and take advantage of the new resources available.

Species distribution and abundance are related to important habitat variables such as provision of shelter, food, comfortable spaces, and an appropriate climate.

Therefore, it is essential to analyze these data adequately to predict where conflicts are most likely to arise and to design successful mitigation strategies. The second key factor for adequate management of human-wildlife interactions is to monitor system change. An analysis of the variety of data on population dynamics, hunting, wildlife collisions, and wildlife presence in urban areas would

provide a basis for adaptive management. Social factors strongly influence perceptions of human-wildlife conflicts but the methods used to mitigate these conflicts often take into account technical aspects but not people's attitudes. A new, more innovative and interdisciplinary approach to mitigation is needed to allow us to move from conflict towards coexistence.

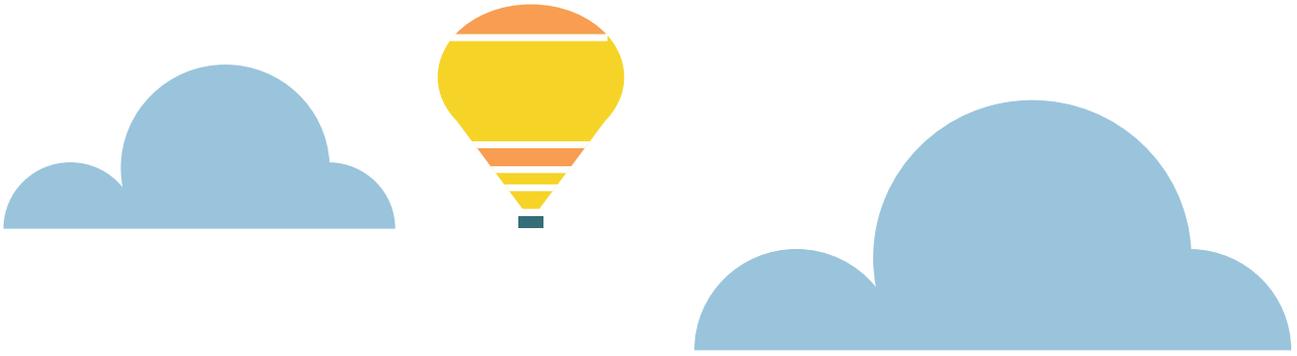
It is clear that human-wildlife interactions are inherently complex because many stakeholders are usually involved. A rational approach that incorporates all interested parties would seem to be a productive way of solving these kinds of problems.





MODULE 6

Urban Agriculture



Introduction

Nowadays, our cities are centres of information, ingenuity, and collaboration, where new approaches to housing, employment, and service provisions (such as water, transportation, education, and healthcare) are introducing and, increasingly, mainstreaming new forms of building, working, and living in the city.

However, meeting the Sustainable Development Goals in cities and addressing the growth limits we now face call for smart, sustainable, and inclusive urban development. In that sense, urban agriculture has become of great interest in finding new answers for how cities can master recent social, economic, and ecological challenges.

Moreover, it is considered a livelihood strategy that enables urban dwellers to sustain themselves and is recognized on the international agenda as part of a comprehensive solution to the problems of the rampaging growth of cities.





6.1 Towards an Understanding of Urban Agriculture

“

Urban agriculture is not the total solution to the issues facing the future of cities, but it is an essential part to any program to make those cities more livable, and to improve the lives of city dwellers.

”

Luc J. A. Mougeot, senior program specialist at the International Development Research Centre (IDRC), reviewer for the International Science Foundation.

Learning outcomes

the teachers/youth workers should be able to:

- Define the concept of urban agriculture

Urban Agriculture

Urban agriculture is characterized by various forms of interaction between agriculture and the urban sphere and constitutes a well-orchestrated strategy that brings human expertise, financial resources, and institutional networks together to tackle issues that hamper the development of healthier, more prosperous, equitable, and sustainable cities. The consortium of the [COST Action](#) Urban Agriculture Europe, a networking project funded by the European Cooperation for Science and Technology (COST) defined Urban Agriculture as follows:

Urban Agriculture spans all actors, communities, activities, places, and economies that focus on biological production in a spatial context, which –according to local standards– is categorized as ‘urban’. Urban Agriculture takes place in intra- and peri-urban areas (i.e., within or on the fringe of a town, a city, or a metropolis), and one of its key characteristics is that it is more deeply integrated in the urban system compared to other agriculture. Urban Agriculture structurally embedded in the urban fabric; it is integrated into the social and cultural life, the economics, and the metabolism of the city.

