LIVING CITIES

INTEGRATING NATURE INTO THE URBAN LANDSCAPE

Designing Futures 2050
Envisioning the Future

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INTRODUCTION

THE PROBLEM

The accelerating effects of climate change are causing extreme biodiversity loss and ecosystem degradation, particularly in urban areas where dense development disrupts habitats and threaten vital pollinator and keystone species.

This impacts both urban residents and natural ecosystems by reducing green spaces, diminishing air and water quality, and weakening cities' resilience to climate change impacts, like flooding and extreme temperatures.

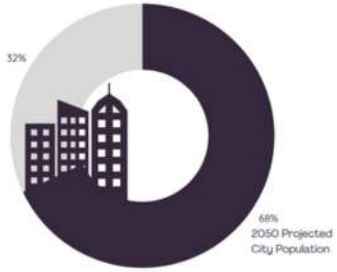
DESIGNING NATURE-FIRST CITIES

To address these challenges, I envision a future that redefines the relationship between nature and urban environments at a fundamental level. By integrating bio-based and nature inspired technologies and empowering residents to become active stewards of their local environments we can create resilient, biodiverse cities that support both humans and the natural world.

By empowering urban residents to actively participate in conservation and restoration efforts, cities could become more resilient and biodiverse, fostering a sense of collective environmental responsibility among communities.

WHY DOES URBAN BIODIVERSITY MATTER?

BIODIVERSITY is the variety and abundance of life on earth. In urban areas, biodiversity is concentrated in green and blue spaces like parks, gardens, and rivers. A healthy urban ecosystem contributes to important **ecosystem services** like **air purification, temperature control, and climate resilience**. Factors like **habitat fragmentation** and **excessive land use** mean that urban areas generally have lower biodiversity than natural environments. Increasing urbanisation exacerbates this issue, particularly in low- and middle-income countries that lack infrastructure and sustainability initiatives. By 2050, 68% of the global population is expected to live in cities, with only 40% of the necessary infrastructure currently built. Cities also contribute disproportionately to climate change and are the source of between 50 to 70 per cent of global greenhouse gas emissions. (Powers and Jetz, 2023) (Southeast Asia Biodiversity Research Group, 2023)



Suburban housing, Las Vegas, Navada (Britannica, 2024)

URBAN SPRAWL is the unplanned and uncontrolled spread of urban and suburban development into rural areas, and is characterized by **low density development, inefficient resources use,** and **increased car dependency.** This leads to increased greenhouse gas emissions, social challenges, environmental degradation and the fragmentation and loss of vital habitats and ecosystems.

Integrating biodiversity-friendly urban planning, like green infrastructure and efficient land use, can mitigate these impacts and promote resilient cities that accommodate the predicted urban population growth. (Yale University, 2024) (Nature Education, 2024).

CHALLENGES FACED BY URBAN ECOSYSTEMS

URBAN BIODIVERSITY LOSS is driven primarily by **destructive human activity** and **unsustainable resource use**. Changing environmental conditions like rising temperatures and extreme weather events disrupt urban ecosystems and make habitats less suitable for the flora and fauna that belong there (LibreTexts Biology, 2024).

Rising urban temperatures are intensified by the **URBAN HEAT ISLAND EFFECT (UHI)**, where modern infrastructure like black pavements and dense buildings retain heat, and by **"Waste heat"** produced by the constant burning of energy from cars and industries. This **degrades habitats, increase energy consumption, and reduce air quality** (Copernicus Climate Change Service, n.d.).

Downtown New York, example of an UHI (National Geographic, n.d.)

The increased energy consumption for cooling required to combat rising temperatures further exasperated the problem. In contrast, natural landscapes and traditional architecture can effectively control temperatures, either by reflecting heat or by natural cooling through transpiration from greenery (Jim and Chen, 2017) (World Economic Forum, 2023).

