freeland

Promoting STEAM through participatory urban regeneration

FREELAND

METHODOLOGY

Guidelines for secondary school teachers

Co-funded by
the European Union
2024-1-IT02-KA220-SCH-000251173

freeland

Co-funded by the European Union

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

freeland

Co-funded by the European Union

Index

FREELAND Project **2**
FREELAND Themes **6**
Urban Regeneration 7
Ecosystems services and Biodiversity 16
Climate Change 24
Environmental quality of urban spaces and urban pollution 33
Sustainable Cities 38
Outdoor laboratories on STEM subjects 41
Citizenship and communication 45
Art for effective urban regeneration 47
FREELAND Learning objectives **49**
Citizenship and Soft Skills 50
STEM Area 52
Digital and technology-based competences 53
FREELAND students' and teachers' learning needs **54**
Main findings from the students' survey 55
Main findings from the teachers' survey 56
Citizens' interest and attitude on urban regeneration **59**
Survey structure 59
Main outcomes 60
Concluding remarks 63
Learning approaches and methods **64**
Project-Based Learning 64
Outdoor Learning 66
Inquiry-Based Learning 68
Integrated STEAM approach 70
Circle Time 72
FREELAND Learning Methodology **74**
FREELAND Learning Modules **76**
References **77**

FREELAND Project

The quality of urban planning and the presence of green spaces are essential to the quality of life in a city. Degraded or poorer neighbourhoods, however, tend to have fewer green spaces and neglected urban spaces in general. Additionally, exposure to nature promotes people's wellbeing and health, and it even facilitates adaptation in the migrant population by promoting a sense of belonging (Charles-Rodriguez et al., 2023).

The PISA report (OCSE, 2023 A) highlighted a diffused low capacity in critical thinking and a disparity between countries in Science, Maths and reading competences. PISA 2022 data show that "across OECD countries, peer-to-peer tutoring links to an increase in students' sense of belonging at school" (OECD, 2023 B). The PISA report highlights the need to move from teaching where teachers are merely service providers, parents are customers and students are consumers of already processed education content, to an education viewed as a shared action that sets as its primary objective that of helping the next generation have reference points to move safely in a rapidly changing world. According to the report, "students who reported more support from teachers and a better disciplinary climate in mathematics lessons scored higher in mathematics and reported greater well-being" (sense of belonging at school, life satisfaction, learning confidence, less anxiety regarding maths) (OECD, 2023 B). The same report however notes that teacher support has declined, and "almost 40 percent of students reported that, in most lessons, the teacher does not show an interest in every student's learning or does not continue teaching until students understand" (OECD, 2023 B). Other than teachers' support, anxiety influences maths performance and since girls are more anxious in maths than boys, they are less likely to perform well (OECD, 2023 A). As adults, women are as a result less likely to pursue STEM careers. Today's challenges, however, require people with STEM knowledge and creative thinking. Compared to advantaged students, socio-economically disadvantaged students are seven times more likely not to achieve basic maths proficiency, thus supporting students in and beyond the classroom is key (OECD, 2023 A).

It is widely agreed that solutions to challenges that the world faces today will require a new multidisciplinary scientific workforce equipped with a skill set of new technology and interdisciplinary thinking that may "require the integration of multiple STEM concepts to solve them" (Wang et al., 2011, p. 1). It is important to provide young people with the right knowledge and competences, including STEM competence, digital competence, active citizenship, transversal skills and soft skills. Integrating multiple disciplines in an interdisciplinary approach is crucial for preparing students for the complex challenges of the professional work environment of our globalised world. An interdisciplinary curriculum provides opportunities for learners that are more relevant, less fragmented and more stimulating; this helps improve student's motivation to learn, making them better problem solvers, logical thinkers and technologically literate (Stohlmann et al., 2012). Real-world project-based learning (PjBL) is an effective teaching strategy that immerses students in an experiential learning environment where they can apply classroom knowledge to real-world scenarios, bridging the gap between theory and practice (Alsmadi et al., 2024). Real world-based learning creates new categories of skills and knowledge networks that disregards traditional subject boundaries.

The **FREELAND Project** creates an innovative and interdisciplinary methodology that promotes interest and proficiency in STEM subjects by integrating the STEAM and PjBL approaches with urban regeneration projects of neglected urban and green spaces. The fieldwork required connects students with nature and urban spaces and enhances experiential learning through independent outdoor and practical activities. Students work in urban regeneration projects collaborating with other students of different ages and skills in formal and non-formal settings to increase their competences in basic skills, STEM subjects, critical thinking, common values and civic engagement and participation.

The FREELAND methodology has an interdisciplinary approach to the school curriculum and further encourages knowledge sharing, peer-to-peer learning and dialogue between schools, citizens and local stakeholders through events and a digital platform. The open-air laboratories reinforce the awareness of environmental sustainability by integrating the study of local issues through STEM

subjects with the broader context of climate change. The active role of Art in the projects stimulates creativity, freedom of thinking, inclusion and dialogue across schools, citizens and stakeholders.

The **points of innovation** of the project are:

1) Innovative Methodology and Learning Modules
2) Collaboration between schools, Municipalities, researchers and artist to support the transformation (via design or actual implementation) of neglected urban spaces
3) Exploiting the educational potential of neglected urban spaces (e.g. microclimate monitoring, social aspects, biodiversity, nature resilience and adaptation, etc.)
4) Create connections between European countries and communities through the project's digital platform.

FREELAND Themes

The teaching methodology developed in the FREELAND project promotes students' civic engagement while simultaneously developing their skills in STEAM subjects.

The themes developed by the methodology refer to abandoned places in the city, places that have no specific function.

The project is aimed at schools located in areas where the main challenge is social integration, such as neighborhoods with public housing and communities with a high percentage of students with migrant backgrounds, where the risk of dropping out is high due to the fragility of the system.

The living environment of their neighborhood or city, usually well known to students, is transformed by the FRELAND methodology into a learning environment. Nature in these places demonstrates its ability to withstand the environmental challenges of the urban environment. The methodology involves informal outdoor learning activities to create a stimulating and enjoyable learning environment for STEAM subjects.

Outdoor educational and interdisciplinary activities (STEAM subjects) analyze the environmental, social, and cultural characteristics of selected intervention areas using a scientific approach (e.g., assessing microclimatic conditions, accessibility, cultural relevance, historical development; inventorying existing plant species and the physical characteristics of the site).

During the course, students will design participatory cultural events in collaboration with stakeholders and external experts (representatives of local authorities, citizens' associations,

scientists, urban planners, artists, etc.) to initiate urban regeneration of the abandoned area where they conducted the workshops. Regeneration involves not so much physical and impactful transformations of the site, but rather cultural actions aimed at social reactivation and participation.

Urban Regeneration

Urban Regeneration does not have a defined origin, but historical precedents can be found whenever there is an effort to improve the urban form according to principles of order, functionality, and healthiness.

We find it in the Renaissance, when cities were redesigned based on mathematical laws and proportions to enhance space and livability. In 19th-century England, it took the name "urban renewal", a policy aimed at addressing the sanitary and social problems caused by industrialization in cities.

During the same period, Haussmann's transformation of Paris became a model for European cities, reshaping medieval urban layouts through the construction of grand boulevards, squares, and monumental intersections, as well as the introduction of green spaces, sewage systems, and water networks.

In contemporary times, reference is often made to the URBAN policies of the European Union in the 1990s, which marked the beginning of regeneration actions aimed at counteracting urban decay and social inequalities.

Nowadays, Urban Regeneration can therefore be defined as a set of actions aimed at **recovering, reusing, and reactivating** unused spaces, decommissioned infrastructure, and services of collective interest.

In addition to limiting land consumption and pursuing sustainability, urban regeneration also encompasses economic, environmental, social, and cultural aspects, involving local communities in the creation of inclusive spaces and liveable environments for all.

The general objective of Urban Regeneration is to **redevelop what already exists** without constructing anything new but instead transforming and enhancing existing spaces for the benefit of people. The transformations are therefore aimed at making cities more sustainable and human-centered, improving social and environmental conditions, and reducing land consumption.

Urban Regeneration does not follow codified rules but is an intervention methodology that must be adapted to individual contexts, according to different needs and requests, like for example:

- **Reuse**: unused spaces, such as abandoned railway tracks or vacant buildings, can be redeveloped to accommodate new functions.
- **Remediation**: the regeneration of disused industrial areas can provide citizens with new experiences, services, and leisure spaces.
- **Revitalisation**: anonymous spaces or underused buildings can be brought back to life through conviviality, art, culture, and creativity.
- **Efficiency Improvement**: even through the energy retrofitting of existing buildings, living spaces can be redesigned with social and environmental considerations in mind.

A fundamental element is the **involvement of the local community and actors** in the phases of understanding, designing and implementing the areas to be redeveloped. Physical-spatial recovery is not the only objective of the transformations; they must also trigger an improvement in the social and environmental context.

Examples of Urban Regeneration

Vacant Spaces - Casilino Sky Park (Rome)

The top floor of a parking garage has been transformed into a unique and evocative space combining sports, culture, and entertainment, with particular attention to environmental sustainability. This new elevated square serves as a gathering and social hub for residents of the Alessandrino, Centocelle, Torre Maura, Tor Tre Teste, and Torre Spaccata districts, as well as for the entire city of Rome. Open daily from 9 AM to 1 AM, visitors can play padel, listen to concerts, or enjoy a drink at sunset while participating in the many evening events that will animate the Roman summer. A project of reuse and regeneration of an empty and unused space, fully aligned with a circular economy approach, serving as an example of social inclusion, integration, and urban redevelopment.

Degraded Areas - Tunnel Boulevard (Milan, Italy)

A symbolic place of abandonment and conflict has been redeveloped through social design and public art initiatives that encourage active citizen participation and foster social cohesion. This process has reclaimed the railway tunnels of Via Pontano through public space projects, social design, public art, and active citizenship.

Public Squares - "Surround Sound" (Amsterdam, The Netherlands)

The "Surround Sound" project was designed to build connections between the city's vibrant street artist community and the residents of Nieuw-West, a mixed-income area in the far west of the city with a diverse immigrant population. The project is the result of a unique partnership between the city's central district government, Nieuw-West, the Street Art Museum Amsterdam, and Spanish artist Kenor. It brings bright splashes of color to benches, planters, and portions of sidewalks near the bustling Plein 40-45 market, attracting customers on market days and revitalizing the neighborhood for residents year-round.

Abandoned Spaces - Estonoesunsolar (Zaragoza, Spain)

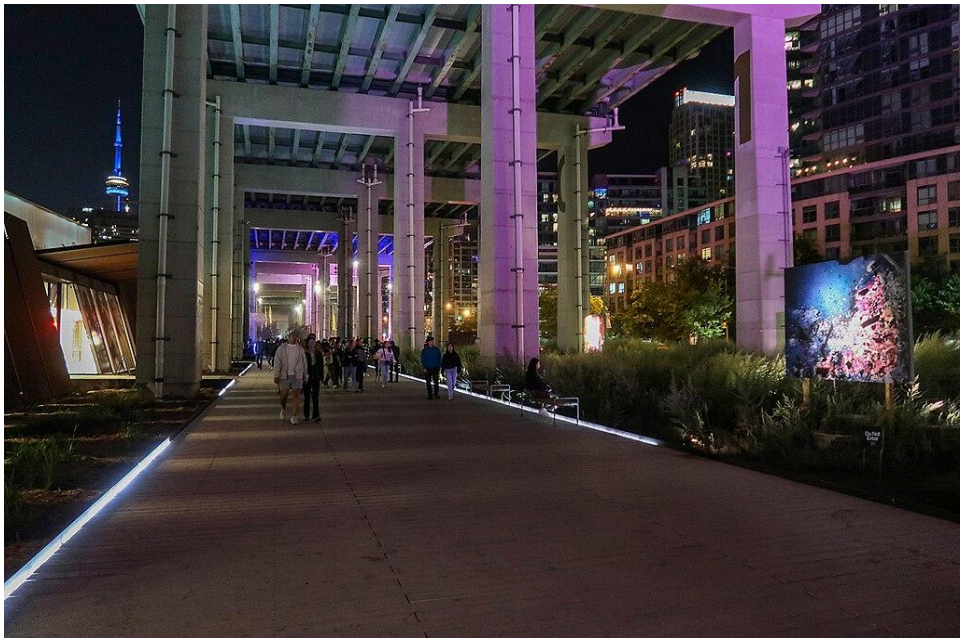
The Estonoesunsolar project in Zaragoza originated from an initiative called "Daily Voids," aimed at temporarily occupying unused and abandoned urban spaces. Following this initial experience in 2006, the Zaragoza Municipal Housing Company, along with architects Gravalos – Di Monte, launched a series of interventions. The key aspects of the program include the rehabilitation of degraded and abandoned areas, focusing not only on improving the historic fabric but also on revitalizing the city's peripheral areas. Particular attention was given to reclaiming disused urban lots by actively involving neighborhood residents and employing a team of long-term unemployed workers.



Licence: Creative Commons Attribution 4.0 International

Infrastructure - The Bentway (Toronto, Canada)

In Toronto, the revitalisation of underutilised spaces finds its greatest expression in The Bentway Islands project. This experimental initiative began in 2018 under the Bentway organization, aiming to revitalise the area beneath the Gardiner Expressway. By 2025, an expansion is planned to create islands of public space along the highway. Feedback, suggestions, and ideas from local communities who have experienced the pilot project will be integrated into the design of these new spaces. This project, which integrates public spaces, bike lanes, retail shops, and multifunctional green areas, was developed through a mix of public and private resources and community involvement. By intelligently repurposing space occupied by a critical urban infrastructure, it has improved urban connectivity and community engagement.



Licence: Canmenwalker, CC BY 4.0 via Wikimedia Commons

Tactical Urbanism

A widely adopted methodology is **Tactical Urbanism (TU),** thanks to its simple approach and ability to achieve a lot with limited resources. Originating in North America and later embraced worldwide, this design practice promotes the implementation of short-term, low-cost projects aimed at improving neighborhood livability while also sparking long-term urban transformation policies.

The "**build-measure-learn**" philosophy characterises TU's highly practical approach: urban space regeneration becomes a collective opportunity for learning, exchange, and rethinking traditional city planning and governance processes.

The main objectives of Tactical Urbanism can be summarised as follows:

- Improve the livability of an urban areas
- Revitalize disused urban spaces

- Change the perception of public spaces
- Restore unused and abandoned structures or areas
- Promote slow, cycling, and pedestrian mobility

Several types of interventions can be undertaken to reach the above goals, including pedestrianisation, improvement of lighting, removal of architectural barriers, installation of urban furniture (seating, bike stations) or plants, realisation of play areas or refreshment points, artistic interventions (like, for example, pavement coloring).