Urban Agriculture can be described as the growing, processing, and distribution of food and non-food plant and tree crops and the raising of livestock, directly for the urban market, both within and on the fringe of an urban area. It does this through tapping on resources (unused or under-used space, organic waste), services (technical extension, financing, transportation), and products (agrochemicals, tools, vehicles) found in this urban area and, in turn, generates resources (green areas, microclimates, compost), services (catering, recreation, therapy), and products (flowers, poultry, dairy) largely for this urban area. The very close connection in space that urban agriculture shares with the ecology and economy of cities makes this very distinct from but complementary to rural agriculture.



For in-depth explanation of the highlighted terms, go to the glossary on page 118 or click on the terms in the text.

¹All cases listed in this module can be found in the Online Atlas developed by the consortium of the COST Action Urban Agriculture Europe. Available here: Online Atlas - COST Project (urban-agriculture-europe.org)

Urban agriculture practitioners have evolved and adapted diverse knowledge and know-how to select and locate, farm, process, and market all manner of plants, trees, and livestock. There is a wide range of farming systems, ranging from horticulture to aquaculture, kitchen garden to market gardens, and livestock. Where does all this agriculture take place? Apart from farming in backyards, there is crop and animal production on rooftops, in window boxes, on roadsides, beside railroads, in vacant lots of industrial estates, and on the grounds of schools, hospitals, prisons, and other institutions.

In short, urban agriculture is anywhere and everywhere that people can find even the smallest space to plant a few seeds. A regular supply of homegrown food can make a considerable difference to the lives of the

urban poor. It not only contributes to improved nutritional health but also may free up some of a family's income for other kind of expenses, such as education. It also includes commercial operations producing food in greenhouses and other spaces but is more often small-scale and scattered around the city. The produce is usually processed and marketed by the producers and their families.





6.2 The typology of Urban Agriculture

“

Learn how growing your own food can improve your physical and mental health, as well as the health of the environment.

”

Meghan Lussier, Social Work, University of New Hampshire

Learning outcomes

the teachers/youth workers should be able to:

- Distinguish between the different types of urban agriculture and their basic characteristics

Urban Food Gardening

Advocates for Urban Agriculture hold good arguments on the benefits it provides—from contributing to urban resilience, to strengthening local economy and creating social capital. In that sense, Urban Agriculture can take many different forms. It includes, for example, household, school, and community gardens, as well as rooftop, vertical and indoor farms. The COST project referred to earlier sought to develop a common language in order to communicate more effectively the potential offered by urban agriculture from a European perspective. Thus, researchers have made a distinction between the gardening and the farming level:

Urban food gardening encompasses agricultural activities with generally low economic dependence on material outputs, while using the production of food for achieving other, mostly social, goals. In this case, a distinction has been drawn between areas for individual production, such as allotments and family gardens, and areas where more collective actions are performed, such as educational, therapeutic and community gardens.

Let's explore some of the urban food gardening types:

Family gardens

Family garden in urban settings are non-commercial, food producing undertakings that aim to provide the respective household and their families or friends with vegetables, fruit, or herbs. The type of urban setting highly influences the character of the gardens. In very dense urban areas, balcony or rooftop cultivations in pots are more common, whereas in detached housing, a part of the garden is allocated to growing vegetables, fruit, or herbs.



Kokalyane Family garden, Bulgaria

Allotment gardens

An allotment garden is an area subdivided into small plots, which are rented under a tenancy agreement. They usually stem from municipal initiatives on public land and their regulation is highly formalized. In many Northern, Western, and Central European countries, allotment gardens are common and have a long tradition. In general, their functions have shifted from self-provision to leisure with a focus on healthy food and socially and physically active environments. Allotments are seen as a good option for underused area: for example, abandoned school gardens (Geitmyra Parsellhagelag, Oslo), or land classified as suitable for construction but not developed yet (Granada). Some allotment gardens specifically target social problems—for example, in Portugal (Hortas Sociais Coimbra), Spain, Greece, or Estonia.



Allotment gardens in Oslo - Geitmyra parsellhagelag

Educational gardens

[Educational gardens](#) offer a teaching tool addressing the production, processing, and consumption of food and their environmental impact, with a high potential for raising public awareness and spreading environmentally and climate-friendly gardening ideas and practices. They may be gardens located in educational institutions that provide garden-based learning to their community (schools, kindergartens, etc.), or gardens developed by environmental or social centres that offer educational services to visitors.