Declining keystone species populations trigger ecological imbalance, disrupting essential ecosystem services like pollination, air and water purification, and climate regulation. As these services deteriorate, urban residents face **increased risks of flooding, heat waves, food insecurity, and diminished quality of life**.

SUSTAINABLE URBAN SOLUTIONS

LEGISLATION & POLICY

Governments play a crucial role in promoting urban biodiversity through regulations and legislation that encourage sustainable practices and protect natural areas.

CARBON REMOVAL

Reducing carbon emissions and removing existing carbon dioxide from the atmosphere are crucial for mitigating climate change impacts on biodiversity. Carbon removal strategies like **carbon capture and storage** (CCS), **reforestation**, and **direct air capture** are used to prevent or offset emissions.

Sanya Mangrove Park "sponge city" project, China

GREEN-BLUE INFRASTRUCTURE

Integrating green spaces and water management systems, provides habitats, like **sponge cities**, strengthens ecosystems, reducing flood risks, and mitigates climate change.

NATURE-INSPIRED SOLUTIONS

PASSIVE TEMPERATURE REGULATION

Natural structures, like **termite mounds**, effectively regulate temperature by maintaining stable internal temperatures despite fluctuating external conditions through a network of intricate airflow channels. This principle has inspired passive cooling systems in architecture, reducing reliance on energy-intensive air conditioning.

The thermal properties of **terracotta clay**, allow it to absorb moisture and releases it slowly, which helps regulate temperature in its surroundings. It has been used traditionally in natural refrigeration and can be applied to passive cooling systems, that help to reduce heat island effects in cities (Red Dot, 2024).

STORMWATER MANAGEMENT

Systems like rainwater harvesting and Sustainable Urban Drainage combat flooding and conserve water, supporting biodiversity and reducing water pollution from urban runoff.

CONNECTING FRAGMENTED HABITATS

Innovative solutions like 3D printed biomaterials used to create modular urban habitats can support urban ecosystems. These habitats can be strategically placed to create corridors and stepping stones for wildlife, enabling movement and genetic exchange between isolated populations.

AIR QUALITY IMPROVEMENT

Moss and lichens can sequester carbon and filter pollutants from the air. Moss has a dense surface area that can filter carbon dioxide and pollutants more efficiently than many other plants. It can also be used to monitor pollution levels in urban environments. This provides a natural, cost-effective way to improve air quality in cities.

3D Printed "living" Biomaterial Reef (Urban Reef, 2023)

Moss-based Air Filters (CORDIS, 2024a)

WHAT DRIVES HUMAN CONNECTION WITH NATURE?

Since the key to designing for long-lasting change is to implement solutions that people can easily adapt to, primary research methods were used to gain a deeper understanding of **urban residents' perspectives and experiences with biodiversity**. This provided insights into individual behaviours and cultural attitudes towards urban biodiversity conservation.

In-depth interviews with a variety of experts were conducted to gain a deeper understanding of the topic.

ELIZABETH GABBETT, LECTURER IN ECOLOGY

The interview focused on public engagement in biodiversity conservation, like rewilding green spaces and promoting less active forms of conservation.

DR. YVONNE RYAN-FOGARTY, PROFESSOR OF ENVIRONMENTAL SCIENCE

Explored the impact of urban development on biodiversity and the potential of nature-based solutions.

LIAM MURPHY, HEAD CITY GARDENER

The interview provided insights from a practitioner's perspective. Discussed balancing aesthetics with biodiversity and the need for public education.

CATHERINE O'SULLIVAN, CITIZEN GARDENER

Discussed personal experiences with gardening, exploring motivations, challenges, and the benefits of community gardening initiatives.

KEY INSIGHTS

TAILORED NATURE-BASED SOLUTIONS

Since biodiversity varies so much between cities, one strategy can't work for every city. Solutions like improved stormwater management, climate-adaptive drainage, and habitat creation need to be customized to each city's unique ecosystem and biodiversity profile.

SIMPLIFIED CONSERVATION PARTICIPATION

Off-the-shelf solutions, reduced-maintenance green roofs, and lightweight green infrastructure options encourage community involvement by minimizing the burden of upkeep.