The main characteristics related to such types of interventions are meant to drive rapid planning solutions, in order to ensure concrete results in a reasonable time frame. In particular, we may refer to quick and low-budget interventions or light interventions with high visual impact, including an open and interactive process, special attention to children, the elderly, and people with disabilities, use of affordable materials or lightweight and removable structures.

Examples of Tactical Urbanism

Self-Built Spaces - Restart (L'Aquila, Italy)

These projects involve the transformation of residual spaces into accessible and usable public spaces through self-construction.

Restart is a project that transformed a small abandoned lot—an 8x8 meter square space in the historic center of L'Aquila, in front of the Department of Human Sciences—into a micro public space. The goal was to convert a neglected area into a genuine public space for rest, socialization, and sharing among local residents and university students.

Given its location in the historic centre of L'Aquila, heavily affected by the earthquake, the project chose to use rubble as the primary building material.

Public Use of Streets - Via Val Lagarina Project (Milan, Italy)

These initiatives promote the transformation of streets and parking spaces into public areas through micro-interventions that challenge and reverse the car-pedestrian hierarchy.

A project for the redevelopment of the former parking lot on Via Val Lagarina was undertaken in collaboration with WAU! Milano volunteers and students from the adjacent school, I.C.S. "Via Val Lagarina". The goal was to return a recreational, play and gathering space to the neighborhood.

Antagonistic Claims for Public and Collective Use of the City - Red Line District (Catania, Italy)

Some initiatives deliberately act as forms of dissent against local government decisions. Their goal is to reclaim unused spaces or buildings for collective use or to publicly highlight the inadequacy of responses to socio-spatial marginalization.

A social and artistic project in the style of street art, created without official permits but with the support of local residents and organizations was developed in San Berillo, Catania's old artisan district. The project aims to revive and protect a neighborhood left to decay due to private interests and speculation.

Community Hubs - Ex Asilo Filangieri (Naples, Italy)

These initiatives activate self-managed spaces to promote social innovation and cohesion as tools for urban regeneration.

The Ex Asilo Filangieri is a former 16th-century convent in Naples' historic centre, occupied in 2012 by citizens, artists, students, and researchers to reclaim it for public use. Today, it functions as a shared and participatory public space dedicated to culture and has been declared "civic use," offering an open and transparent governance model for those working in the arts, culture, and entertainment sectors.

Implementation of urban regeneration actions

The implementation of experiences in the field of urban regeneration require careful and realistic planning, as many are the factors that may impact on the final results, also due to different types of stakeholders that should be involved.

An effective roadmap for the design and realisation of such projects should therefore include the following steps.

1. UNDERSTANDING NEEDS

- mapping needs of local community
- defining intervention objectives

2. CHOOSING A PLACE

- selecting a space adequate to the objectives
- choosing a space that is easily accessible and usable

3. IDENTIFICATION OF STAKEHOLDERS

- stimulating citizens' interest
- promoting and coordinating participation

4. SHARE DEVELOPMENT OF THE PROJECT

- prioritising "light" interventions that do not require costly or invasive installations and equipment.
- defining the timeline.
- considering the possibility of incremental and long-term transformations.
- proposing one or more design alternatives.

5. REQUEST FOR AUTHORISATIONS

- identification of property ownership of the site.
- in-depth analysis of applicable regulations.
- submission of any necessary requests.

6. IMPLEMENTATION

- prioritizing inclusive implementation methods.
- coordinating proposals and participating stakeholders

7. MANAGEMENT

- coordinating the different uses.
- activating the space through micro-events, meetings, and activities.

Some of the steps might be led in parallel, according to the leadership and organisation capabilities of the group working on the project, but all of them need to be taken into account for a successful intervention. In particular, a special care should be posed in the final step, regarding the real use and management of the recovered space: it is important to have clear ideas on how such space should live after the project conclusion, to avoid the risk of a “cathedral in the desert” result. This will require a strong commitment inside the local community, even in collaboration with the public administration and other possible stakeholders. Clearly, this final phase is strongly connected to the first one: the capability of detecting a real need to be answered inside the local community is the essential trigger for a successful and satisfactory urban regeneration experience.

Ecosystems services and Biodiversity

Green spaces and trees in general are fundamental to cities as they play important ecological roles - through plant and soil functions - and are beneficial to psychological and physical health of citizens. These benefits are called Ecosystem Services and depending on the type of service, they are grouped in four typologies:

Regulatory: as green spaces enable the regulation of

- Climate (influencing air temperatures and humidity);
- Water flows (canopies intercept rain) and quality;
- Air quality (canopies trap particles, leaves absorb CO2 and other gases).
- Pest dispersion, pollination

Support: as green spaces support

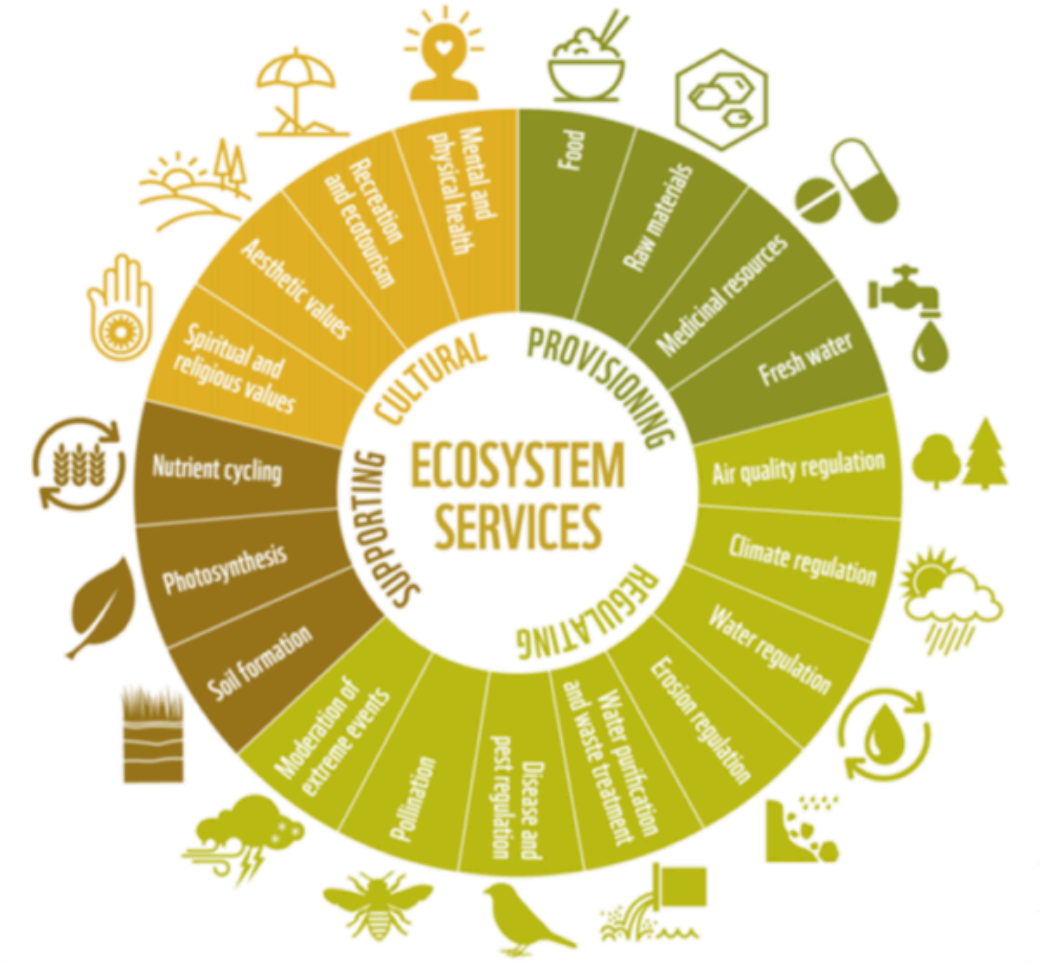
- Biodiversity (diverse plant species,y hosting living beings such as fungi, animals)
- Soil formation and functions, nutrient cycling
- Photosynthesis and plant functions

Provision: as green spaces provide

- Raw materials and food (urban agriculture, timber, active principles)

Culture: as green space allow people to

- Meet and socialize
- Play and do physical exercise
- Know new things and make tourism
- Feel connected to spirituality and religion
- Appreciate the beauty and feel mental distress



Source: WWF Living Planet Report 2016.
https://awsassets.panda.org/downloads/lpr_2016_full_report_low_res.pdf

These services are essential for human well-being and are often taken for granted, leading to concerns that human impact is compromising them.

Biodiversity is defined as the number of species of all the different kinds of living organisms within a given area, including plants, animals, fungi and other living things. The way to measure biodiversity is to count the total number of species living within a particular area. Generally, biodiversity tends to increase in regions

closer to the Equator. For instance, the Amazon Rainforest in South America, recognized as one of the world's most biodiverse areas, is home to at least 40,000 different plant species. In stark contrast, the Antarctic continent and its lakes support only about 600 plant species. (https://education.nationalgeographic.org/resource/biodiversity/). Biodiversity is threatened by many factors, indeed, nowadays scientists have defined the "sixth mass extinction" due to anthropogenic changes and extreme climate events (IPCC 2021). The rapid loss of biodiversity around the world (e.g., Convention on Biological Diversity; United Nations 2015) due to the increase of human population, land use change have been claimed by scientists and international policy organizations, particularly in the world's biodiversity hotspots (Mazor et al. 2018).

Cities can play a crucial role in conservation (Soanes and Lentini 2019; Spotswood et al. 2021). Through urban planning and initiatives aimed at preserving species and habitats, and fostering residents' awareness and stewardship of biodiversity (Knapp et al. 2021; Nilon et al. 2017; Oke et al. 2021). However, the conservation and management of biodiversity in cities requires knowledge of the ecological patterns and processes that drive the species' responses and adaptation. Many cities have a network of green habitats which are represented not only by green spaces such as parks, gardens, street tree corridors, green roofs, but also remnant natural patches —which play a crucial role in maintaining and enhancing biodiversity within city environments and ruderal and pioneer environments and open areas, which are important features both as stable and as transient habitats (McIntyre et al., 2001), and playing possible function as 'corridors' and 'stepping stones' to facilitate species dispersal (Spellerberg and Gaywood, 1993).

Despite being embedded in highly anthropized landscapes, these areas provide vital habitats for a broad spectrum of taxa, including vascular plants, birds, insects, mammals, fungi, and soil microorganisms and represent green corridors that enable animals and plants to move around urban areas and thus to preserve or enhance urban biodiversity. The chain of different habitats, naturally developed and evolved permeating into the urban environment have positive impacts on a wide range of species (Angold et al. 2006).



Urban green pockets colonized by spontaneous species with different levels of competition.

Ecological Value of Urban Green Spaces

Urban ecosystems often host a mosaic of native and non-native species, resulting in unique assemblages that reflect both natural biogeography and human influence. The ecological value of these areas depends on their size, connectivity, structural complexity, and management regime. Larger and less intensively managed spaces tend to support higher species richness, such as woodland birds and specialist pollinators, while microhabitats within green spaces—such as deadwood, bare soil patches, wetlands, and flowering meadows—support ecological niches essential for maintaining functional biodiversity. These features contribute to ecosystem services such as pollination, seed dispersal, pest control, and climate regulation.

Drivers of Urban Biodiversity

Several factors influence biodiversity levels in urban green spaces:

- **Landscape connectivity:** Corridors and stepping stones facilitate species movement and gene flow.
- **Plant species composition:** Diverse, native-dominated plantings typically support a wider range of fauna.
- **Management practices:** Practices like reduced mowing, organic fertilization, and retention of natural elements promote ecological integrity.
- **Public participation:** Citizen involvement in urban greening projects often fosters habitat diversity and species monitoring.

Importance of biodiversity

Any kind of ecosystem hosts living species that are interconnected, depending on one another. Soil hosts microorganisms, fungi, arthropods and other macro-organisms that play important roles in sustaining soil fertility and plant growth. Plants (grasses and trees) provide homes for animals, and these constitute a food chain between herbivorous and carnivorous etc. Insects and pollinators enable plants to reproduce.

Biodiversity is important to people as it provides services and benefits: air quality regulation (oxygen production, carbon dioxide absorption), climate regulation (shade), water regulation (evaporation, rain interception, flood prevention), raw materials, food and medicines etc. and many human activities rely on biodiversity (e.g. agriculture, construction, medicine etc.).

Therefore, biodiversity is important to preserve the whole system: if one ring of the chain falls, the whole chain may break, hampering the survival of the whole. Ecosystems rich in biodiversity can be more resilient to diseases than those with fewer species, indeed, if only one main species is present and this is threatened by an external risk factor - that it can be represented by an alien invasive species, it may lead to the whole disappearance of such species and drastic change of the environment.



Pioneering spontaneous species on built surfaces.



Biodiversity of introduced plants. It is essential to identify the species, and if they are allochthonous (foreign), to select those that are non-invasive, in order to prevent their spontaneous and aggressive colonization, which could displace native (autochthonous) species.

How to measure biodiversity

Plant species biodiversity

Biodiversity can be measured at many different levels including genetic, species, community, and ecosystem. One way to measure biodiversity is to assess species richness of an ecosystem, which is the total number of distinct species within a local community. Sometimes, when the species are many or the plant cover is too high, scientists use sampling tools such as “quadrats” or a known internal area. For example, to measure the species richness of a one-hectare field of grass, ecologists randomly place the quadrat in the field and count the species within the quadrat. Another method is the transect, by placing a measuring tape of 20 m and sampling vegetation at pins evenly distributed e.g. every 50 cm along the tape, in the surrounding surface of 2 cm^2 radius.

Species can be recognized by using dichotomous keys, vegetation guides, or Apps such as iNaturalist. A photo-camera, magnifying glass or ideally a pocket microscope can be used for observing plant and animal species. In addition, if plants are collected to make a herbarium, specimens collected must have all elements required for recognition of the plant, if possible, the flowers and the fruit. Samples of herbaceous plants must contain the underground and overground parts. From woody plants a relatively large section should be cut containing leaves, flowers and if possible, the fruit so that the plant's characteristics are discernible (e.g. leaf pattern). If a species is known to be rare, it should only be collected after ensuring there is a large population in the specific area.

The biodiversity can be expressed by two terms:

1) **Richness** of species, represented by the number of species per sample.

2) **Evenness**, as a measure of the relative abundance of the different species making up the richness of an area.

The results of observations can be shown as an accumulation curve which represents the cumulative number of species seen in a series of quadrats or transects or through the calculation of specific indexes (e.g. Simpson's biodiversity index).

In addition, soil is also important to consider as it is the substrate where plants get nutrition and growth. Also soil hosts a large part of microorganisms and arthropods, whose biological assessment provides information about its fertility (Soil Biological Quality) (Menta et al., 2018).