Huerta Cantarranas, Community and Educational Garden, Madrid

Community gardens

[Community gardens](#) typically emerge as bottom-up initiatives and are tended collectively. They are not only about growing vegetables, but also about growing social networks, building meeting places, and establishing a sense of community. Their collective character is therefore essential. The community itself establishes the rules and organization. In France, there is a charter that states their basic principles of solidarity, as well as intergenerational and intercultural exchange. While not as explicit, similar principles apply to most community gardens elsewhere. Most of them are oriented towards organic production and increasingly include composting facilities.



Community garden, Ilôt des Amaranthes Lyon, France



Urban Farming

The second element that the COST researchers have pinpointed in order to develop a common typology for urban agriculture refers to the farming level of urban agriculture.

Urban farming refers to intentional business models taking advantage of proximity to the city by offering local or regional agricultural products or services. This concept does not apply to all farming that takes place in larger urban areas. In this case, the areas have been subdivided into different types, such as those linked to on-site services (for instance, leisure and educational gardens), and others that include local food farms. The latter foster a more direct link with their consumers and operate through short food-supply chains.

Let's explore some of the urban farming types:



Masseria Chicco Rizzo, Sternatia, Lecce, Italy



The Social Farm Strahovice, Opava, Czech Republic

Recreational and Educational farms

Leisure farms aim to meet the urban demand by offering a wide range of recreational opportunities linked to farming activities. Most of them are located in peri-urban areas. They target the general public and range from 'hands-on' experiences with animals or crops—such as feeding the animals or 'pick-your-own' fruit schemes, gastronomy, or agritourism connected to the farm's biological production. Educational farms have a recreational component, but the pedagogical function is dominant. Quite often these farms offer specific learning programmes for visiting school classes. It is common for farm schools to have arrangements with urban schools and kindergartens, such as excursion and short-term stays for pupils.

Social farms

Social farms are aimed at promoting disadvantaged people's rehabilitation and the integration of people at risk of exclusion by offering them job possibilities. France is home to one of the most solid networks of social farms, le Jardins de Cocagne. The first one was created in 1991 under the motto "Let's Cultivate Solidarity."

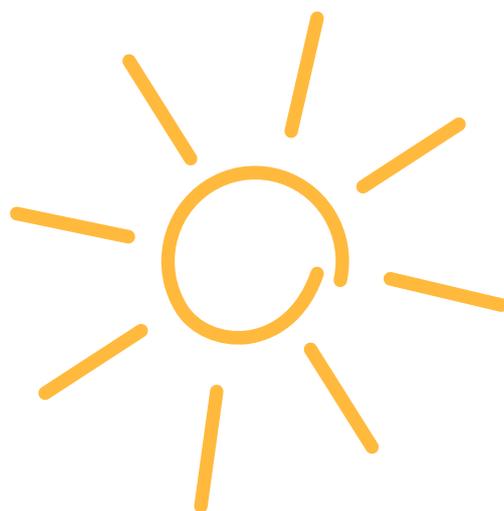
Cultural Heritage farms

Cultural heritage farms covers farms that intentionally contribute to preserving and transmitting the tangible and intangible cultural heritage related to agricultural practices and landscape, through the maintenance of traditional materials and typologies, buildings, crop and breed varieties, and techniques of cultivation. Food production is essential for this kind of farm and generally associated with a label of high quality—such as typical and local products with the Protected Designation of Origin (PDO). Furthermore, cultural heritage farms contribute to a better quality of urban space, increase the identity of the population and enhance economy through tourism.



Environmental farms

Environmental farms have high natural and environmental values and/or contribute to biodiversity (creating mosaic landscapes or as habitat for specific flora and fauna species) and agro-diversity (cultivation of local seeds and native breeds) conservation. This also includes farms involved in streamlining material flows from cities (i.e., organic waste), integrated in plans for food or fire prevention, and/or contributing to the improvement of environmental quality, being part of green infra-structure, green networks, green belts, natural space protection plans, or the Natura 2000 network.





6.3 Urban Agriculture for Decent and Productive Lives

“

Besides providing fresh food to urban areas, urban agriculture is a source of significant environmental, social and health-related benefits as well as economic development opportunities.

”

James McEldowney, European Parliamentary Research

Learning outcomes

the teachers/youth workers should be able to:

- Understand the importance of urban agriculture for the social, economic, educational, and environmental progress of European cities.