ENCOURAGING ACTIVE PARTICIPATION

People are more inclined to support conservation efforts for charismatic species. Conservation minded citizens prefer active involvement with tangible results, like gardening or cleaning to having to wait for results, like with rewilding initiatives.

PUBLIC AWARENESS AND ENGAGEMENT

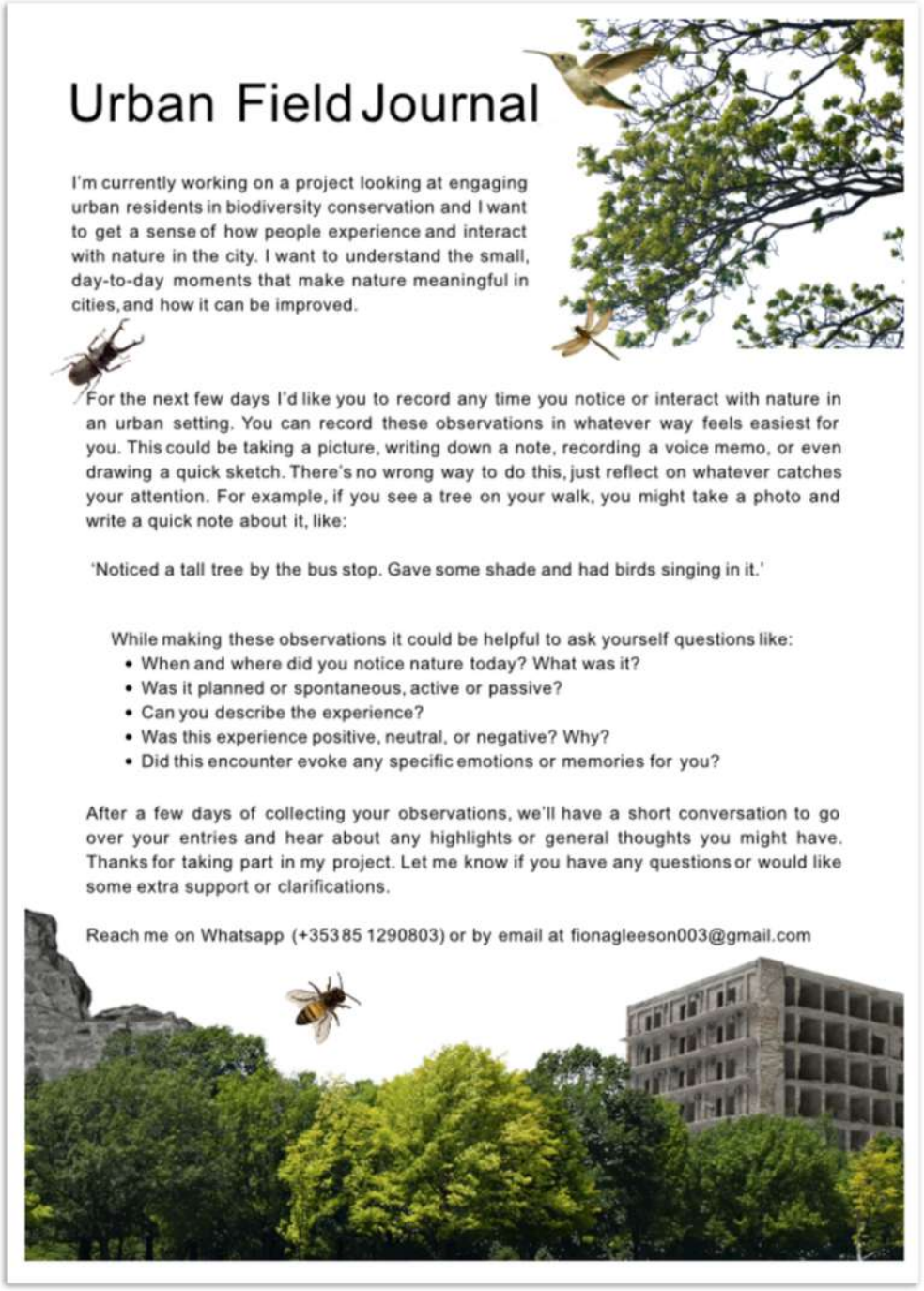
Educating residents on how urban development impacts biodiversity can motivate action and bridge the gap between awareness and actual conservation engagement.