Urban areas have plenty of spots (stone walls, cracks in the asphalt) with pioneering vegetation that are incredibly resilient to extreme temperatures and pressures with respect to commercial species. Understanding the dynamics and the living conditions of these species can be of remarkable interest and curiosity.

Climate Change

Climate is defined as the average meteorological conditions of a region over a long period, typically 30 years. Climate is extremely important, as it determines and influences both biodiversity and composition of ecosystems of that region, and it also regulates the relationships between species (e.g., food chain, which is essential for the balance and well-being of the ecosystem). Climate is not static — it changes due to both natural processes and human activities. Since the onset of industrialization, human-driven anthropogenic activities and associated greenhouse gas emissions have accelerated this variability, posing a serious threat to many species and ecosystems, especially those not able to adapt to such an abrupt change or that live in specialized habitats, such as polar regions, because they have limited or even no options for finding other suitable areas for living. Therefore, the term **Climate Change** refers to the rapid change of climate, induced by human activities such as greenhouse gas emissions by fossil fuels combustion, land use change, or soil sealing in urban areas.

Global warming and its impacts

In 2001, the Intergovernmental Panel on Climate Change (IPCC) released the third report on Climate Change that warned the world: if emissions continued to rise, we could expect global temperatures to increase by around 1°C (compared to the average temperature in 1961-1990) by the early 2020s and between 1.7°C and 4.2°C in 2100, depending on the actions we take (IPCC, 2001). At the time, this sounded like a distant concern, but now, that future has become our present. In fact, global surface temperature reached 1.1°C above 1850-1900 pre-industrial level in 2011-2020 period (IPCC, 2023), and 2024 was the first year to exceed 1.5°C above pre-industrial level, set in the Paris Agreement (COP21, 2016) as "stretch goal" alongside the primary goal of keeping warming "well below" 2°C to mitigate the worst impacts of Climate Change. All these data show that Climate Change is happening faster than many experts originally expected.

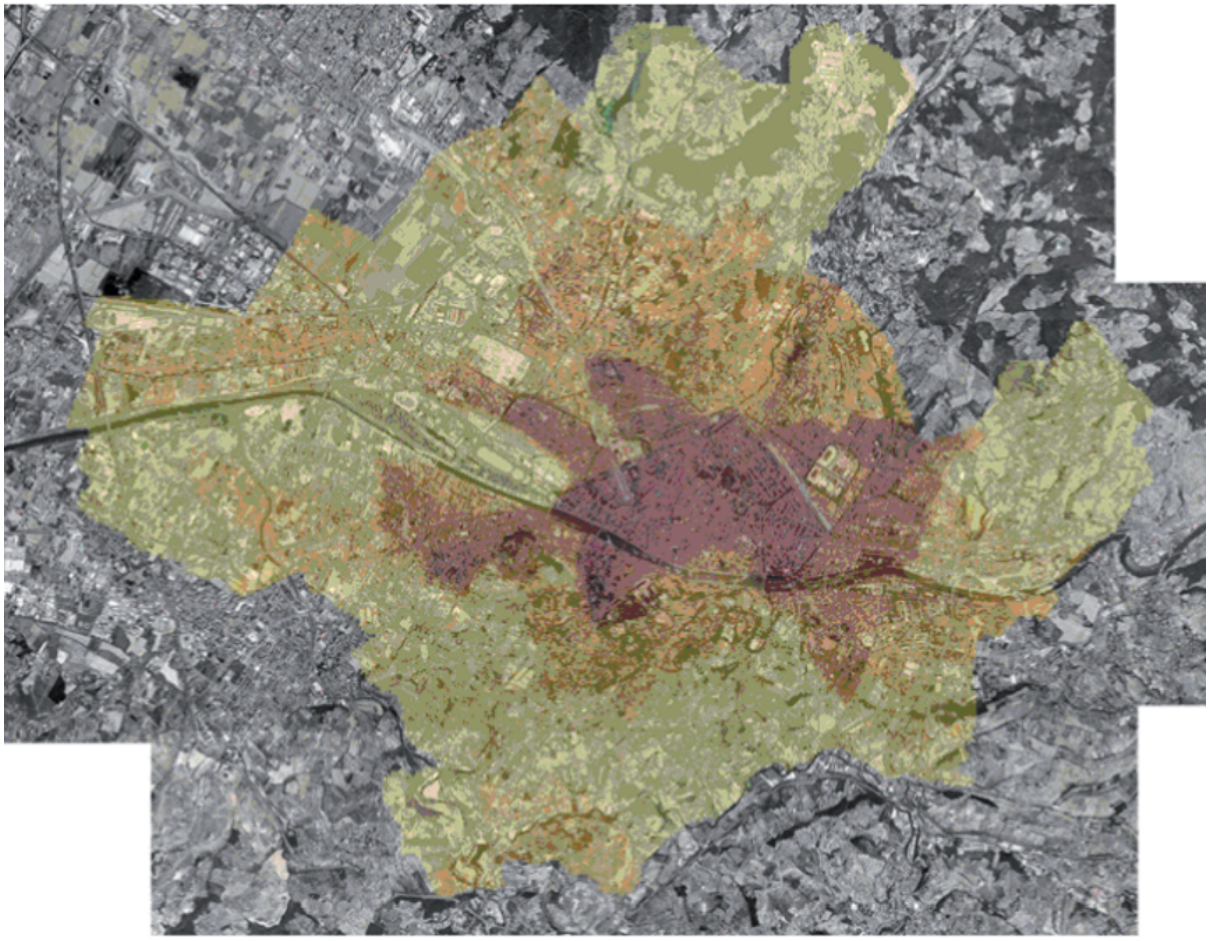
Atmosphere, oceans and lands accumulate more heat and this surplus of energy alters the Earth climate system causing extreme events such as heat waves, wavy

rainfall, floodings, drought, and fires. Moreover, the Sixth IPCC Report (IPCC, 2021) stated that: “The probability of compound events has likely increased in the past due to human-induced climate change and will likely continue to increase with further global warming”.

Urban areas are hot spots of climate impacts and one of the most fragile environments, but also a crucial part of the solution.

The Urban Heat Island Effect

While Climate Change affects the entire planet, cities are feeling the heat even more intensely. Urban areas tend to be warmer than their surrounding countryside due to what is called the *Urban Heat Island* effect (UHI). UHI is a well-documented phenomenon caused by land-use changes, soil sealing, and the widespread use of impervious materials such as concrete and asphalt. These surfaces, along with buildings, absorb solar radiation during the day and gradually release the stored heat at night, leading to elevated temperatures in urban areas compared to their rural surroundings. As a result, day and night city temperatures can be several degrees higher than nearby rural areas. For instance, during summer nights temperature is more frequently higher than 20°C and in these conditions our organism can not find little relief and rest at night. This can have serious effects on people’s health, particularly for the most fragiles like elders and people affected by cardiovascular diseases. On top of that, traffic and heating systems in densely populated areas release large amounts of greenhouse gases and waste heat. Traditionally, the UHI is defined as “the temperature difference between the city center and adjacent rural zones”. However, recent studies increasingly emphasize the concept of intra-urban heat island variability, highlighting significant temperature differences across various neighborhoods within the same city (see the map of Florence, Italy). This spatial heterogeneity is driven by differences in urban morphology, surface materials, vegetation cover, and building density, all of which profoundly influence the microclimate.



Map of Florence (Italy) with a superimposition of a satellite image showing areas with different surface temperatures.

Water availability and soil fertility in the cities

Urban areas represent some of the most vulnerable environments in terms of water availability and soil fertility. Soil sealing and widespread impervious surface coverage significantly reduce the extent of exposed soil, and the remaining soil is often degraded due to the increasing frequency and intensity of extreme weather events. Prolonged droughts, heat stress, and intense precipitation events can alter the physical and chemical properties of soils, leading to a decline in their productive capacity. Moreover, the combined effect of extreme climatic

phenomena and impervious surfaces severely compromises the soil's infiltration capacity, exacerbating surface runoff and reducing groundwater recharge.

Urban Climate Change mitigation and adaptation options

Enhanced mitigation actions can deliver local adaptation benefits, like reduced flood risk, limiting urban heat island impact, and enhanced health. How cities and urban areas are planned, designed, built, retrofitted, managed and powered will influence urban GHG emissions. However, to be effective many of the solutions require that urban decision makers act in partnership with the private sector, civil society and other urban stakeholders.

Urban adaptation options reduce risks, but any further delay in concerted actions and measures will miss the rapidly closing window to secure a liveable future for all.

To accelerate system transition to successful climate action several conditions are necessary, including: inclusive governance, strong institutional capacity and political commitment, adequate finance, technology and innovation, lifestyle and behaviour change, monitoring and evaluation mechanisms, attention to culture and heritage, effective communication of problems and solutions.

Cities offer critical spaces to realize climate resilient development by integrating economic, environmental and social dimensions, and implementing adaptation and mitigation simultaneously with sustainable development.

Measuring and communicating the "Climate Change challenge"

An extensive body of data exists highlighting the urgency of the climate crisis; however, this is often insufficient to foster awareness that the issue affects individuals at a personal level. Effective communication strategies, particularly those incorporating visual arts, can enhance cognitive engagement and facilitate more impactful learning processes.

Climate stripes are an example of an immediate and simple communication of the temperature rising, mixing visual art and science.



Example of Climate stripes: Photo by Steffenster - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=117443683



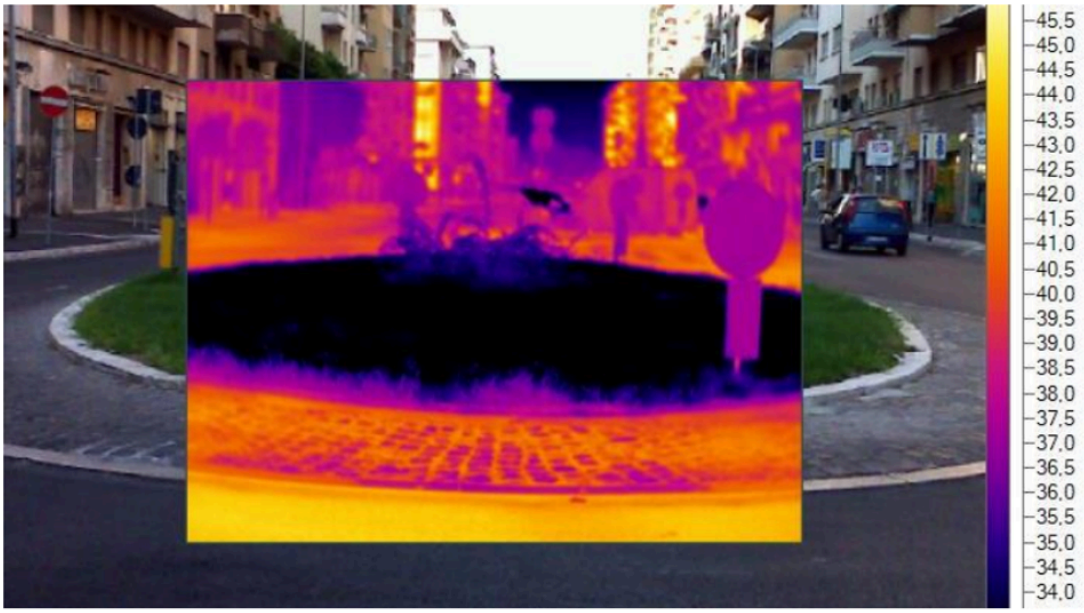
Example of Climate stripes: Photo by km30192002 - YN14MYA Reading Buses 431 Scania K270UB with ADL Enviro300SG bodywork, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=125652973

An even more artistic and impressive vision is done by the Climate Art Project (https://www.climateartproject.com/).



Photo from the “Climate art project”: https://www.climateartproject.com/climate-04-see-level-rise/

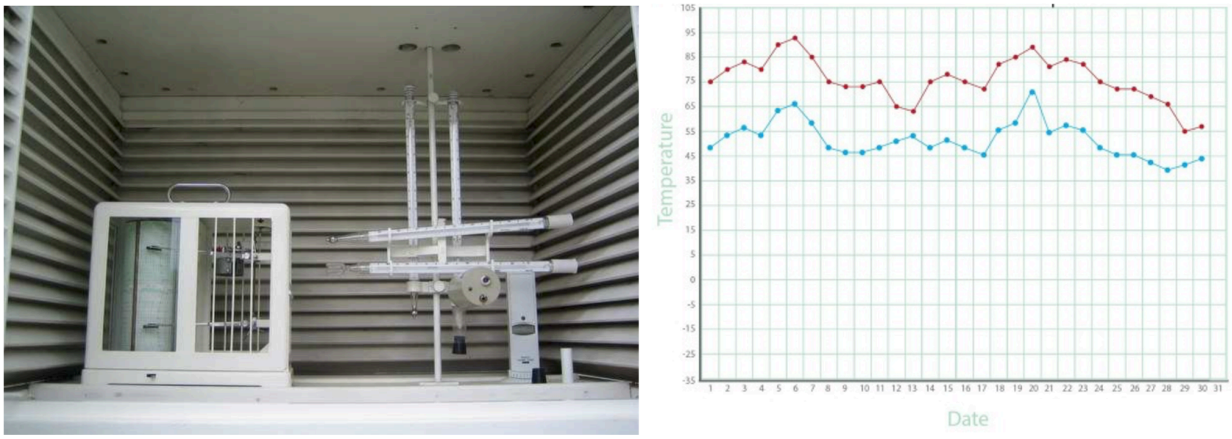
In other cases, it may be beneficial to illustrate natural processes using instruments and through hands-on experiments, actively engaging individuals in the experience so that the knowledge becomes more deeply embedded within their cultural and cognitive framework.



Using a thermocamera to measure of surface temperature of different materials.



Plant transpiration experiment. Photo by
https://www.jpl.nasa.gov/edu/resources/lesson-plan/transpiration-demo/



Weather station and example of hourly temperature visualization.

Urban green spaces

Urban vegetation plays a crucial role in mitigating the UHI effect. Trees and green spaces can mitigate the microclimate of their surrounding area through the shading and evapotranspiration. Vegetated and permeable surfaces also cool down faster during the night, offering thermal comfort during both day and night. Additionally, urban parks contribute to air quality by absorbing pollutants and serve as important recreational areas that enhance social well-being and provide a refuge from urban stressors.