In various studies, Urban Agriculture has been assessed relevant regarding nutritional self-sufficiency and access to affordable and fresh food especially for socially disadvantaged and food-insecure groups and beyond improving dietary quality and diversity as well as human health. This is incredibly important if we consider that urban areas rely heavily on a multitude of food systems to meet their food needs. This makes them vulnerable to any crisis in the [food supply chain](#). For example, reference is made to London, where it has been calculated that it needs 'around 150 times its own footprint just to feed itself'.² Another study also explains that urban agriculture '...can improve the psychological status of individuals by allowing them to guarantee a secure supply of food to their household and helping them to acquire skills in a new field of work'.³



Did you know that in all places across the world that urban agriculture is practiced, we can see that with fair access to resources and services, urban agriculture can be an integral component of income and employment strategies, while also building more self-reliant local food supply systems?

Roads are associated with the most frequent human activities and the most potent interference. In recent years, urbanization and additional automobiles have resulted in many large and wide main roads. The density of the road network has gradually increased, which has enhanced the communication between cities and has improved the convenience of travel.

Moreover, studies that took place in developing countries in Africa, Asia, and Latin America showed that urban agriculture, as a means of improving food security – and earning extra income – is particularly attractive to women as it allows them to work close to their homes and to provide extra food to improve the nutritional status of their children.

Urban agriculture then provides access to employment opportunities and job training skills to traditionally marginalized social groups (e.g., unqualified, disabled, immigrants) and thus enhancing social inclusion through integration into the urban social network, while it creates a secondary system of employment related to marketing and processing activities, thus sustaining small communities and families.

For example, Gut Koenigsmuehle is an ecologically operated historical 11 ha farm site in the metropolitan area of Dortmund (Ruhr Metropolis). It is offering a housing and living community for disabled persons, jobs for them in horticulture and other social services.

² Keeffe, 2016, p. 16

³ Miccoli et al. 2016

Research also highlights the potential social impact of urban agriculture, whether for recreation and leisure time, for education or health issues, or for disadvantaged people in the form of specialised-care farming.

There are examples of urban agriculture projects that include target groups, such as drug addicts, juvenile offenders, and immigrants, who are at risk of social exclusion. Examples include the Jardins de Cocagne in France, the Schultenhof in Dortmund, La Cordata (covering people with disabilities) and the social cooperative Cascina Bollate (covering prisoners), both in the Milan metropolitan area. A study for the development of intercultural gardens in Germany highlights how such gardens fostered mutual respect. The study found how migrants gained respect for themselves and others by developing a sense of their own

worth through working in the gardens. It noted from other studies that that this was particularly the case for migrant women: the gardens helped restore their socio-economic role, which is central to a person's self-respect.

Also, the Werkhof Projekt, located in Dortmund, is a non-commercial social farm mainly producing vegetables. The farm is focussing on young people facing problems on the labour market, for example for an apprenticeship. The involved young people are supposed to learn regular daily schedules to stabilise their everyday life. The main work for them on this farm is in agriculture ranging from production over processing to selling. The qualification of the young people for the regular labour market is the main task and objective.



Werkhof Projekt, Dortmund, Germany

In general, urban farms and gardens can diversify their business by offering services for example: agro-tourism, social care, kindergarten farms or nursery-school services. Particularly, in the educational sphere, it is noted that it is feasible for pupils to develop their skills to implement sustainable development ideas in practice through hands-on experience in educational gardens, farms, and environmentally friendly projects.

In Hasle, Denmark, a community and educational garden of 300 square metres is being cultivated that is attached to the local kindergarten. The garden includes a cooperation with the local nursing home and entails fruit trees and raised beds for herbs and vegetables. Also, Copenhagen Municipality has run an educational garden since the 1930s. Thousands of primary school kids annually obtain direct experience with gardening and crops.

The is an educational farm for children and young people in the city of Duisburg, Germany. It is a charity institution of the Workers Welfare Federal Association. It tries to preserve the rural cultural landscape in the now urbanized north of Duisburg and to give pupils, residents and interested persons an understanding of the workflow of a small farm and the possibility to participate actively. School classes and youth groups can care for the animals and help with farming in the morning.



Educational farm for children and young people, Ingenhammshof, Duisburg, Germany



6.4 Urban Agriculture as a tool for Sustainable Urbanization

“

Cities are in charge of majority decisions, and urban farming is part of the solution to future challenges associated with food supply and the increasing urbanisation.

”

University of Copenhagen, Urban Farming Science

Learning outcomes

the teachers/youth workers should be able to:

- understand the ways that urban agriculture helps environmental sustainability

Sustainable Urbanization

As urban areas grow in population, they expand outward, often overwhelming the natural environment, destroying ecosystems, and drawing resources from well beyond their defined limits. Cities' dependence on massive and relentless imports of food, energy, and other resources from distant areas, and often on exports of their wastes to those areas, can also be destructive. The cities' ecological footprint, coupled with rising consumption levels, has long been a problem across the world.