HUMAN-CENTRIC PERSPECTIVE ON GOVERNMENT POLICY

While biodiversity conservation should not center solely on human needs, an anthropogenic approach can be the best way to engage policy makers.

BENEFITS OF GREEN AND BLUE SPACES

Access to green and blue spaces supports residents' mental and physical health. Features like green walls, trees, and roof gardens can create habitats and increase biodiversity.



Urban Field Journal

I'm currently working on a project looking at engaging urban residents in biodiversity conservation and I want to get a sense of how people experience and interact with nature in the city. I want to understand the small, day-to-day moments that make nature meaningful in cities, and how it can be improved.

For the next few days I'd like you to record any time you notice or interact with nature in an urban setting. You can record these observations in whatever way feels easiest for you. This could be taking a picture, writing down a note, recording a voice memo, or even drawing a quick sketch. There's no wrong way to do this, just reflect on whatever catches your attention. For example, if you see a tree on your walk, you might take a photo and write a quick note about it, like:

'Noticed a tall tree by the bus stop. Gave some shade and had birds singing in it.'

While making these observations it could be helpful to ask yourself questions like:

- When and where did you notice nature today? What was it?
- Was it planned or spontaneous, active or passive?
- Can you describe the experience?
- Was this experience positive, neutral, or negative? Why?
- Did this encounter evoke any specific emotions or memories for you?

After a few days of collecting your observations, we'll have a short conversation to go over your entries and hear about any highlights or general thoughts you might have. Thanks for taking part in my project. Let me know if you have any questions or would like some extra support or clarifications.

Reach me on Whatsapp (+353 85 1290803) or by email at fionagleeson003@gmail.com

A **cultural probe** and follow-up interviews, aimed to gain a deeper understanding of urban residents' thoughts, perspectives, and experiences of the nature they encountered throughout their daily routines. For this, 6 participants were asked to document any interaction they had with nature and explain what the interaction meant to them. This approach encouraged spontaneous reflection and personal storytelling.

This people-centred approach allowed the research to find deeper personal insights into how urban residents perceive and interact with nature, revealing individual **motivations, challenges**, and the role of **social and cultural factors** in shaping attitudes towards conservation.

HUMAN-NATURE CONNECTION: The psychological, sensory, and emotional bonds between humans and the natural environment. Proximity to and interaction with nature enhance well-being and inspire environmental responsibility.

POWER OF COLLECTIVE ACTION: Social influence and community engagement influence how people engage with biodiversity and can bridge the gap between awareness and action.

CULTURE, AESTHETIC, & ENGAGEMENT: People's perceptions of nature impact how they engage with biodiversity. Aesthetic preferences and cultural traditions influence their perceptions.

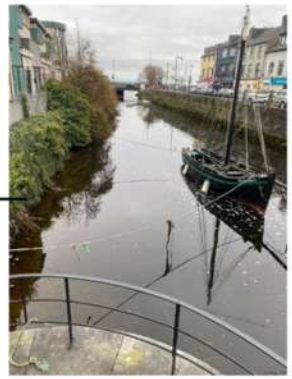
URBAN BARRIERS & OPPORTUNITIES: Urban settings have specific constraints, like limited space and resource, but also a large potential for innovation.

CLIMATE & ECOLOGICAL ESSENTIALS: There is an urgent need to address climate change and biodiversity loss.

Photographs collected from the cultural probe, highlighting urban residents relationship with nature.