A group of person under the shadow of a tree in a hot day

Green spaces play a fundamental role in making cities more livable. Public spaces availability and accessibility are now perceived by citizens as extremely important because they are spaces for doing several leisure activities, facilitating socialization and inspiring positive feelings such as calm, wellbeing and relaxation (Ugolini, 2020). Urban planning is paying attention to effective green space availability following specific approaches and objectives like the 3, 30 and 300

strategy (every dwelling should have a view of at least three trees, have 30% tree canopy cover in its neighborhood, and be within 300 meters of a high-quality green space). However, for instance most Italian cities are already densely built, especially in their central areas. Therefore, the availability of free space for building new green areas is very limited. For this reason, municipalities are paying attention to the opportunity of recovering small, abandoned, or underused spaces into functional public areas or climate-mitigating zones.

How to measure benefits of green spaces

1) Measuring tree cover
2) Surface temperature of various types of surfaces (grass, asphalt, concrete) and the mitigation effect of tree shade
3) Thermal walk

Environmental quality of urban spaces and urban pollution

The growth of modern cities has undoubtedly transformed our societies. Urban areas are centres of innovation, culture, and opportunity. Yet, the very processes that enable cities to thrive—industrial activity, intensive mobility, and continuous development—often degrade the environmental quality of urban life. Among the most concerning effects of urbanisation are the forms of pollution we consider routine: **noise pollution, light pollution, and air pollution**. Each of these pollutants is closely tied to human activity and significantly impacts both public health and the ecological balance of cities.

While these challenges are global in scope, they are often experienced locally—and solutions must reflect that. Cities across Europe have responded in various ways, providing valuable examples of both the complexity and the possibility of managing urban pollution.

Noise Pollution: The invisible stressor

In the urban environment, sound is inescapable. From the early morning rush of traffic to late-night social activity, cities are rarely quiet. The main contributors to urban noise include road traffic, construction work, airports, railways, and industrial operations. While noise may seem less tangible than smoke or dust, its effects are no less real. Chronic exposure to noise can lead to hearing loss, cardiovascular problems, anxiety, and sleep disruption. Moreover, animals in urban ecosystems—such as birds and bats—often suffer from disoriented communication and altered behavior due to elevated noise levels.

"Over 20% of the EU population lives in areas with levels of transport noise that are harmful to health, based on Environmental Noise Directive (END) thresholds. When the more stringent World Health Organization (WHO) thresholds are applied, this figure increases to over 30%" and "Road traffic is the most widespread source of transport noise, exposing an estimated 92 million people to levels above the END threshold of 55 dB for the day-evening-night period, compared to 18 million affected by rail traffic and 2.6 million by aircraft noise" (source: Environmental noise in Europe 2025 - https://www.eea.europa.eu/en/analysis/publications/environmental-noise-in-europe-2025#:~:text=The%20Environmental%20noise%20in%20Europe%20%E2%80%94%202025%20report,on%20human%20health%20and%20the%20environment%20across%20Europe).

Managing noise begins with monitoring, typically using sound level meters, which record levels in decibels (dB). According to the World Health Organization (WHO), average residential areas should not exceed 55 dB during the day and 40 dB at night. However, many cities regularly surpass these limits, especially in high-traffic zones.

Cities have responded in varied ways. In Milan, Italy, authorities introduced Area C, a congestion pricing scheme in the city centre. While primarily aimed at reducing emissions, the policy also led to a measurable decrease in ambient noise,

particularly during peak commuting hours. Across Europe, Berlin has designated “Ruhebereiche” (quiet zones) where traffic speed is restricted, and green infrastructure is used to buffer sound.

In the United Kingdom, London’s Ultra Low Emission Zone (ULEZ)—discussed further in relation to air pollution—has also helped reduce noise pollution by encouraging a shift away from older, noisier vehicles. Additionally, Transport for London has invested in quieter bus models and noise-dampening road surfacing, which has made parts of central London less acoustically stressful for both residents and visitors.

Light Pollution: When Darkness Disappears

The bright glow of city lights may be iconic, but excessive artificial illumination has a darker side. Light pollution—caused by artificial light emissions at night (ALAN) by streetlights, advertising boards, architectural lighting, and poorly shielded residential lighting—disturbs natural rhythms for both humans and animals.



The suppression of melatonin production caused by nighttime light exposure is linked to sleep disorders and other health impacts. For wildlife, artificial lighting can disrupt migration, reproduction, and predator-prey interactions.

Light pollution is measured in lux or candela per square meter, and monitoring is increasingly supported by satellite imagery and devices like the Sky Quality Meter (SQM). Many European municipalities are now rethinking lighting strategies—not only to improve human health and protect biodiversity but also to conserve energy.





Emilia-Romagna, a region in northern Italy, is at the forefront of light pollution reduction. Regional legislation mandates the use of fully shielded lighting fixtures and limits the brightness and colour temperature of new public lighting systems. This has made it a national model for sustainable lighting policy.

In the UK, Exmoor National Park was designated Europe's first International Dark Sky Reserve, setting an example for how rural and peri-urban areas can preserve natural nightscapes. Moreover, Leeds has begun retrofitting thousands of streetlights with low-intensity, downward-directed LEDs, following BS5489 lighting standards to minimise upward light spill and energy waste.

Across Europe, France has implemented a national decree that regulates lighting times for commercial and public spaces, requiring businesses to switch off non-essential lights between 1 a.m. and 6 a.m. Such policies balance urban vibrancy with ecological and human health.

Air Pollution and Particulate Matter (PM): The Most Measurable Threat

Of all forms of urban pollution, air pollution—especially fine particulate matter—is perhaps the most visible and dangerous. Particulate matter (PM) is a mixture of microscopic solids and liquid droplets suspended in air. The two most commonly monitored fractions are PM10 (particles less than 10 microns in diameter) and PM2.5 (less than 2.5 microns), both of which are small enough to penetrate the respiratory system and enter the bloodstream. Sources include diesel and petrol exhaust, industrial emissions, construction activities, and even domestic heating using wood and biomass.

The World Health Organization's 2021 guidelines recommend that average annual PM2.5 concentrations should not exceed 5 μg/m³, yet many European cities—including several in the Po Valley of northern Italy—far exceed this threshold, especially during winter months.

Turin and Milan are frequently among the most polluted cities in Western Europe due to a combination of industrial activity, traffic density, and topographical conditions that trap pollutants. Both cities have adopted seasonal restrictions on private vehicles and introduced subsidies for replacing older wood-burning stoves. Milan has also launched the Move-In program, which uses GPS tracking to monitor vehicle emissions and enforce personalised circulation limits.

The United Kingdom has made similar strides, particularly in London. The ULEZ, first implemented in 2019 and expanded since, charges drivers of high-emission vehicles to enter the city centre. This measure has significantly reduced concentrations of NO_2 and PM2.5 in key areas. Air quality sensors, installed at schools and along major roads, have allowed local authorities to monitor improvements in real time. In parallel, Manchester, through the Clean Air Greater Manchester plan, has introduced electric buses and bike-sharing schemes to reduce road emissions.

Elsewhere in Europe, Paris has introduced car-free zones on weekends, restricted wood burning during smog events, and invested heavily in cycling

infrastructure—all of which have contributed to measurable improvements in air quality.

An Integrated Path Forward

What's clear from the European experience is that no single intervention is enough. Noise, light, and air pollution often stem from the same sources—overreliance on motorised transport, poor planning, and unchecked consumption of energy. Addressing these issues requires multi-dimensional, integrated strategies.

Cities that successfully reduce pollution tend to focus on urban greening, public transportation, smart infrastructure, and community involvement. Green roofs and urban forests, for example, absorb CO_2, block noise, trap particulates, and soften artificial light. Likewise, "smart cities" use real-time data to adjust lighting levels, traffic flows, and air quality alerts in response to local conditions.

In Italy, projects like "Forestami" in Milan, which aims to plant 3 million trees by 2030, show how urban forestry can be a unifying solution to multiple forms of pollution. In the UK, Glasgow's "Liveable Neighbourhoods" program integrates clean air, reduced noise, and green transport in urban planning to improve health outcomes and community resilience.

Sustainable Cities

The 1987 Brundtland Report identified for the first time the **three pillars of sustainability** as strategic points to enable development that meets current needs without compromising the ability of future generations to meet their own.

Environmental, economic and social sustainability are thus the cornerstones of sustainable development, achieved only when environmental protection, social equality and financial sustainability coexist in harmony, merging to define an **integrated and ecosystemic approach**.

Environmental sustainability concerns the ability to preserve natural resources and ecological systems, maintaining a balance between human needs and the environment while minimizing negative impacts on ecosystems.

Social sustainability, on the other hand, refers to the ability to build a fair, just and inclusive society by promoting human rights, social justice, equal opportunities and participation from a perspective of equality and inclusion.

Finally, **economic sustainability** refers to the ability of an economic system to ensure income and employment for the population while maintaining a balance between economic growth, resource management, reduction of environmental impacts, and social inclusion.

Cities are a central theme in sustainable development policies, as they are the main contributors to increasing environmental pressure and, at the same time, centres of innovation and key drivers for guiding the transition, also through urban regeneration policies.

Cities face increasingly **demanding and urgent challenges** related to the need to combine urban development with various needs, particularly concerning environmental protection, sustainable resource use, climate change control, demographic changes such as growing migration to major cities and population aging, and the availability and accessibility of services.

Urban sustainability is therefore a broad concept that must be applied at environmental, social and economic levels. Specific interconnected areas can be identified: energy efficiency, sustainable mobility, responsible resource management, urban design, sustainable construction, active participation, equality and inclusion.

Energy sustainability is a fundamental aspect of urban sustainability. The use of renewable energy sources, the reduction of energy consumption and the use of innovative technologies for energy production and management are major challenges that cities must address. This also includes innovative solutions like

Renewable Energy Communities (REC), which many local administrations are now promoting in collaboration with other stakeholders.

Another crucial aspect of urban sustainability is the need to **implement transportation systems that reduce emissions and improve air quality**. Cities must design and implement efficient public transportation solutions, including the creation of safe pedestrian and cycling paths. Another significant aspect is the promotion of low-impact vehicles.

Reducing waste, recycling and reusing are also essential aspects of sustainable resource management in urban areas, considering the concept of a circular economy that cities are called to contribute to. The main challenges include launching composting programs, conserving and reusing natural resources and using innovative technologies for efficient resource management.

Another essential aspect of sustainability concerns **green spaces, urban parks and the preservation of natural areas within cities**, which contribute not only to physical well-being, but also to improved air and water quality, fostering biodiversity. Urban policies oriented towards green space development also promote socialisation, sustainable cultural activities and low-impact tourism. They are crucial for addressing the increasing challenges related to climate change.

Sustainable urban development cannot disregard **sustainable construction practices**, which involve using eco-compatible materials, optimising thermal and acoustic insulation and utilising innovative technologies to reduce the environmental impact of buildings, beyond just energy efficiency. Building stock in many European cities is old, especially in historic centres, therefore requiring innovative planning and intervention capacities by local administrations, often in collaboration with various stakeholders, which is not always easy to implement.

Active citizen participation is essential for supporting and legitimising urban sustainability practices. Urban policy decisions need the involvement of local communities to promote environmental awareness and encourage sustainable lifestyles. In this regard, the involvement of schools and youth communities is

crucial, as they can significantly contribute to the growth of education on urban sustainability.

Social sustainability means the ability for everyone to meet their basic needs, pursue aspirations for a better life, and access the services, resources, and opportunities needed to live within society. Sustainable development must therefore help reduce income and opportunity inequalities, promote empowerment and ensure equal opportunities. In urban contexts, it is particularly important to create accessible and usable buildings, spaces and services for all, including people with disabilities and those socially or economically disadvantaged, to enhance well-being and create value for everyone.

Urban sustainability is a **strategy that operates complementarity to urban regeneration**: while distinct concepts, they share the goal of providing concrete solutions to environmental challenges and ensuring balanced, long-lasting development that maintains the quality of life for present and future communities.

Outdoor laboratories on STEM subjects

FREELAND laboratories follow the structure of Inquiry Based Learning, in 5 steps (orientation, conceptualization, investigation, conclusion and discussion), and for each step we suggest activities and methodological approaches that are engaging for the students such as group work, brainstorming, hands-on, creative works.

The activities described in each laboratory are suggestions that teachers can adapt or replace with similar activities suitable to students' age and school type.

7 laboratories are developed: Plant Biodiversity Detectives, Ecosystem Services Assessment, Digging into the soil secrets, How hot is your city?, Noise Detectives, Air pollution, Light pollution.

Below is the description of each activity provided.

Plant Biodiversity Detectives

Content and aims: Assessment of Plant Biodiversity in an urban space (garden, park, abandoned area with spontaneous vegetation) by applying scientific methods of sampling, identification of the species. It also suggests the calculation of the mathematical formula to calculate the Simpson's Biodiversity Index, besides the calculation of frequency and percentage.



Learning objectives:

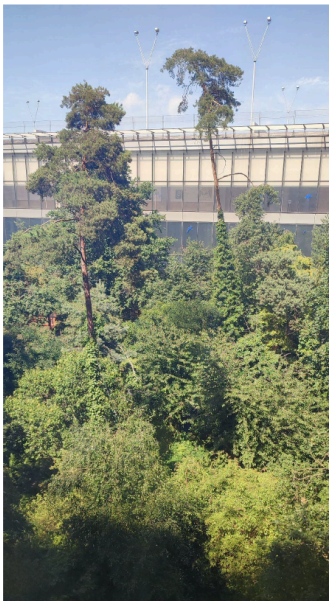
- acquire ability on manual work for sampling
- describe observable and measurable indicators
- use mathematical formulas to analyse data, calculate the Biodiversity Index
- represent their results in a PPT, videos

Duration: 4-5 hours
Subjects: Science, Biology, Botany, Maths,
Materials:

- For sampling: scissors, quadrats or a string, plastic bags
- For identification: pocket guides/dichotomous keys/Apps such as PlantNet, iNaturalist, Google Lens.
- For analysis: Excel for calculations (or calculators)

Ecosystem Services Assessment

Content and aims: This laboratory is about the assessment of the Ecosystem Services that a green space can provide to the community by using a qualitative methods and the perception of the students.



Learning objectives:
Students will be able to

- Learn ecology and botany terminologies, plant functions, ecosystem services and benefits
- Reflect on sustainable development and management of green areas from different perspectives.
- Discuss scientific results and make relationships between diverse disciplines, in connection to the characteristics of the environment
- Represent the results in a PPT, video etc.

Duration: 4 hours
Subjects: Science, Biology, Botany, Maths, Art, Civic education
Materials:

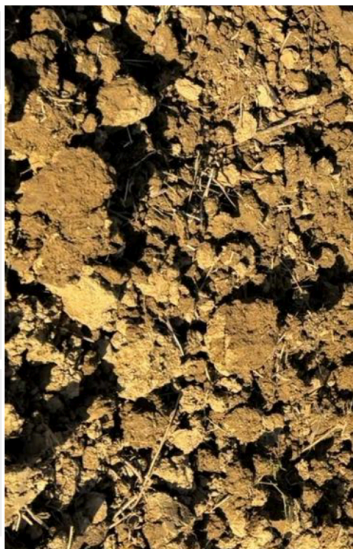
- Worksheet to print, Pen and notes, materials indicated in the worksheets
- Mobile phones for photos and videos

freeland

Co-funded by the European Union

Digging into the soil secrets

Content and aims: This laboratory is about the knowledge of the soil through a series of observations and assessment tests.