Urban agriculture alone will not solve the ecological problems of growing cities, but it does help to protect the environment in a variety of ways, because it links cities and their environment, and it can be an increasingly acceptable, affordable, and effective tool for [sustainable urbanization](#). Poor sanitation, unsafe water supply, uncollected garbage, and polluted rivers, all create environmental health hazards, reduce living standards, increase costs, reduce productivity, and inhibit socio-economic development. The production of trees, shrubs, flowers, and ornamental plants and food crops can beautify the city, cool its climate, curb erosion, and absorb air pollution and odours. In Portugal, the Horta Comunitária de Bairro de S João - Municipality allotments of Cascais promote local sustainable agriculture and healthy eating; implement innovative green spaces that respond to the real needs of the population; foster the socio-cultural potential inherent to the horticulture activity; and strengthen contact of townspeople.



Horta Comunitária de Bairro de S João,
Cascais, Portugal

A most significant link between urban agriculture and environmental and public health is waste management. In many cities urban farmers make productive use of many organic waste products, turning them into soil-enhancing mulch. Wastewater can be used to irrigate crops. Tartu Maheaed Lehe street garden is an organic vegetable garden in Estonia where people can grow food for very low rent. Before its actual use the Tartu Maheaed community garden was an empty wasteland.

By cultivating every available piece of open space -even rooftops- urban farmers contribute to the greening of the city, helping to reduce pollution and improve air quality. Even the fact that less food has to be trucked into the city contributes to sustainability and has a positive environmental impact.

The use of vacant land for crops and grazing livestock reduces the municipal maintenance of green spaces and discourages garbage dumping and squatting. Some urban agriculture systems can safely decontaminate polluted waters and soils while others can safely reuse organic and liquid wastes. The

Olarizu Gardens in Álava, Spain resulted from the adaptation, in 1998, of an area occupied by farms, abandoned fields and uncontrolled dumps. It is now owned by the municipality and is open to the public. The Centre for Environmental Studies (CEA) is responsible for its design and management, and it is now used to promote environment-related education, awareness, and leisure activities.

All in all, urban agriculture helps to reduce a city’s ecological footprint even as the city continues to grow. The following tables summarizes some of the environmental benefits of urban agriculture³:

Local ecosystem services

Reported benefits	Reported limitations
<ul style="list-style-type: none"> • Increased biodiversity • Habitat for pollinators • Reduction in ‘urban heat island effect’ • Increased rainwater drainage, reducing risk of flooding, ground water contamination and groundwater depletion • Recycling of organic waste 	<ul style="list-style-type: none"> • Soil management, irrigation and fertilizer use practices by UA growers may not be ecologically sound

Climate change mitigation

Reported benefits	Reported limitations
<ul style="list-style-type: none"> • Potential reduction in greenhouse gas (GHG) emissions • Carbon sequestration by vegetation and crops • Potentially reduced energy and resource inputs using some technological UA operations • Adds to collective memory of food production and protects urban green spaces reinforcing cities’ capacity to produce food in times of crisis 	<ul style="list-style-type: none"> • If plants are grown in energy or resource-intensive locations, this may increase GHG emissions • Small-scale, fragmented UA may be less efficient in resource use and transport emissions than conventional agriculture • If UA became ubiquitous in cities, it could reduce population density, requiring more driving and greenhouse gas emissions than the current system

³ Source: Adapted from: Santo et al., 2016.



6.5 The Benefits of Learning with Urban Agriculture

“

The garden has become a source of beauty, hope, and nourishment for the many people who pass by, stop in, and get involved.

”

Francey Slater, co-founder of Mill City Grows, an urban farming organization in Lowell

Learning outcomes

the teachers/youth workers should be able to:

- Understand the benefits of learning with urban agriculture

To support the livelihood of the local community is one of the long-term goals of every urban agriculture program. Every step of the way is of elemental importance and school activities that involve hands-on learning with various facets of urban agriculture should be promoted in all schools across Europe. In that sense, any urban farming and urban gardening practices in schools boost learning and engagement and create awareness among students about wellbeing and green issues. Research indicates that gardening at school supports students' inquiry and learning as well as promotes attachment to school. Elementary-age students in a one-year garden program in the US improved their problem solving

and critical thinking skills. Teachers who participated in that garden program report that their gardens acted as calming spaces for students, particularly for those who struggled in a traditional classroom setting. Elementary-age students increased their self-understanding, interpersonal skills, and cooperative skills. Moreover, urban school gardens and farms can increase involvement of external volunteers at schools, allowing students to create connections with non-teacher, non-related adults. Further, when family members participate, it strengthens intergenerational bonds.