Peaceful scene by the water contrasts from the busy city center

Wilder, more diverse greenery next to the water



Spontaneous interactions with wildlife

Finding nature in surprising places

DESIGN FOCUS

Bridge the gap between residents' emotional connection with nature and their active participation in conservation, by addressing aesthetic, cultural, and technological barriers, to leverage urban systems to create opportunities for urban biodiversity restoration.

Grounding design solutions in an understanding of the human experience can create a future where urban environments flourish as vibrant, resilient, and biodiverse ecosystems. This research provides a foundation for developing innovative design solutions that address the challenges of urban biodiversity loss. By prioritizing human experiences and leveraging urban innovation, we can create cities that are sustainable, equitable, and thriving hubs of biodiversity.

ENVISIONING THE FUTURE

As cities grow, the way they are built and expanded is having serious effects on biodiversity and climate resilience. But what if we could change direction? Imagine a future where urban life and the natural world don't just coexist but **thrive together**. To do this, we need to do more than simple "green" our cities, and instead to rethink the **relationship between nature and urban environments** at a fundamental level.

In this future, nature isn't just added as decoration—it's at the core of how we design and build our cities. This vision transforms urban spaces into environments that **improve human well-being, restore biodiversity**, and meet key **Sustainable Development Goals**.

This future can't be accieved over night, but by implementing some of the following changes, we can work to reach it by 2050.

MEETING SUSTAINABLE DEVELOPMENT GOALS

SDG 11 - Sustainable Cities and Communities

The envisioned future addresses the need for sustainable and resilient urban environments by integrating nature into urban design and promoting citizen engagement.

SDG 13 - Climate Action

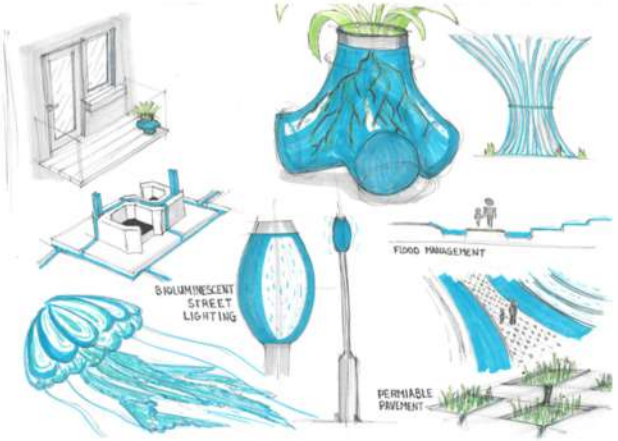
Nature-based solutions for passive cooling, stormwater management, and carbon sequestration help to mitigate the effects of climate change.