Learning objectives:
Students will be able to

- Observe the soil through simple analysis with hands-on tests
- Learn pedological terminologies
- Reflect on sustainable use of soil.
- Discuss scientific results and make relationships between diverse disciplines, in connection to the characteristics of the soil
- Represent the results in a PPT, video etc.

Duration: 5-6 hours
Subjects: Science, Biology, Maths, Civic education
Materials:

- Worksheet to print, Pen and notes, materials indicated for the soil tests
- Mobile phones for photos and videos

How hot is your city?

Content and aims This laboratory aims to raise awareness of:

- the "heat island" phenomenon by applying scientific methods of climatic data analysis and its evaluation
- understanding the effectiveness of vegetation to mitigate this problem.

Learning objectives
Students will be able to:

- Make observations of the urban climate and environment
- Do hands-on computer works
- Learn climate terminologies
- Manipulate data and make graphs
- Discuss scientific results and make relationships between diverse disciplines, in connection with the climate change



Duration: 10-20 days
Subjects: Science, Biology, Maths, Art
Materials:

- Worksheet to print, Pen and notes
- Non-contact infrared (IR) thermometers or hand-held IR cameras
- Mobile phones for photos
- Computer to download and elaborate climate data

Noise Detectives

Content and aims: Raising students' awareness about the noise around us and its causes,. Assessment of level and sources of noise in an urban space (garden, park, abandoned area) by measuring quantitatively and qualitatively the level of noise and proposing solutions to improve the quality of the selected area.



Learning objectives:

- measuring level of noise pollution using their senses and digital tools
- analyse and compare collected data
- present the results of their activities through video and/or presentation
- reflect on the impact of our daily activities and habits in relation to noise
- discuss scientific results and make relationships between diverse disciplines,

Duration: 5-6 hours
Subjects: Physics, Mathematics, Civic education, ICT, social science
Materials:

- Worksheet to print, Pen and notes (to collect data in the field
- Mobile phones for photos, audios and videos, app for measuring sound
- Tools for analysis: and calculation (e.g. Excel) for mapping data (e.g. Google map) and for presentation (e.g. powerpoint)

What is it in the air?

Content and aims: Raising students' awareness about air pollution around us and its causes, Measuring the level of some pollutants (particulate matter) in the selected area and reflecting and proposing actions to improve the quality of the area.



Learning objectives:

- Estimate the level of PM in the air by doing a simple experiment in the area
- analyze and compare collected data
- present the results of their activities through video and/or presentation
- discuss scientific results and make relationships between diverse disciplines, in connection to air pollution
- reflect on the impact of our daily activities and habits on the quality of a living space in relation to air pollution

Duration: 4-5 hours
Subjects: Chemistry, Mathematics, Civic education
Materials: Worksheet to print, Pen and notes,

- Pieces of white thick paper, Vaseline for the experiment
- Mobile phones for photos, audios and videos, Microscope for counting particulate, laptop and software for creating presentations and videos

freeland

Shed light on light pollution

Content and aims: Raising students' awareness about the link between lighting systems that illuminate our cities at night and light pollution (*any alteration of the natural light at night in the external environment caused by humans and all its negative effects of artificial light*). How to estimate light pollution and proposing solutions to improve the quality in the selected urban space.

Learning objectives:

- Learn the concept of light pollution and its causes
- Evaluate the lighting system and personal perception and quantification of the level of light in a selected place
- analyse and present the results through video and/or presentation
- reflect on the personal perception of the night environment

Duration: 4-5.hours
Subjects: Physics, Mathematics, Civic education
Materials:

- Worksheet to print, Pen and notes, questionnaire (optional)
- Mobile phones for photos, audios and videos, app or device for measuring light intensity, laptop and software for creating presentations and videos,
- google form for creating a questionnaire (optional)



Citizenship and communication

Citizenship

Civic engagement regards the commitment of an individual with the 'interests, goals, concerns and common good of a specific community'. It has to do with civic knowledge and sensibility/feelings of solidarity, while civic participation relates to activities that aim at increasing social inclusion and the enhancement of solidarity between citizens and (ethnic and social) groups in society (*Active citizenship in Europe*, Cristiano Bee- 2017[1]).

And more from the report of the project PEACE[2], "civic engagement has to do with civic knowledge and sensibility/feelings of solidarity, while civic participation

[1] Bee, C. (2017), Active Citizenship in Europe, Palgrave Macmillan, London.
[2] Final Report Naples- Participation Erasmus Alumni for Civic Engagement (PEACE)- Paul Blokker Naples – 18-20 December 2022 - https://www.erasmusplus.it/wp-content/uploads/2024/04/Report-Naples-PEACE-.pdf

relates to activities that aim at increasing social inclusion and the enhancement of solidarity between citizens and (ethnic and social) groups in society"

The table below is modified by the final report of PEACE project (original sources Bee 2017) and explain different types of engagement and participation:

	Civic engagement	**Civic participation**
Individual	Civic knowledgeAttention	Civic individual action
Collective	Group belonging Identification	Civic collective action

Through civic participation activities FREELAND promotes civic competences, the development of individual skills, critical awareness, community values, tolerance and solidarity. Although the explicit goal of civic participation is not to connect to formal politics or public policies in the narrow sense, the effects of civic participation can concern broader political dimensions.

European citizenship education in FREELAND is aimed to build a democratic community out of ideological context but based on relationships and knowledge. (https://www.erasmusplus.it/iniziative/peace-long-term-activity/resources/modules/)

The activities have to invite students to participate in discussions on the places renewment and let them be conscious about their form of participation - express consent and influence decision making and assemblies among students, teachers and stakeholders can be useful tools.

The activities promoted by the project are based on forms of bottom-up and short-term collaboration, on crowdsourcing, collecting information or suggestions useful for planning the revitalization of the place by involving schoolmates, family members and residents of the neighborhood.

During the assemblies students can learn together and understand better problems and solutions, different points of view, sometimes contrasting and go deeper in the differences.

Communication

Sharing the outcomes of outdoor laboratories is an essential part of the educational and civic process. Communication should not be seen merely as the final stage of a project, but as a continuous dialogue between schools, institutions, and citizens. Students can play a central role in this exchange, becoming mediators between the learning environment and the urban community. Effective strategies may include public exhibitions, participatory events, digital storytelling, or collaborative mapping, allowing local residents to see how the school's work contributes to the transformation of shared spaces. Communication should highlight not only the results, but also the processes, challenges, and discoveries made along the way. By making these experiences visible and accessible, schools strengthen the sense of collective ownership and foster a shared culture of care for the urban environment.

Art for effective urban regeneration

Working with students to revitalize urban spaces means building bridges between institutions, local communities, and citizens. As Riccardo Dalisi, a professor at the University of Naples and a leading figure in the radical art movement of the 1970s, pointed out, universities and schools can become laboratories for social and spatial experimentation, capable of sparking small revolutions. His projects, born in challenging urban contexts, demonstrate that teaching can be a tool for concrete transformation: the educational act becomes a collective and regenerative experience. However, the main challenge remains maintaining the implemented interventions over time, overcoming the fragility of temporary initiatives and the difficulty of coordinating between different stakeholders. For a project to remain alive, it is necessary to cultivate good practices of shared care, in which the school feels an active part of the local community. Attention to

aesthetic taste, cleanliness, and the pleasantness of the place—even in its imperfection—then becomes an exercise in citizenship: educating about beauty as a shared responsibility, capable of self-sustaining regeneration over time.

FREELAND Learning objectives

The FREELAND Learning objectives stem from the EU approach of promoting key competences for Lifelong Learning. This approach promotes key competences by:

1) Providing high-quality education, training and lifelong learning for all
2) Supporting educational staff in implementing competence-based teaching and learning approaches
3) Encouraging a variety of learning approaches and contexts for continued learning
4) Exploring approaches to assess and validate key competences[3]

In particular, the European Council has identified eight key competences crucial to a sustainable, healthy and fulfilled lifestyle of employability, social inclusion and active participation in the democratic life (European Council, 2018):

1) Literacy
2) Multilingualism
3) Numerical, scientific and engineering skills
4) Digital and technology-based competences
5) Interpersonal skills, and the ability to adopt new competences
6) Active citizenship
7) Entrepreneurship
8) Cultural awareness and expression

Of the eight key competences listed, the **FREELAND Methodology** focuses in particular on fostering the active citizenship skills, the numerical, scientific and engineering skills, the digital and technology-based competences, interpersonal skills and cultural awareness and expression. By stimulating a dialogue between European students, schools and communities, multilingualism and literacy competences are also promoted.

The **FREELAND Learning objectives** address three target groups:

[3] https://education.ec.europa.eu/focus-topics/improving-quality/key-competences

1) **Students** (primary target group): increasing their key competences and skills and raising awareness on social issues regarding urban spaces, sustainability, climate change and responsible behaviours.
2) **Teachers** (secondary target group): increasing their key competences and skills and enhancing their teaching efficacy, their competence with innovative learning methodology (PjBL and STEAM in particular), their collaboration with teachers of different subjects and with citizens and stakeholders.
3) **Citizens and stakeholders** (tertiary target group): facilitating their awareness of social and civic issues, their civic engagement, their sense of belonging to the EU and their collaboration with schools to create more cohesive and inclusive communities.

To achieve this learning objectives, FREELAND offers teaching and learning materials based on the FREELAND methodology, that has been developed on the basis of the findings emerged from three questionnaires (one addressed to students, one to teachers and one to citizens), whose results are reported in the following sections of this document.

The learning objectives of the project are described in detail in the following paragraphs.

Citizenship and Soft Skills

As stated by the European Council (2018, p. 10), “Citizenship competence is the ability to act as responsible citizens and to fully participate in civic and social life, based on understanding of social, economic, legal and political concepts and structures, as well as global developments and sustainability”. This involves an understanding of common values, such as the European common values expressed in the Treaty on European Union (Article 2) and in the Charter of Fundamental Rights of the European Union (European Council, 2018).

By taking care of public neglected urban spaces within a cooperative framework of schools, Municipalities, citizens and stakeholders, students learn the meaning of civic engagement and acquire the means for a successful participation in

democratic life. Additionally, by providing non-formal learning opportunities within the aforementioned framework, FREELAND contributes to the formation of a sense of belonging and of solid common values based on sharing, respect and care. The social and cultural issues, common values and the principle of unity in diversity are especially conveyed through art, a medium that requires no words to be understood and that surpasses barriers and frontiers, unifying human beings while expressing their diversity and complexity.

By addressing the project themes of climate change, biodiversity and sustainable cities, FREELAND promotes an understanding of climate and demographic change and their underlying causes, and explores the advantages of sustainable systems. In order to reach a sustainable development of society, these themes are crucial especially in conjunction with interpersonal and communication skills, that allow to engage effectively with others and to develop constructive arguments of public and civic interest.

Interpersonal skills comprehend the ability to "work with others in a constructive way" and need the ability to "remain resilient and manage one's own learning" (European Council, 2018, p. 10). The open air laboratories, the non-formal education setting, the investigations and the collaboration between students, schools, scientific institutions, Municipalities and local communities created by the project increase students' interpersonal and soft skills such as teamwork, active listening and assertive communication, and increase also students' problem-solving and critical thinking skills, crucial to the learning to learn competence.

Non-formal and informal learning supports the development of essential interpersonal and communication skills alongside crucial cognitive skills (e.g. creativity, critical thinking, problem solving, resilience) that facilitate the transition to adulthood and the active participation in the democratic and working life (European Council, 2017). Observing, studying and improving disused urban green spaces improves the understanding of nature resilience and its importance. The meaningful participation, engagement and collaboration between participants creates non-formal and informal learning opportunities where transversal,

interpersonal and communication skills are developed. Students work on their cognitive skills by proposing solutions and elaborating projects while promoting inclusion, knowledge sharing and collaboration among peers and non-peers.

The element of communication between countries present in the project facilitates the expressions of ideas and cultural awareness. The cultural awareness and expression competence "involves having an understanding of and respect for how ideas and meaning are creatively expressed and communicated in different cultures and through a range of arts and other cultural forms" (European Council, 2018, p. 11). Through the designing of projects on urban regeneration and the sharing of such projects on the digital platform, students, teachers and citizens are engaged in expressing their own ideas and culture and understanding the ideas and culture of others, thus forming a stronger sense of place and sense of belonging and a stronger acceptance of creative ideas communicated through different cultures. As stated before, art plays a crucial role in facilitating both expression and understanding of cultures.

STEM Area

One of the general objectives of the FREELAND project is to promote interest and excellence in science, technology, engineering and mathematics (STEM) through the STEAM approach, and to foster girls' interest in STEM. Improving competence in the STEM area means building a "sound mastery of numeracy" and of "mathematical modes of thought and presentation (formulas, models, constructs, graphs, charts)", increasing the ability to "explain the natural world" with observations and experimentations "to draw evidence-based conclusions" and increasing the "understanding of the changes caused by human activity and responsibility as an individual citizen" (European Council, 2018, p. 9).

FREELAND uses the STEAM approach in open air laboratories and offers the possibility to share data and scientific suggestions on the digital platform. The use of art in designing urban regeneration projects links maths and science education and knowledge with broader and transversal themes such as climate change, inclusion, sustainability, resilience and respect of common values. Fostering STEM

competence is thus linked to the development of citizenship, soft skills and digital competence, thanks to the interdisciplinary nature of the methodology and the learning modules.

Fostering the competence in this area also "includes an attitude of critical appreciation and curiosity, a concern for ethical issues and support for both safety and environmental sustainability, in particular as regards scientific and technological progress in relation to oneself, family, community, and global issues" (European Council, 2018, p. 9) that is addressed by the FREELAND themes.

Digital and technology-based competences

Developing a digital competence translates to a "confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society" (European Council, 2018, p. 9). A competent and responsible use of the digital technology facilitates and supports social inclusion, active citizenship and collaboration with others, and it also fosters creativity (European Council, 2018).

The **FREELAND multilingual digital platform** connects schools through the virtual designing and sharing of projects, laboratories, data and knowledge. Thanks to the interaction with the platform, users develop access and evaluation skills, they develop their creativity, communication and sharing skills and their digital content designing skills. They collaborate and develop media literacy together while learning about an ethical and safe use of ICT tools.

By communicating with users of different countries through the platform, students and teachers increase their ability to use different languages to communicate effectively in cultural contexts.