Further studies show that garden-enhanced nutrition education is a profoundly engaging and effective way to establish healthy eating habits with youth. It is now well documented that, when children have a hand in growing food, their understanding of food and its relationship to their health increases. Recent studies have shown a combination of direct instruction and hands-on school gardening activities to be a remarkably effective way to influence students' attitudes about fruits and vegetables.

These innovative educational methods have yielded positive results in increasing children's long-term knowledge of and preference for fruits and vegetables and have ultimately resulted in increased consumption of fresh fruits and vegetables by children.

All in all, urban school gardens and farms or urban gardening and urban farming that serve educational purposes act as life labs -places where students are inspired to ask questions and seek answers through their own research and observations, and places where students observe the workings of a diverse ecosystem first-hand. Throughout so much of their day children are being told what to think. In the garden or farm, as with all experiential learning, children learn HOW to think. Children are led by the magic of discovery and as educators we need to secure children's right to learn with nature.





Glossary

Allotment Gardens: small plots stemmed from municipal initiatives on public land and their regulation is highly formalized. Their functions have shifted from self-provision to leisure with a focus on healthy food and socially and physically active environments.

Animal migration: the relatively long-distance movement of individual animals, usually on a seasonal basis.

Biodiveristy: Diversity of life forms that exist in nature and all the interactions between them. Diversity can range from the smallest gene (genetic diversity), which is responsible for each individual within the same species being different from its sibling or cousin to the diversity of large living systems such as forests, soils or oceans, and including all species from bacteria and other single-celled creatures to fungi, animals and plants.

Biophilia means “love for life” if translated literally. It describes the inherent human drive to connect with other forms of life such as plants or animals. This psychological need to be in contact with the natural world, is considered by research to be a reason why we strived as a species. In the biophilia hypothesis evolutionary biologist Edward O. Wilson claims that the affinity to natural habitats and ecosystems and human’s commitment to protect them can be explained by the dependency on those. Wilson argued that a decline in biophilic behaviour and desire to connect with nature will result in environmental destruction.

More on biophilia: <https://www.britannica.com/science/biophilia-hypothesis>

Biosphere: The sum of all ecosystems (life) and living organisms on the Earth.

Child-friendly City is a concept that measures cities to their ability of accommodating children’s needs, may it be exploring independently, getting enough physical movement or nature contact or providing features, that attract their interest and interaction. Urbanists in the 90s established the POPSICLE TEST, a rule-of-thumb for evaluating your neighbourhood’s child-friendliness: Can a kid get to a store on her own, buy a popsicle and get home again before it melts? For a comprehensive guide on child-friendly cities with a great number of inspirational case studies, look into the report:

Arup (2017). Cities Alive. Designing for urban childhoods. <https://www.arup.com/perspectives/publications/research/section/cities-alive-designing-for-urban-childhoods>

Circadian Migration: where birds utilize circadian rhythm (CR) to regulate migration in both the fall and the spring.

Community Gardens: they typically emerge as bottom-up initiatives and are tended collectively. They are not only about growing vegetables, but also about growing social networks, building meeting places, and establishing a sense of community.

COST Action: European Cooperation for Science and Technology. Note that information included in Module 6 has been extracted from the networking project Urban Agriculture Europe funded by COST Action.

Cultural Heritage Farms: they contribute to preserving and transmitting the tangible and intangible cultural heritage related to agricultural practices and landscape.

Diel Vertical Migration (DVM): also known as diurnal vertical migration, is a pattern of movement used by some organisms, such as copepods, living in the ocean and in lakes.

Ecological corridors: The concept of ecological corridor is associated with a green space that may or may not have human intervention, which allows the movement of fauna and connectivity between wild fauna and flora populations. Examples are forest areas, riparian galleries and riverbanks, patches of scrub and undergrowth that form a continuum, among others.

Ecological Succession: An ecological succession corresponds to the sequence of biological communities occupying a given space, from their colonisation to the climax state.

Ecosystem: consists of the combination and relationship that exists between different living organisms and the physical environment where they live and with which they interact. The biotic components - corresponding to living organisms such as animals and plants - are directly related to the abiotic components - water, light, radiation, temperature, humidity, atmosphere and soil - corresponding to everything that is not alive.