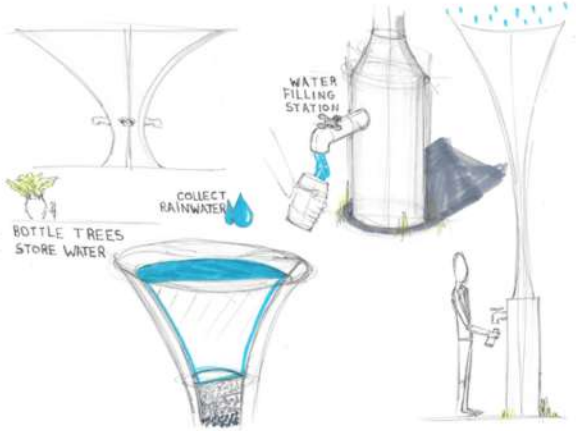
SDG 15 - Life on Land

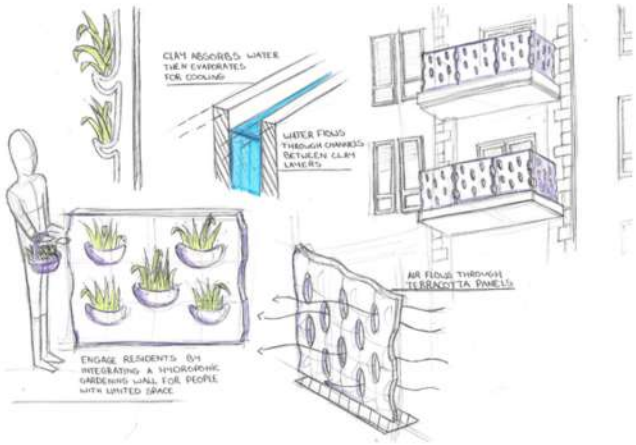
Fostering urban biodiversity by restoring habitats and reconnecting fragmented ecosystems promotes sustainable land use and supports plant and animal life on land.

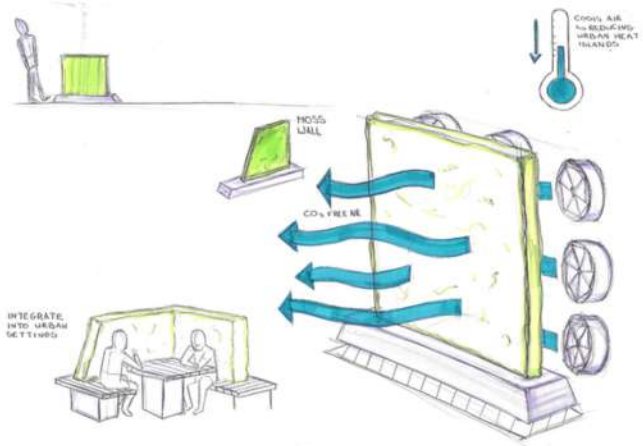
SDG 3 - Good Health and Well-Being

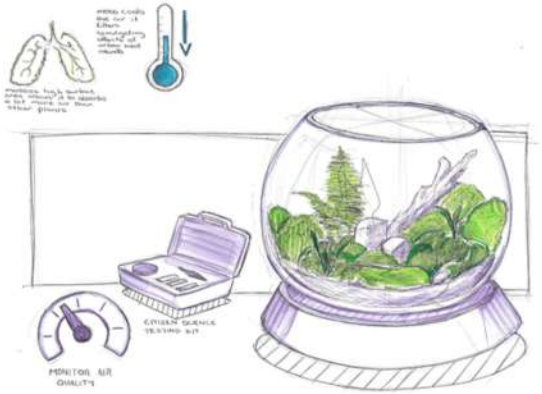
The state of our environment has a huge impact on human well-being. Improving air and water quality, providing access to green spaces, and promoting active engagement with nature have.