FREELAND students' and teachers' learning needs

The methodology construction process was based on the results of initial surveys which had the dual objective of investigating knowledge and attitudes of students, teachers and citizens regarding interest and attitudes towards urban regeneration, environmental threats, concepts and terminology, and their interest and familiarity in educational methodologies and tools. The surveys, in the form of questionnaires, created in October 2024 were anonymous, and divided in 4 sections: personal details, Urban regeneration, Climate Change and Sustainability, Innovative Learning Methodologies and tools. For each theme, they asked to assess three aspects: knowledge and experience, interest and attitudes. The questionnaires for the students, in three languages, are available at the following links:

Italian: https://forms.gle/dcjvp6PTWrS7GvTU6

Croatian: https://forms.gle/YJQJzBTLBx8YAQ8ZA

Polish: https://forms.gle/bjZwZTrkZWWX6svKA

The questionnaires for the teachers, in three languages, are available at the following links:

Italian: https://forms.gle/24KLQH2DsmUvmyd56

Croatian: https://forms.gle/j96aVVsLR5DeJioW8

Polish: https://forms.gle/wVynEU2ucA4u1h7x5

The questionnaires were administered between the 9th and the 20th of January 2025 in three countries of the project, at the Scientific Lyceum "N. Copernico" in

Prato and Lyceum “M. Hack” in Baronissi in Italy; the Lyceum in Gandsk, Poland and the Gymnasium in Rijeka, Croatia.

Main findings from the students’ survey

The Student Survey identified the following findings:

- **Profile:** Participants came from various age groups and educational levels of the secondary schools participating in the project: two Lyceums and one Gymnasium.

Urban regeneration and civic engagement:

- Most students had basic knowledge of main common terms, but they knew lesser extent the term urban regeneration.
- Students were very much interested in learning ways to become aware and active citizens and had a very positive attitude, agreeing with the importance of being an active citizen and of preserving urban spaces.

Sustainability and climate change:

- Most students had basic knowledge of main common terms such as sustainability and climate change and its impact on cities and human health, but fewer students knew the concept of circular economy.
- Students were interested in learning about climate change and its impacts on cities and human health, and to a lesser extent in “participating in activities that make our own city more sustainable”.
- Students thought that “a citizen should be aware about climate change” and they felt the need to do something to prevent the impacts of climate change.

Innovative learning environment and ICT tools

- A few students regularly used ICT tools in education and even less had experience in fieldwork, but they had experience in learning by doing and in group work.
- Students would like to use personal devices for studying and they would like to do projects that involve external experts (e.g. visiting their labs), but less students were interested in school projects that involve the local community (e.g. families, associations, experts, municipality) or in creating artistic outcomes (drawing, painting, design, photography, etc.) to communicate ideas and notions.
- Students thought that "the use of ICT tools (e.g. digital platforms) can make lessons more interesting, and that fieldwork would motivate more in learning. They also feel most school subjects are detached from modern life.

Overall Perception about School and Learning

- Students would like to connect school disciplines to better understand things
- More were the students who liked Science and Technology than those who liked Humanistic studies) and subjects related to Art.

Main findings from the teachers' survey

The Teacher Survey identified the following findings:

- **Profile:** Most teachers were females and between 36-55 years old, older teachers were particularly the Italian ones.

Urban regeneration and civic engagement:

- Teachers reported understanding the concept of biodiversity and incorporating discussions on social issues or civic engagement in their

teaching and including ecology-related topics in their lessons. However, fewer teachers demonstrated knowledge on urban design/regeneration.

- Most teachers were interested in learning about urban regeneration and in how to become more aware and active citizens, and all teachers recognized the value of incorporating civic engagement into their teaching.
- All teachers agreed on the importance of actively taking care of a neglected space in an urban context and on civic education and active engagement in modern teaching. They believed that students would be more motivated when teaching includes civic life and social issues, especially when learning deals with one's specific area.

Sustainability and climate change:

- Most teachers felt skilled enough to discuss the implications of climate change and its impact on cities and human health with students and peers and include topics of climate change and sustainability in their own teaching, but only a few the concept of circular economy.
- The majority were interested in teaching about climate change and its impact and in integrating more critical discussions on sustainability.
- Most teachers had positive attitudes, believing about the importance of being aware about climate change as citizens.

Innovative learning environment and ICT tools

- Most teachers regularly used ICT tools in teaching (fewer Italian teachers) and almost all teachers stay updated on innovative teaching methodologies. Integrated STEAM teaching is less practiced, but teachers were engaged in interdisciplinary collaborations. Fieldwork was practiced by a few, mostly Croatians. Collaboration with local stakeholders was more common among Croatian teachers.
- The majority of the teachers were interested in being informed about innovative teaching methods and in collaborating with colleagues and with the local community and local stakeholders.

- Almost all teachers believe that innovative teaching methodologies can improve students' learning, and that fieldwork improves students' motivation to learn. Personal devices were considered important for learning. However, teachers thought that "innovative teaching methodology requires great workload" although they were in favour of a topic-centred approach for teaching instead of a subject-centred one.

Challenges in Teaching:

- Only about 50% of teachers recognized constraints in the application of innovative teaching methodologies, such as limited time in terms of class hours, high number of students in the class, logistic issues that prevent outdoor activities, lack of time and facilities to introduce new different teaching protocols.

Conclusions and Recommendations

From the surveys, we obtained some important considerations for the methodology, such as:

- Considering the integration of sustainability into educational programs.
- Encouraging more interactive teaching methods, field work and the use of personal devices to engage students. Keep group work as an appreciated learning method.
- Including civic education and active engagement on social issues in teaching.
- Improving collaboration between schools and local organizations for concrete initiatives.

Citizens' interest and attitude on urban regeneration

A fundamental aspect in urban regeneration approaches is the involvement of local communities and stakeholders in the phases of understanding, designing and implementing the spaces to be redeveloped. Physical and spatial recovery is not the sole objective of these transformations: they must also trigger an improvement in the social and environmental context.

On the basis of such assumptions, one of the actions in the FREELAND project is dedicated to investigate citizens' interests and feelings about the topics of urban regeneration, environmental sustainability and climate change in the partner countries, in order to try and shape a trend that can support the development of the project methodology and learning products. The investigation process was based on a specific online survey designed by Major Cities of Europe (MCE) with the support of the other partners, aimed at investigating citizens' interests and attitudes towards the topics of urban regeneration, climate change and city sustainability as possible contexts where cooperation with schools and local communities can improve life quality and social cohesion.

Survey structure

The survey was prepared with the Google Form tool and included the following sections:

1. Part I - Personal information
2. Part II: Urban regeneration and civic engagement
3. Part III: Sustainability and climate change

Both Part II and Part III were structured in three different subsections:

- Knowledge and Experience
- Interests

- Attitudes

The purpose of such structure was to focus on different aspects of citizen's involvement in the project topics, since not only it's interesting to understand how much citizens already know about urban regeneration, climate change and city sustainability, but also to investigate their interest in learning more and being involved in concrete actions, even in collaboration with schools.

The survey was made in English and translated in Italian, Croatian and Polish, in order to facilitate the spread in partner countries through specific links that the consortium members circulated through their own distribution channels. The Italian version was also made available on the website of the Municipality of Prato (associated partner), while the English version was circulated among MCE members.

In the following paragraph a summary of the main outcomes springing from the analysis of the survey results is provided. A detailed account is available in the document "**Report on citizens' knowledge, interest and attitudes on urban regeneration and sustainability"**, produced by the Freeland consortium.

Main outcomes

The total amount of responders in the different countries is as follows, where the item "Other" includes responders from different countries reached through the English version of the survey:

Italy - 176. Croatia - 158. Poland - 147. Other[4] - 15

A large majority of women responders is registered in all cases, namely 65.7% in Italy, 73.1% in Croatia, 82.9% in Poland and 71.4% in Other.

[4] Responders in this category come from different countries: 2 from Italy, 2 from Spain, 1 from The Netherlands, 1 from Lithuania, 1 from Norway, 1 from Poland, 1 from Slovenia, 1 from Belgium, 1 from Cyprus, 1 from Czech Republic, 1 from Denmark, 1 from Germany and 1 from Greece. Due to the scarcity of responders and country inhomogeneity, the sample is less meaningful than the others.

Urban regeneration and civic engagement

The main purpose of this part of the survey was to analyse both citizens' interest towards urban regeneration, biodiversity and ecology topics and their attitude in being involved in urban regeneration activities in their city. Actually, some interesting elements are emerging from the collected answers, that can help in outlining possible actions in the partner countries that might include the participation of citizens.

Responders in all partner countries appear well aware of the topic of urban regeneration, biodiversity and ecology, but are also interested in learning more and this can pave the way to the organisation of informative opportunities to increase such knowledge.

The most appreciated aspect in urban regeneration seems to be the improvement of environmental quality, followed by the renewal of public spaces, while less attention is given to aspects related with social inclusion and community reinforcement. Therefore, it seems there is some work to be done to improve the perception that such a topic has a fundamental Since this latter topic is a fundamental element in effective urban regeneration actions.

The possibility of collaborating with schools is also appreciated by a large majority of responders in all partner countries, both including available and partially available subjects. This result opens up the possibility to design some interesting opportunity for testing a collaborative approach inside the project. In particular, most of the responders seem more interested in design applications, although a significant percentage is also available for a more concrete involvement and support.

As far as the willingness of working together for reaching common results is concerned, only very few people think this is useless, which is a quite encouraging result. On the other hand, it's important also to highlight the declaration of some percentage of responders about having no time for being involved in collaborating activities, together with the opinion that it's a duty of public administration to

manage urban regeneration plans. This leads to the need of reflecting carefully on the type of collaborative actions that might be put in place, that on one hand should identify those who might be more available and, on the other hand, try and design flexible opportunities to involve as many persons as possible. On the other hand, it should be observed that, rather encouragingly, really few people feel a sense of uselessness in doing something to improve the quality of life in the city.

Sustainability and climate change

The main purpose of this part of the survey was to analyse both citizens' interest towards sustainability and climate change topics, together with their attitude in being involved in collaborative actions aimed at increasing environmental awareness in their city. Like in the case of the urban regeneration issue, some interesting elements can be outlined to better understand the possibility of including citizens as partners in actions that might be developed with a focus on climate change and sustainability.

Responders in all partner countries appear well aware of the topic of climate change and sustainability, but are also interested in learning more and, like in the case of urban regeneration, this opens up the possibility of organising informative opportunities to increase such knowledge. This is reinforced also by the consideration that a large majority is also in favour of collaborating with schools in activities oriented to increase environmental awareness.

Most responders in all partner countries adopt a variety of strategies aimed at reducing climate change effects and improving sustainability. There is also a strong feeling that individuals and communities are both responsible for facing climate change effects in cities and improving sustainability, which leads to opportunities for reinforcing collaboration at different levels (including the public administration).

On the other hand, it's worth to outline that environmental sensitivity might somehow differ from country to country, as for example was observed in the case of the question on climate change being one of the greatest challenges for cities:

such awareness seems much higher in Italy rather than in Croatia and Poland and this could be also due to the evolution of climate change effects in different areas. This might also impact the different perception on the public administration's capacity to face climate change challenges registered in different countries: Poland shows the highest percentage of unawareness on this issue, while in Italy and Croatia the negative feeling is prevailing.

Concluding remarks

Despite some differences, even relevant in some cases, among the responding groups, the investigation revealed a strong awareness on the project topics and even the interest of learning more. This seems to indicate that the design of urban regeneration activities should also include some informative opportunities dedicated to citizens in collaboration with schools, that were acknowledged as relevant subjects for cooperation.

Citizens expressed also the interest for being involved in concrete initiatives even in the design and realisation of urban regeneration solutions, but this might require a careful evaluation on how to involve different categories of people: lack of time appears the major obstacle, that might prevent citizens to actually take active part in collective initiatives, Therefore, flexibility in managing different options should be taken into account, when asking for citizens' contribution.

In conclusion, several opportunities can be found to enhance cooperation within local communities, including schools, and between citizens and public administration, to foster city sustainability and improve the quality of life in urban contexts: information, education and knowledge building are basic and necessary steps, but there seems to be room also for more operational involvement and collaboration, where the final goal is not only to build something together, but to generate common value and strengthen community ties.

Learning approaches and methods

The **FREELAND Methodology** is based on effective teaching methodologies, strategies and tools that best suit the learning objectives, combining them in an innovative methodology that integrates real-world problems with subjects' curricula. Formal and non-formal learning environments should adapt to changing society's needs, offering a multitude of perspectives to face an increasingly complex world, where Internet access and the capillary diffusion of Information and Communication Technologies (ICT) give people access to information without giving them the skills necessary to retrieve, verify and analyse it.

In this context, the **basis of the FREELAND Methodology** are:

1) Project-Based Learning
2) Outdoor Learning
3) Inquiry-Based Learning
4) Integrated STEAM approach
5) Circle Time

Project-Based Learning

Project-Based Learning (PjBL) is a "student-driven, teacher-facilitated approach to learning" (Bell, 2010, p. 39) described by Thomas's literature review (2000, p.1) as "complex tasks, based on challenging questions or problems, that involve students in design, problem-solving, decision making, or investigative activities; give students the opportunity to work relatively autonomously over extended periods of time; and culminate in realistic products or presentations". PjBL is a learning approach for creating independent learners and thinkers that was initially developed in the 1960s (Mills & Treagust, 2003) and that has its foundation on the learning-by-doing philosophy proposed by J. Dewey (1938).

This approach has been thoroughly studied and the scientific literature has listed numerous positive outcomes for students. Compared with traditionally taught classes PjBL fosters the development of higher thinking skills such as critical

thinking among students with a higher skill level (Horan et al., 1996) but also among students with average to low literacy skills (Horan et al., 1996; Mergendoller et al., 2006). Moreover, regarding the implementation of PjBL to teach STEM subjects, students traditionally underrepresented in STEM-related fields (e.g. minorities, females), were more interested and engaged in STEM subjects if these were presented with the PjBL approach, with real-world and practical problems (Lou et al., 2011). In synthesis, through this approach students learn to communicate effectively to collaborate with peers, they learn to self-manage, they increase their learning motivation, they achieve higher-level thinking skills and critical skills, and they arrive at a greater understanding of the proposed problem or topic (Horan et al., 1996; Mergendoller et al., 2006; Bell, 2010; Chandrasekaran et al., 2013).

The effectiveness of PjBL in promoting interest, motivation and meaningful learning is due to the fact that it is based on the constructivism approach, where students learn by creating their own knowledge. In meaningful learning students learn beyond memorization, liking the newly acquired knowledge with knowledge already possessed and applying it in different theoretical or real-world contexts. Learning in a meaningful way thus requires active participation by the students, which is facilitated with PjBL. The teacher's role is that of a facilitator or a mentor, who organizes, directs and guides the learning process while encouraging students to boost their self-confidence.