Ecosystem Service is the collective term for all benefits that derive from natural environments and ecosystems for humankind. This includes PROVISIONING SERVICES, such as the production of food and water, REGULATING SERVICES, such as the control of climate and disease, SUPPORTING SERVICES, such as nutrient cycles and oxygen production, and CULTURAL SERVICES, such as spiritual and recreational benefits.

More on ecosystem services: <https://www.britannica.com/science/ecosystem-services>

Educational Gardens: they offer a teaching tool addressing the production, processing, and consumption of food and their environmental impact, with a high potential for raising public awareness and spreading environmentally and climate-friendly gardening ideas and practices.

Environmental Farms: they have high natural and environmental values and/or contribute to biodiversity (creating mosaic landscapes or as habitat for specific flora and fauna species) and agro-diversity (cultivation of local seeds and native breeds) conservation.

Family Gardens: they are non-commercial, food producing undertakings that aim to provide the respective household and their families or friends with vegetables, fruit, or herbs.



Glossary

Food Security: the state of having reliable access to a sufficient quantity of affordable, nutritious food.

Food Supply Chain: The food supply chain comprises all the stages that food products go through, from production to consumption. It also means that as food gets lost or wasted at every stage of the chain, a longer chain leads to more and more overall food waste.

Forestry: Forestry, or silviculture, is a form of forest management and involves different processes aimed at producing goods in the forests that have an associated economic value and generate income.

Green Belt: a policy and land-use zone designation used in land-use planning to retain areas of largely undeveloped, wild, or agricultural land surrounding or neighboring urban areas.

Green Urban Infrastructure is a city's ecosystem of vegetation in parks, squares and vacant plots and on and at buildings. Together with urban waterways, Green Urban Infrastructure brings social, environmental and economic benefits that turn cities into spaces worth living. Green Urban Infrastructure encourages healthy sustainable city lifestyles, strengthens a city's climate resilience, fosters urban biodiversity and enables energy and resource efficiency. The goal of strengthening existing and establishing new Green Urban Infrastructure is to rebalance people and nature in the light of growing urbanization.

More on Green Urban Infrastructure in this reader: Arup (2014). Cities Alive. Rethinking Green Infrastructure. <https://www.arup.com/perspectives/publications/research/section/cities-alive-rethinking-green-infrastructure>

Greenhouse Effect: The greenhouse effect, in the context of climate change, as the name suggests, is the heating of the Planet's atmosphere, due to human activities that elevated the level of certain gases (e.g. methane or carbon dioxide). It's a phenomenon similar to what happens in a glass or plastic greenhouse, in which the coating will prevent the sun's heat from escaping into the atmosphere and will concentrate inside the greenhouse, causing the atmosphere to heat up.

Greenway: is usually a shared-use path along a strip of undeveloped land, in an urban or rural area, set aside for recreational use or environmental protection

Geomorphology: is the study of the surface of the Earth: Its shapes, landforms, surface processes such as air, water and ice, and how these affect the landscape today and throughout history.

Hydrology: The study of the movement, distribution, and management of water on Earth. This includes the study of the water cycle and water resources. Hydrology subdivides into surface water hydrology, groundwater hydrology and marine hydrology.

Land Degredation: a process in which the value of the biophysical environment is affected by a combination of human-induced processes acting upon the land.

Landscape Linkages: refer to broad areas that allow for the movement of wildlife and plant species from one area of suitable habitat to another and that support ecological processes.

Leisure Farms: they aim to meet the urban demand by offering a wide range of recreational opportunities linked to farming activities.

Limnology: The study of inland water systems such as rivers, lakes, ponds, streams, wetlands and groundwater.

Monumental Tree: Old or immense trees are considered «monuments of nature», for they survived over the centuries, their existence running alongside many important historical events. Some trees may also be considered of relevant social importance due to their size, rarity or cultural significance.

Nature-deficit disorder can be described as the negative effects on our physical, psychological and cognitive condition, if we experience alienation from nature. According to Richard Louv who established this term, this applies especially for children in their developing years. While the term is not serving as a medical diagnoses, it is meant as a call for finding ways to connect children to nature.

New Urbanism is a school of urban design focusing on creating for the human-scale. New Urbanists' effort to design environmentally friendly, multi-functional, dense and walkable cities can be seen as a counterpoint to the suburban sprawl that defined post-WWII-cities especially in the United States. It aims to prevent isolation and car-dependency while fostering community-building, diversity and restoration of the natural environments.

The Charter of the New Urbanism Movement can be found here: <https://www.cnu.org/who-we-are/charter-new-urbanism>

Oceanography: The scientific study of the ocean. This includes the physical, chemical, and biological features of the ocean as well as the ancient history, the current condition, and the future of the ocean.