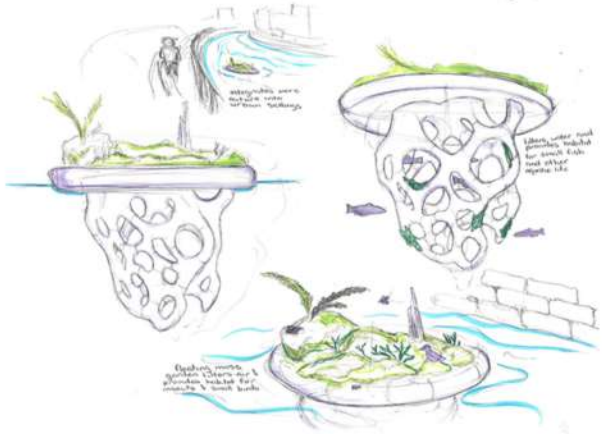


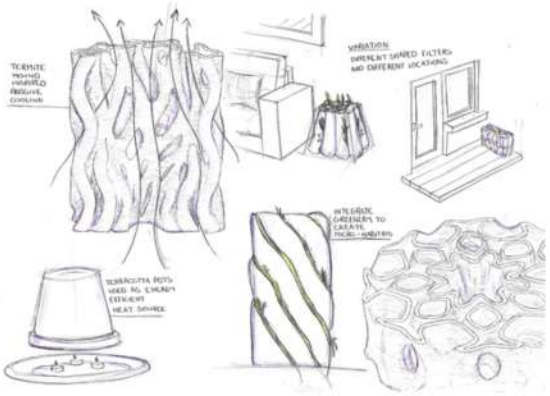












IDEA GENERATION

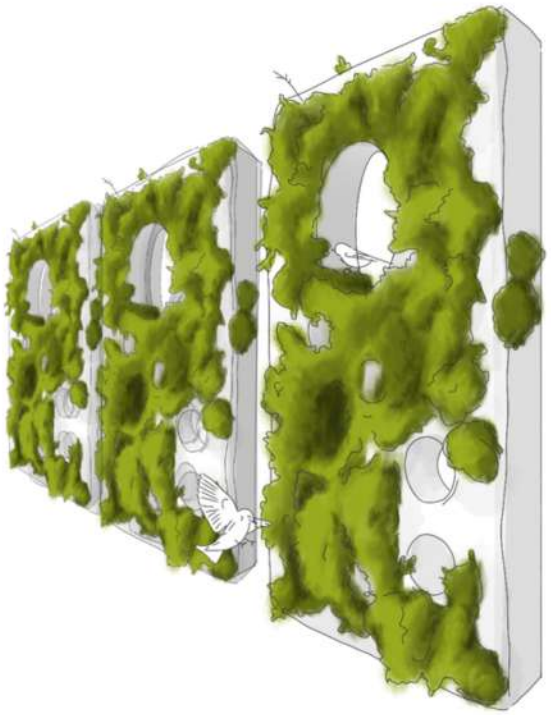
A variety of concepts were explored to find ways of meeting this vision of the future.