PjBL is usually conceptualized as a five-step (Chandrasekaran et al., 2013; Felipe et al., 2016) or a seven-step process (Jalinus et al., 2017). Regardless of the number of steps, the starting point of the project is a problem or an inquiry that students research and discover, and the result is the delivery and presentation of the project itself. The declination of PjBL that best suits the FREELAND methodology is outlined in the following five phases:

1) Problem
2) Research
3) Design development
4) Evaluation

5) Project delivery

Outdoor Learning

Outdoor learning is a term that refers to fieldwork and the use of school grounds or other outdoor spaces as a learning environment. The pedagogical framework of outdoor learning is experiential learning, which has been theorised by Dewey (1938) and Kolb (1984). The learning-by-doing process described by Dewey (1938) outlines a linear learning process of trial and error, where every experience links to previous experiences and impacts further experiences. Kolb (1984) model of experiential learning is similar to a cycle in which a concrete experience stimulates a reflection and a process of understanding that culminates with an abstract conceptualisation, which can then be applied to different contexts and new experimentations (see figure 1).

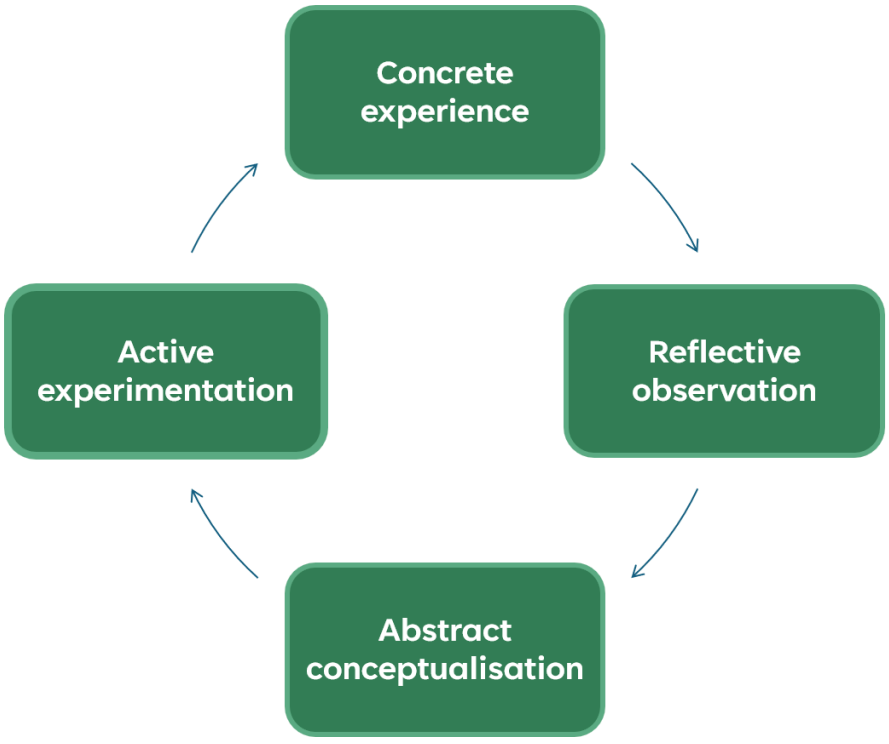


Figure 1: Experiential Learning Cycle (Kolb, 1984).

In this four-step process, learning occurs “through a process whereby knowledge is created through the transformation of experience” (Kolb, 1984, p. 41). As the cycle repeats, students’ knowledge and understanding is deepened and theory and practice are conceptualised and reconceptualised, a process that while cyclical, progresses forward, forming a spiral (Kolb, 1984).

As stated by Rickinson et al. (2004, p. 15), “the concept of ‘outdoor learning’ is a broad and complex one, which touches on a wide range of educational activities in many different settings. Relevant examples include outdoor adventure education, field studies, nature studies, outdoor play, heritage education, environmental education, experiential education, and agricultural education”. For the purpose of the FREELAND Methodology, the type of outdoor learning considered is that in proximity to the school building, especially in the local community settings of neglected urban places.

Outdoor activities in school grounds and community projects have the capacity – compared to the other types of outdoor experiences – to link with various areas of the curriculum, particularly regarding science and technology. Evidence suggests that such outdoor educational activities increase learning motivation, responsibility, a sense of community and a sense of belonging (Rickinson et al., 2004). Moreover, it helps students develop more positive relationships with fellow students, teachers and the wider community that participates in the project (Rickinson et al., 2004). Compared to the impact of fieldwork and visits, there is less evidence to support outdoor learning in proximity to the school (but not on school grounds), while substantial evidence indicates that fieldwork helps in developing knowledge and skills, even if, according to Dillon et al. (2008, p. 110), “to be effective, fieldwork needs to be carefully planned, thoughtfully implemented and followed up back at school”.

Green school grounds have also been used to facilitate learning: going from a book-centred classroom to a nature and student-centred environment makes learning more meaningful to students and provides opportunities for formal, non-formal and also informal learning (Dyment, 2005). In this learning setting, school subjects are less easily seen as discrete entities as subject integration is

often required to complete outdoor projects or tasks: students are then able to experience subjects' interconnections (Titman, 1994; Dyment, 2005). Additionally, the urban environment as an outdoor learning environment has some characteristics that allow to integrate delicate social issues into student's education: the lack of biological diversity could further a discussion on the importance of biodiversity and of diversity in general, while the poor condition of urban places in some areas brings issues such as social equity and urban planning into a teacher's lesson (Martil-de Castro, 1999). It is a form of environmental education that links to a variety of social issues related to citizenship and citizens' inequalities.

Even if outdoor learning has many benefits and helps in diversifying the learning process, many researchers have noted that there are some barriers to outdoor learning (Rikinson et al., 2004), which are:

1) Concerns about students' safety
2) Lack of teachers' confidence in teaching outdoors
3) Strict curriculum requirements
4) Not enough time or resources
5) Class issues (e.g. larger size, need more basic lessons)

Inquiry-Based Learning

While the main approach in the FREELAND Methodology is Project-Based Learning integrated with an outdoor learning environment, the scientific laboratories that can be implemented in the selected urban places are based on inquiry (lesson plan).

Inquiry-Based Learning (IBL) is a student-centred learning approach where students acquire new knowledge with a process similar to how scientists construct new knowledge (Pedaste et al., 2015). This allows students to be active in their knowledge acquisition process, while the teacher's role is to facilitate and support students in the inquiry and learning processes by asking them thought-provoking

and critical questions and encouraging them to express and debate their ideas (Chin, 2007).

The benefits of IBL in STEM subjects are an enhanced interest in learning, interactive discussions that deepen the knowledge on the subject and its relevance in the real world, and collaborative learning (Bruder & Prescott, 2013; Bogador et al., 2024)

Dewey (1910) had already described several of IBL aspects, such as stating and defining a problem, formulating a hypothesis and testing it. Since then, more definitions of the IBL phases have been introduced with different frameworks and terminologies that have been summarized by Pedaste et al. (2015) as follows:

1) Orientation
2) Conceptualization
3) Investigation
4) Conclusion
5) Discussion

During the Orientation (1), the teacher raises curiosity about a topic, highlighting a problem or a challenge. In the second (2) phase, students formulate hypotheses and questions to understand the phenomenon. Starting from the research question, the Investigation phase (3) consists of planning and then exploring or experimenting. The exploration can include bibliographical research while the experimentation includes the designing of an empirical protocol in order to test the hypothesis. Results obtained should be interpreted to synthesise new knowledge. Students draw conclusions (4) based on these results and relate them to the initial hypothesis, then in the Discussion (5) they present their summarised results to the class/public, thus verifying that they have learned the topic.

In the **FREELAND methodology**, IBL is mainly used in the curriculum-based experiences of outdoor laboratories, integrated with PjBL that refers to the broader urban regeneration project of the neglected urban place.

Integrated STEAM approach

The STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach is a practical and holistic model that interprets Science and Technology through Engineering, Arts and Humanity disciplines, all based on mathematical elements (Yakman, 2012; Watson & Watson, 2013). Traditional formal education is based on different subjects with few connections between them, that divide the real-world knowledge. However, the world we live in cannot be understood by viewing it only through one perspective; we can't understand science without technology, which in turn needs engineering, which is based on an understanding of mathematics and the arts (e.g. creativity, design, aesthetics, ergonomics, ethics, values, innovation, inclusion, different perspectives…) (Yakman, 2012; Honey et al., 2014).

STEM education was already being promoted as an interdisciplinary teaching approach to STEM subjects within complex problems, however, the inadequacy of the school system, the fixedness of the school schedule and the lack of teachers' skill in applying this approach (Blackley & Howell, 2015) resulted in the STEM approach being utilised as a curriculum of different unintegrated subjects (Thuneberg et al., 2017). Even when incorporating STEM disciplines together in Project-Based Learning, without Art the project tends to examine the problem under a purely functional framework. Real-world problems require the implementation of design elements to combine form and function, so integrating Art in STEM could be viewed in some cases even as a necessity: students need exposure to real-world problems to learn how to apply their knowledge in multiple solutions (Watson & Watson, 2013). As scholars have increasingly realised, the inclusion of Art makes STEM disciplines more engaging, relevant and life-like to students, and more, Arts and Humanities subjects can help them understand inherent disciplines' connections and achieve a comprehensive view of the complexity of the real world (e.g. Watson & Watson, 2013; Daugherty, 2013; Kant et al., 2018). Additionally, the application of the STEAM approach promotes the acquisition of interdisciplinary knowledge, self-efficacy and learning motivation (Jia et al., 2021), and it promotes creativity, which has been viewed as the most important ability for the 21st century (Trilling & Fadel, 2009).

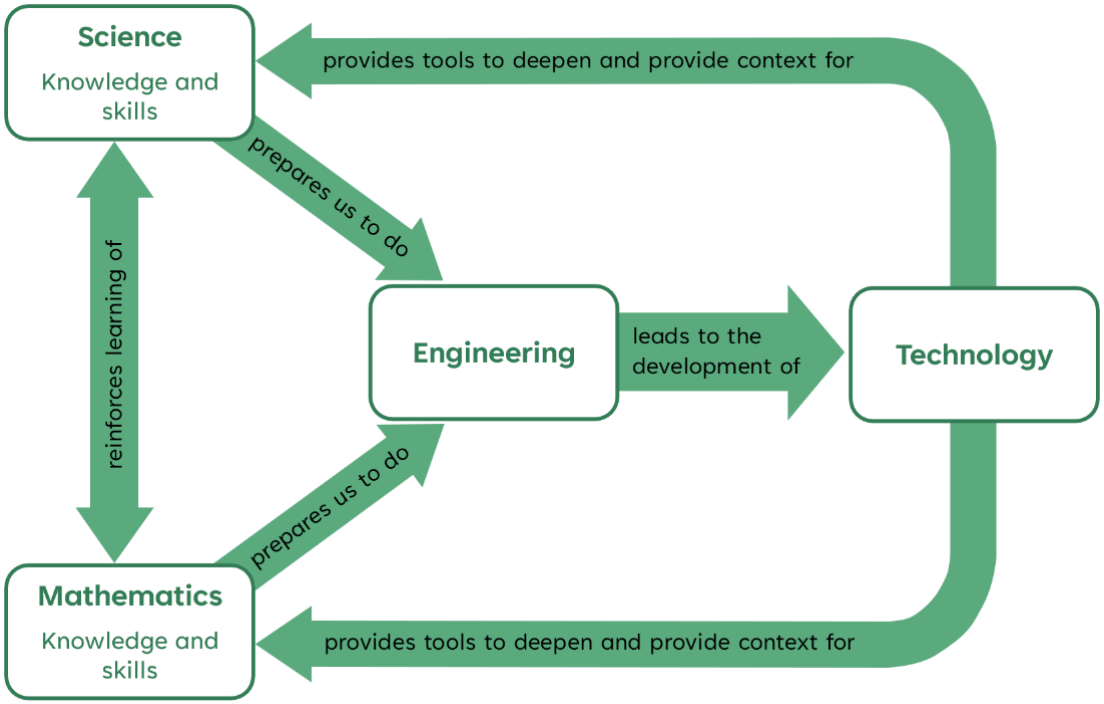


Figure 2: Relationship Model of the STEM Approach to teaching Science, Technology, Engineering and Mathematics (Watson & Watson, 2013).

What is needed is an integrated approach to STEM education that is applicable to real-world problems: the **Integrated STEAM Approach** (Honey et al., 2014; Liao, 2016). This approach focuses on providing transformative learning experiences where STEAM subjects are presented together, in an interdisciplinary – or if possible a transdisciplinary – manner (Liao, 2016).

Art can be integrated in different ways: to present a technology project in a creative or aesthetic way, or science is used to understand Art beyond its artistic components (e.g. analysing the physics of colours, materials, music instruments, etc.). Although all the subjects in STEAM education should be equally important, art faces the risk of being used as a mere vehicle for learning STEM disciplines. Liao (2016) proposes that STEAM should then create a transdisciplinary space that goes beyond discrete disciplines, a space where students are not required to

categorize their learning into the discrete categories of study subjects. This proposal, albeit innovative and promising, faces numerous challenges due to the school being conceptualised as composed of different teachers for different subjects, with rigid schedules and curricula.

In the **FREELAND learning methodology**, Art is considered a means to integrate subjects, motivate students, and discuss broader topics such as aesthetics, inclusion, resilience, self expression, sustainable development, climate change and urban regeneration and conservation.

The benefits of this approach, integrated into the FREELAND methodology, can be summarized as follows:

1) Holistic learning: combining data to approach problems from multiple perspectives, with an integration of different disciplines.
2) Real-world applications: by approaching a real-world problem, students learn how to apply theoretic principles to solve practical issues.
3) Increased engagement: integrating disciplines fuels students' motivation and engagement with the learning material, especially when working on real-world problems.
4) Collaboration: students are encouraged to share their expertise and apply their knowledge collectively (group work is required to develop the final project of PjBL).

Circle Time

Circle time is a commonly used approach to practise and develop socio-emotional skills in an inclusive and democratic environment. In the Quality Circle Time Model devised by J. Mosley, a "variable number of individuals can participate in a circle, which helps everyone to be of equal status and encourages all to participate", this teaching tool "lends itself efficiently to practising skills such as speaking, listening, turn-taking, problem-solving, and enjoying and appreciating each other's company" (Mosley, 2009, p. 120).