Glossary

On-Demand Mobility will be an important building block in transforming urban mobility. Technology-driven solutions help to bridge gaps in the public transport system by providing flexible services that are often not covered by the public transport net, like door-to-door service, night time transport or serving sparsely populated areas. Seats in cars or small busses can be booked via app. For a sustainable implementation pooling such demands and avoiding empty runs is absolutely necessary, as well as emission-free solutions.

Pollinators: are animals that move from plant to plant while searching for protein-rich pollen or high-energy nectar to eat.

Seasonal Migration: is the movement of various species from one habitat to another during the year.

Social Farms: they are aimed at promoting disadvantaged people's rehabilitation and the integration of people at risk of exclusion by offering them job possibilities.

Species: The biological concept of species, defined since the 1930s, refers to a group of organisms that can reproduce and produce fertile offspring. While *Amanita muscaria* is a species of mushroom, the fox (*Vulpes vulpes*), a mammal, corresponds to another species, and these species can never reproduce among themselves.

Sustainable Development Goals (SDGs) were set up in 2015 by the United Nations General Assembly as a collection of 17 interlinked goals to achieve a more sustainable future for all. They are included in the UN Resolution AGENDA 2030 and provide for every SDG specific targets and indicators to measure the progress towards reaching each goal by 2030. The 17 SDGs are: 1) No Poverty 2) Zero Hunger 3) Good Health and Well-Being 4) Quality Education 5) Gender Equality 6) Clean Water and Sanitation 7) Affordable and Clean Energy 8) Decent Work and Economic Growth 9) Industry, Innovation and Infrastructure 10) Reducing Inequality 11) Sustainable Cities and Communities 12) Responsible Consumption and Production 13) Climate Action 14) Life Below Water 15) Life on Land 16) Peace, Justice, and Strong Institutions 17) Partnerships for the Goals.

The UNESCO provides educational resources for every SDG: <https://en.unesco.org/themes/education/sdgs/material>

Sustainable Forest Management: involves applying methods and practices which aim is to maintain and enhance the social, ecological and economic values of the forest today, while safeguarding the same conditions for future generations. A well-managed forest, by representing a balanced and functional ecosystem, will not only be more profitable, by aggregating various values, but also more resistant to all kinds of threats, such as fires, droughts, pests and other phenomena, for example caused by climate change.

Sustainable Urbanization: is both the study of cities and the practices to build them (urbanism), that focuses on promoting their long-term viability by reducing consumption, waste and harmful impacts on people and place while enhancing the overall well-being of both people and place.



Tidal Migration: the use of tides by organisms to move periodically from one habitat to another. This type of migration is often used to find food or mates.

UA: Urban Agriculture. Urban Agriculture can be described as the growing, processing, and distribution of food and non-food plant and tree crops and the raising of livestock, directly for the urban market, both within and on the fringe of an urban area.

Urban Farming: is a school of urban design focusing on creating for the human-scale. New Urbanists' effort to design environmentally friendly, multi-functional, dense and walkable cities can be seen as a counterpoint to the suburban sprawl that defined post-WWII-cities especially in the United States. It aims to prevent isolation and car-dependency while fostering community-building, diversity and restoration of the natural environments.

The Charter of the New Urbanism Movement can be found here: <https://www.cnu.org/who-we-are/charter-new-urbanism>

Urban Food Gardening: it encompasses agricultural activities with generally low economic dependence on material outputs, while using the production of food for achieving other, mostly social, goals.

Urban Heat Islands (UHI) are densely populated metropolitan areas that have higher temperatures than the rural areas surrounding it. Urban structures like buildings, roofs, roads, industrial complexes and other infrastructure absorb the heat of the sun more than vegetation or water bodies. Urban building materials also store the heat longer which causes the temperatures not to cool down during night. The negative impacts of UHI are an increased energy consumption through a higher demand for building cooling technologies, consequentially increased greenhouse gas emissions and above-average rates of mortality due to heat-related illnesses.

More content on UHI for children: <https://climatekids.nasa.gov/heat-islands/>

Urban Sprawl: rapid expansion of the geographic extent of cities and towns, often characterized by low-density residential housing, single-use zoning, and increased reliance on private means for transportation, often with little concern to sustainable land planning.

Waste Management: refers to the various schemes to manage and dispose of wastes. It can be by discarding, destroying, processing, recycling, reusing, or controlling wastes. The prime objective of waste management is to reduce the number of unusable materials and to avert potential health and environmental hazards

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