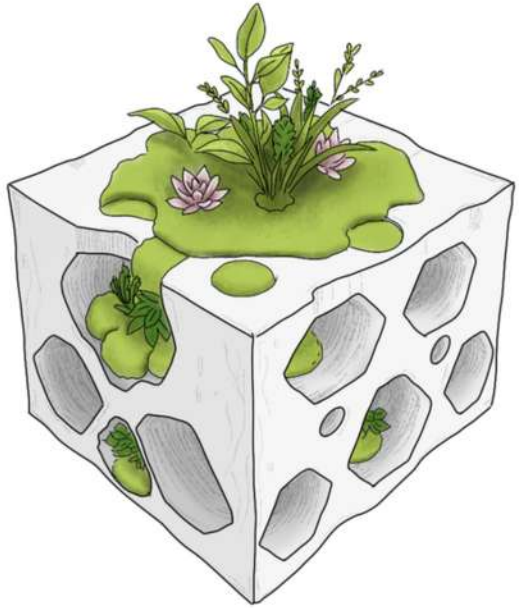
ACTIVE PARTICIPATION WITH NATURE

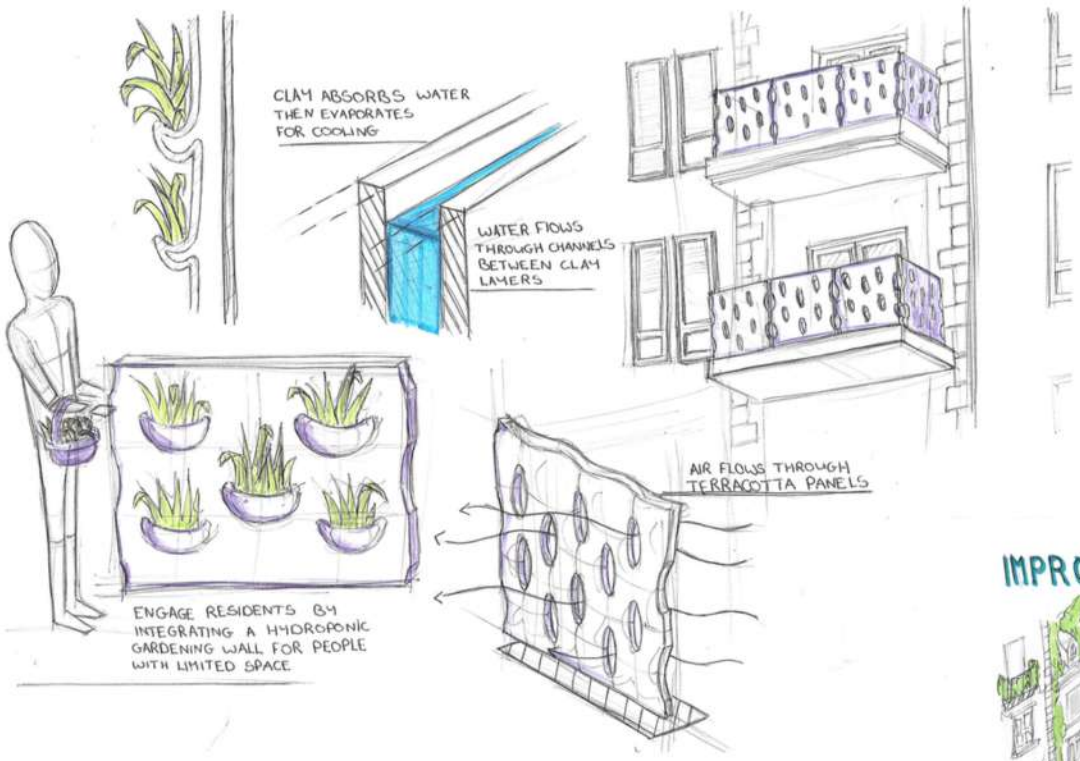
In this vision, urban residents have **hands-on** experiences with nature in their day-to-day lives. As you walk through each neighbourhood, you see the residents **culture, creativity**, and **personal touches** have shaped their surroundings. Some areas may focus on **community gardens** for growing herbs or vegetables, while others grow flowers and cultivate **green facades** and spaces that provide habitats and decorate their surroundings. **Educational** programs teach people to grow native plants, monitor pollinators, and care for the environment.

RESTORING BIODIVERSITY

Imagine the sounds of running water, bees buzzing and birds chirping in their nests as you pass through the city. In this future, cities **reconnect fragmented ecosystems** with green corridors, vertical forests, and rooftop habitats. Urban planning ensures that native plants and animals thrive alongside human developments. Parks are reimagined as biodiverse havens, supporting flora and fauna while enhancing residents' connection to nature.







PASSIVE CARBON FILTRATION

Picture walls covered in moss and other vegetation that **clean the air** as you walk by, without the need for extensive maintenance. Streams run clean through parks, lined with lush plants that act as natural carbon filters. **Moss walls, urban forests, and plant-covered facades filter pollutants and absorb carbon dioxide.** Stations are found dispersed around the city where moss is tested to monitor air quality.

PASSIVE COOLING

Picture a city with lush, green rooftops and walls, shaded walkways, and bright buildings that reflect heat. Urban architecture will take inspiration from natural systems to stay cool **without relying heavily on energy-intensive air conditioning**. Green roofs and walls, and reflective surfaces will prevent the urban landscape from absorbing too much heat. **Nature-inspired solutions**, like vents inspired by termite mounds and natural materials like terracotta clay, will **improve airflow** and **insulation**.

VISION OF THE FUTURE

BIO-MATERIALS

Sustainable, nature-based materials like moss or mycelium are used to form modular habitats that support urban ecosystems and create stepping-stones for wildlife.

PASSIVE COOLING

Nature-inspired designs that regulate temperatures without energy-intensive systems, reducing emissions and making cities more comfortable.

HABITAT STEPPING-STONES

Small, strategically placed green features connect larger habitats, allowing wildlife to move freely and thrive in urban environments.

PERMEABLE PAVEMENTS

Surfaces allow water to filter through, reducing urban flooding and pollution from runoff.

ACTIVE PARTICIPATION

Community-driven initiatives, like gardening or monitoring local ecosystems, engage people in nurturing biodiversity.

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