The Circle Time sessions are timetabled, solution-focused and can be used to teach thinking and problem-solving skills, while having the requirements of preventing negative attitudes to offer a safe space for self growth and expression. Circle Time meetings progress through 5 phases, where the meeting's theme is handled differently (Mosley, 2009):

1) Meeting up: initial enjoyable time to form a group with a supporting atmosphere.
2) Warming up: a first easy speaking and listening round to warm up and reduce embarrassment or anxiety.
3) Opening up: exploring the issues that need to be discussed, encouraging the expression of personal beliefs and ideas.
4) Cheering up: switch off from issues of concern with a closing activity.
5) Calming down: transition to the next activity.

FREELAND Learning Methodology

The **FREELAND Learning Methodology** integrates the previously described learning approaches into an innovative methodology that discovers and utilises the educational potential of neglected urban places. The methodology is declined in different themes, each explored in depth in one of the learning modules. The general structure of the learning modules is based on the five steps of **Project-Based Learning** (PjBL):

1) Problem
2) Research
3) Design Development
4) Evaluation
5) Project delivery

Since the first two steps would be implemented on site, these lessons would have the benefits of **outdoor learning**. In particular, making learning more meaningful to students, providing opportunities not only for formal learning but also for non-formal and informal learning, and making it easier to integrate citizenship and social issues into STEAM laboratories.

The scientific laboratories on STEM subjects, different for each learning module, are conducted with the **Inquiry-Based Learning** (IBL) approach in order to stimulate students' curiosity and teach them the basis of research methodology such as formulating hypotheses and designing ways to test them, collecting data, inferring results from the experiments and drawing conclusion based on the analysis of the data collected.

The overall framework is the **Integrated STEAM approach**, that integrates STEM subjects with humanistic subjects and topics to communicate the complexity of our world and how to be an active and formed citizen.

The **Circle Time** teaching tool is used to give everyone a voice, to teach respect, listening skills and communication skills, to teach equality and how to manage dissent and different opinions in a constructive way.

The **4 tips for implementing the FREELAND Learning Methodology** are:

1) **Identifying the place**: identifying a place, sufficiently near the school, that is neglected and in need of regeneration. Contacting the local authorities …
2) **Choosing theme, Designing the laboratories**: Choosing at least one learning module and designing the scientific laboratories. If more than one module is chosen, the design is based on both module's themes.
3) **Implementation**: Implementing the chosen learning module. Integrating all the learning approaches, the five steps of PjBL are revised into the **5 steps of the FREELAND Learning Modules**:
    1. Place presentation & problem discussion: orientation and conceptualization of the real-world problem of urban regeneration.
    2. Research: In groups, the students work in open-air laboratories, research the problem, gather information and suggestions.
    3. Designing: students think of possible solutions and develop one of them for the project.
    4. Data evaluation & Revision: students share their work-in-progress and apply feedback to improve the final design of the project.
    5. Project Delivery: the students present and share their project and propose a civic engagement plan or actions to solve the issues in the place through the approach based on urban regeneration principles.
4) **Activating the place** with public exhibitions, participatory events, digital storytelling, or collaborative mapping, allowing local residents to see how the school's work contributes to the transformation of shared spaces. These actions, if consolidated by the interaction between schools, local authorities and stakeholders, increase the sense of belonging of the promoting students and will remain as support for future students and citizens.

FREELAND Learning Modules

The general context of the Learning Modules is provided by urban regeneration: a neglected urban place is selected where urban regeneration principles can be applied.

The problems that such a place poses are highlighted (e.g. high local temperature, low biodiversity, scarce or no usage of the place, etc.). The chosen Learning Module(s) will represent the proper tool with which to frame and face such problems, linking them to major themes of our time:

1) Ecosystem Detectives
2) Climate Change
3) Sustainable Cities
4) Pollution
5) Resilience of the places
6) Social impact

Art, ICT and urban regeneration are present in all learning modules. The structure of the learning modules follows the 5 steps of Project-Based Learning, re-articulated as the **5 steps of the FREELAND Learning Modules**:

1) Place presentation & problem discussion: orientation and conceptualization of the real-world problem of urban regeneration.
2) Research: In groups, the students work in open-air laboratories, research the problem, gather information and suggestions.
3) Designing: students think of possible solutions and develop one of them for the project.
4) Data evaluation & Revision: students share their work-in-progress and apply feedback to improve the final design of the project.
5) Project Delivery: the students present and share their project and propose a civic engagement plan or actions to solve the issues in the place through the approach based on urban regeneration principles.

References

Alsmadi, H., Kandasamy, G., Kafri, A., & Zahirah, K. (2024). Empowering computing students through multidisciplinary project based learning (PBL): Creating meaningful differences in the real world. *Social Sciences & Humanities Open*, 10, 101180. https://doi.org/10.1016/j.ssaho.2024.101180.

Angold, P.G., Sadler, J.P., Hill, M.O., Pullin, A., Rushton, S., Austin, K., Small, E., Wood, B., Wadsworth, R., Sanderson, R. and Thompson, K., (2006). Biodiversity in urban habitat patches. Science of the Total environment, 360(1-3), pp.196-204.

Bell, S. (2010). Project-based learning for the 21st century: Skills for the future. *The Clearing House*, 83(*2*), 39–43.

Blackley, S., & Howell, J. (2015). A STEM Narrative: 15 Years in the Making. *Australian Journal of Teacher Education*, 40(*7*), 102–112.

Bogador, C. J., Camarao, M. K. G., Matunding, C. G., & Sombria, K. J. F. (2024). Challenges and Benefits of Inquiry-Based Learning in Physics. *International Journal of Multidisciplinary: Applied Business and Education Research*, 5(*7*), 2716–2732. https://doi.org/10.11594/ijmaber.05.07.26.

Bruder, R., & Prescott, A. (2013). Research evidence on the benefits of IBL. *ZDM Mathematics Education*, 45, 811–822. https://doi.org/10.1007/s11858-013-0542-2

Chandrasekaran, S., Stojcevski, A., Littlefair, G., & Joordens, M. (2013). Project Oriented Design Based Learning: Aligning Students' Views with Industry needs. *International Journal of Engineering Education*, 29, 1109–1118.

Charles-Rodriguez, U., Venegas de la Torre, M., Hecker, V., Laing, R., & Larouche, R. (2023). The Relationship Between Nature and Immigrants' Integration, Wellbeing and Physical Activity: A Scoping Review. *J Immigrant Minority Health*, *25*, 190–218.

Chin, C. (2007) Teacher Questioning in Science Classrooms: Approaches That Stimulate Productive Thinking. *Journal of Research in Science Teaching*, 44, 815–843. http://dx.doi.org/10.1002/tea.20171.

Daugherty, M. K. (2013). The prospect of an "A" in STEM education. *Journal of STEM Education*. 14(*2*), 10-15.

Dewey, J. (1910). *How we think*. Boston: Heath & CO.

Dewey, J. (1938). *Experience and education*. New York: Simon and Schuster.

Dillon, J., Rickinson, M., Teamey, K., Morris, M., Choi, M.Y., Sanders, D., & Benefield, P. (2008). *The value of outdoor learning: evidence from research in the UK and elsewhere. School Science Review*, 87(*320*), 107–111.

Dyment, J.E. (2005). Green School Grounds as Sites for Outdoor Learning: Barriers and Opportunities. *International Research in Geographical and Environmental Education*, 14(*1*), 28–45.

European Council (2017). Council conclusions on the role of youth work in supporting young people's development of essential life skills that facilitate their successful transition to adulthood, active citizenship and working life. *Official Journal of the European Union*, 60(*C 189/06*), 30–34.

European Council (2018). Council Recommendation of 22 May 2018 on key competences for lifelong learning. *Official Journal of the European Union*, 61(*C 189/01*), 1–13.

Felipe, A.L., Amouroux, E., Pham, T., & Stojcevski, A. (2016). *Vietnamese Students Awareness towards a Project Based Learning Environment*. 8th International Symposium on Project Approaches in Engineering Education, Guimaraes, Portugal.

Honey, M., Pearson, G., & Schweingruber, H. (2014). *STEM Integration in K-12 Education: Status, Prospects, and an Agenda for Research*. Washington, DC: The National Academies Press.

Horan, C., Lavaroni, C., & Beldon, P. (1996). *Observation of the Tinker Tech Program students for critical thinking and social participation behaviors*. Novato, CA: Buck Institute for Education.

IPCC (2021) Climate change 2021: The physical science basis. Contribution of working group I to the sixth assessment report of the Intergovernmental Panel on Climate Change. In: Masson-Delmotte V, Zhai P, Pirani A, Connors SL, Péan C, Berger S, Caud N, Chen Y, Goldfarb L, Gomis MI, Huang M, Leitzell K, Lonnoy E, Matthews JBR, Maycock TK, Waterfield T, Yelekçi O, Yu R, Zhou B (eds). Cambridge University Press, p 3949 pages

IPCC (2023) Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001

Jalinus, N., Nabawi, R.A., & Mardin, A. (2017). The Seven Steps of Project Based Learning Model to Enhance Productive Competences of Vocational Students. *Advances in Social Science, Education and Humanities Research*, 102, 251–256.

Jia, Y., Zhou, B., & Zheng, X. (2021). A Curriculum Integrating STEAM and Maker Education Promotes Pupils' Learning Motivation, Self-Efficacy, and Interdisciplinary Knowledge Acquisition. *Frontiers in Psychology*, 12: 725525. doi: 10.3389/fpsyg.2021.725525.

Knapp S et al (2021) A research agenda for urban biodiversity in the global extinction crisis. Bioscience 71:268–279. https://doi.org/10.1093/biosci/biaa141

Kolb, D. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, N.J.: Prentice Hall.

Liao, C. (2016). From Interdisciplinary to Transdisciplinary: An Arts-Integrated Approach to STEAM Education. *Art Education*, 69(*6*), 44–49. https://doi.org/10.1080/00043125.2016.1224873.

Lou, S., Shih, R., Diez, C., & Tseng, K. (2011). The impact of problem-based learning strategies on STEM knowledge integration and attitudes: An exploratory study among female Taiwanese senior high school students. *International Journal of Technology and Design Education*, 21, 195–215.

Martil-de Castro, W. (1999). Grounding environmental education in the lives of urban students. *Pathways: The Ontario Journal of Outdoor Education*, 11(*2*), 15–17.

Mazor T et al (2018) Global mismatch of policy and research on drivers of biodiversity loss. Nat Ecol Evol 2:1071–1074. https://doi.org/10.1038/s41559-018-0563-x

McIntyre, N.E., Rango, J., Fagan, W.F. and Faeth, S.H., (2001). Ground arthropod community structure in a heterogeneous urban environment. *Landscape and urban planning*, *52*(4), pp.257-274.

Menta, C., Conti, F. D., Pinto, S., & Bodini, A. (2018). Soil Biological Quality index (QBS-ar): 15 years of application at global scale. *Ecological Indicators*, *85*, 773-780.

Mergendoller, J., Maxwell, N., & Bellisimo, Y. (2006). The effectiveness of problem-based instruction: A comparative study of instructional methods and student characteristics. *Interdisciplinary Journal of Problem-based Learning*, 1(*2*), 49–69.

Mills, J.E., & Treagust, D.F. (2003). Engineering education—Is problem-based or project-based learning the answer. *Australasian Journal of Engineering Education*, 3(*2*), 2–16.

Mosley, J. (2009). Circle time and socio-emotional competence in children and young people. In C. Cefai & P. Cooper (Eds.), *Promoting emotional education:*

engaging children and young people with social, emotional and behavioural difficulties (pp. 119–130). London: Jessica Kingsley.

Nilon CH et al (2017) Planning for the future of urban biodiversity: a global review of city-scale initiatives. Bioscience 67:332–342. https://doi.org/10.1093/biosci/bix012

OECD (2023 A). *PISA 2022 Results (Volume I): The State of Learning and Equity in Education*. PISA, OECD Publishing, Paris. https://doi.org/10.1787/53f23881-en.

OECD (2023 B). *PISA 2022 Results (Volume II): Learning During – and From – Disruption*. PISA, OECD Publishing, Paris. https://doi.org/10.1787/a97db61c-en.

Oke C et al (2021) Cities should respond to the biodiversity extinction crisis. npj Urban Sustainability 1: 11. https://doi.org/10.1038/s42949-020-00010-w

Pedaste, M., Mäeots, M., Siiman, L.A., de Jong, T., van Riesen, S.A.N., Kamp, E.T., Manoli, C.C., Zacharia, Z.C., & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational Research Review*, 14, 47–61. http://dx.doi.org/10.1016/j.edurev.2015.02.003.

Rickinson, M., Dillon, J., Teamey, K., Morris, M., Choi, M.Y., Sanders, D., & Benefield. P. (2004). *A Review of Research on Outdoor Learning*. Slough: National Foundation for Educational Research and King's College London.

Soanes K, Lentini PE (2019) When cities are the last chance for saving species. Front Ecol Environ 17:225–231. https://doi.org/10.1002/fee.2032

Spellerberg, I.F. and Gaywood, M.J., 1993. *Linear features: linear habitats & wildlife corridors*. Center for Environmental Sciences.

Spotswood EN et al (2021) The Biological Deserts Fallacy: Cities in their landscapes contribute more than we think to regional biodiversity. Bioscience 71:148–160. https://doi.org/10.1093/biosci/biaa155

Stohlmann, M., Moore, T., & Roehrig, G. (2012). Considerations for Teaching Integrated STEM Education. *Journal of Pre-College Engineering Education Research*, *2*(1), 28–34. https://doi.org/10.5703/1288284314653.

Thomas, J. (2000). *A review of research on project-based learning*. San Rafael, CA: Autodesk Foundation.

Thuneberg, H., Salmi, H., & Fenyvesi, K. (2017). Hands-On Math and Art Exhibition Promoting Science Attitudes and Educational Plans. *Education Research International*, 9132791. https://doi.org/10.1155/2017/9132791.

Titman, W. (1994) *Special Places, Special People: The Hidden Curriculum of School grounds*. Surrey: World Wildlife Fund, UK

Trilling, B., & Fadel, C. (2009). *21st century skills: Learning for life in our times*. San Francisco, CA: Jossey-Bass.

United Nations (2015) 2030 Agenda for sustainable development. https://sdgs.un.org/2030agenda

Wang, H., Moore, T. J., Roehrig, G. H., & Park, M. S. (2011). STEM Integration: Teacher Perceptions and Practice. *Journal of Pre-College Engineering Education Research*, *1*(2), 1–13. https://doi.org/10.5703/1288284314636.

Watson, A.D., & Watson, G.H. (2013). Transitioning STEM to STEAM: reformation of engineering education. *Journal for Quality and Participation*, 36, 1–4.

Yakman, G. (2012). Recognizing the A in STEM Education. *Middle Ground; Westerville*, 16(*1*), 15–16.

Website:

Simpson's biodiversity index (D) http://www.countrysideinfo.co.uk/simpsons.htm