Nature in Urban Planning for Better Human Health

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Acknowledgements

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Introduction

By Jennifer Egan, Ph.D.

Urban planning, public health, and nature are intricately connected. Research documenting the positive associations between human health and urban forests, as well as nearby nature experiences in parks, gardens, and streetscapes has greatly expanded in recent years. Studies show that exposure to natural environments reduces stress, improves mental health, increases social cohesion, and promotes physical activity. Recent studies also indicate that trees and green spaces are unevenly distributed across urban areas, contributing to health disparities.

Understanding the specific elements of nature experiences and their health benefits is crucial for tailoring urban planning efforts to meet health goals. Current planning guidance for nature-based human health primarily focuses on access to parks. Professional planning processes and frameworks typically do not incorporate the detailed extent of the linkages between nearby nature and health outcomes.

To address this gap, the University of Maryland Environmental Finance Center, in partnership with the American Planning Association and the University of Washington, was funded by the *US Forest Service National Forest Resiliency Innovation Challenge Cost Share Grant Program* to help translate the health benefits of nearby nature to planning practices. The resulting *Nature in Urban Planning for Better Human Health* guide provides a roadmap to incorporate nearby nature into the planning process to promote health and create vibrant urban living spaces. It provides guidance to treat nearby nature as a comprehensive system, including trees, parks, and natural areas; to promote equitable nature access; and to support physical, mental, and social wellbeing for all residents. Using evidence from the literature and case stories, this guide will help planners align their efforts with public health priorities and establish goals that maximize the benefits of natural assets. It shows how planners can carefully consider nature as part of an urban system in order to design environments that enhance residents' interactions with nature and improve overall health outcomes.

Chapter 1 of the guide provides the background and growing body of evidence that proximity to nature has a positive impact on human health – both in terms of general wellness and as therapy or treatment for illness and disease. Chapter 2 builds upon the evidence and presents pathways and mechanisms for how nature can influence health outcomes. Chapter 3 introduces plan-making and describes how public engagement, data collection and goal envisioning, and cross-sector collaboration and partnerships are integral to successfully incorporating nature into all plans within a community. Chapter 4 focuses on how to translate the research in planning to nature-based systems within cities and communities. It discusses the nature experience elements and principles of "activating elements" such as dosage and sound that influence

residents' well-being, providing guidance and case story examples on how to incorporate greening into city planning. Perceptual and experiential aspects of urban nature, such as wayfinding, spatial definition, and safety considerations, are described in Chapter 5, providing valuable insights to creating environments that are inclusive and supportive of diverse needs. Finally, Chapter 6 focuses on the implementation of community plans. It describes how public land use, development regulations, and economic approaches such as incentives can be used to attract public and private capital to fund, preserve, and expand urban green spaces.

Chapter 1: Planning, Health, and Nature

By Kathleen L. Wolf, Ph.D.

The U.S. has become increasingly urbanized with ever greater proportions of people living in cities and higher-density settings. By 2050, 67 percent of the world's population will live in urban areas (UNDESA, 2018). While cities are important places of production, economic activity, and innovation, they also face challenges of "urban externalities" such as air and water pollution, congestion, and rapid communicable disease spread—all of which cause health complications (Sachs, 2015). Growing research literature indicates that green space in urban landscapes counters many public health issues and generates benefits to human health and wellness (Sundermann et al., 2023). Despite a growing appreciation for the importance of how urban green space impacts human health and wellness, the inextricable connection between health and nature in cities has not been sufficiently realized and integrated into urban planning practices.

Planning efforts of the past resulted in the deconstruction of ecosystems in urban areas, generating fragmented small reserves and leftover spaces. Likewise, public initiatives for parks creation and tree planting, with some exceptions, were often opportunistic—located where land was donated or in wealthier areas—and executed without a master plan. In addition, disadvantaged communities often have fewer amenities and services due to historic discriminatory practices and power dynamics (Nesbitt & Quinton, 2023). Historic legacies now mean that nature-based public amenities, such as parks and trees, are often unequally distributed across many urban areas. Today, urban planning policies and practices are rapidly evolving to address historic and structural inequities, including the vital role of nature for all in cities.

In a similar arc of changing perceptions about nature's influence on human health in cities, the role of environmental health is shifting. Environmental health—a sector within public health that explores the relationship between the natural environment and human well-being—is closely linked to the field of planning. Planners play a vital role in safeguarding environmental health by ensuring individuals have access to uncontaminated air, water, and soil. A more balanced perspective of environmental health focuses not only on eliminating toxins, but also embracing the potential for nearby nature to benefit human health and wellness (Frumkin, 2001; Antonelli et al., 2022). The Biophilic Cities concept (Box 1) strategizes how nature can be incorporated into planning to enhance the well-being of residents and the ecological sustainability of a city.

Mounting evidence suggests that place- and nature-based systems serve a variety of critical functions in cities. Urban green spaces, parks, and trees are part of an organic infrastructure system that merits full planning attention—elevated to the status of other essential city systems and infrastructure such as transportation and utilities. Nature-based solutions, in place of or in addition to costly "gray" infrastructure, are promising ways to address some of the most

***Box 1.* Biophilic Cities**

The concept of biophilic cities is based on the idea of biophilia, which is the innate human tendency to connect with nature and other forms of life. Biophilic cities are designed to foster a strong sense of connection between urban dwellers and the natural world, recognizing the importance of nature in enhancing quality of life, reducing stress, and promoting overall health and happiness.

In biophilic cities, urban planning and architecture prioritize the integration of green spaces, parks, gardens, and natural habitats within the urban environment. These cities often invest in creating urban forests, green roofs, vertical gardens, and accessible public parks. Biophilic design principles are applied to buildings, streets, and public spaces, incorporating natural light, ventilation, and materials to create a more harmonious relationship between the built environment and nature.

Additionally, biophilic cities encourage biodiversity conservation, promote environmental education, and engage citizens in activities that reconnect them with the natural world. The aim is to create urban environments that support the physical, mental, and emotional well-being of residents while also promoting environmental sustainability and ecological resilience. For more information, go to the Biophilic Cities website.

persistent problems of urban resource management. These creative methods are becoming a cornerstone of programs aimed at urban sustainability and resilience. For example, green stormwater infrastructure innovations are being broadly implemented as complementary facilities to traditional drain and pipe systems to ease the burden of stormwater runoff entering a gray system. Additionally, reestablishing flood zones by reconnecting the land with water bodies has been used to reduce flooding and storm damage while also providing aesthetic improvements and recreational space (Figure 1).

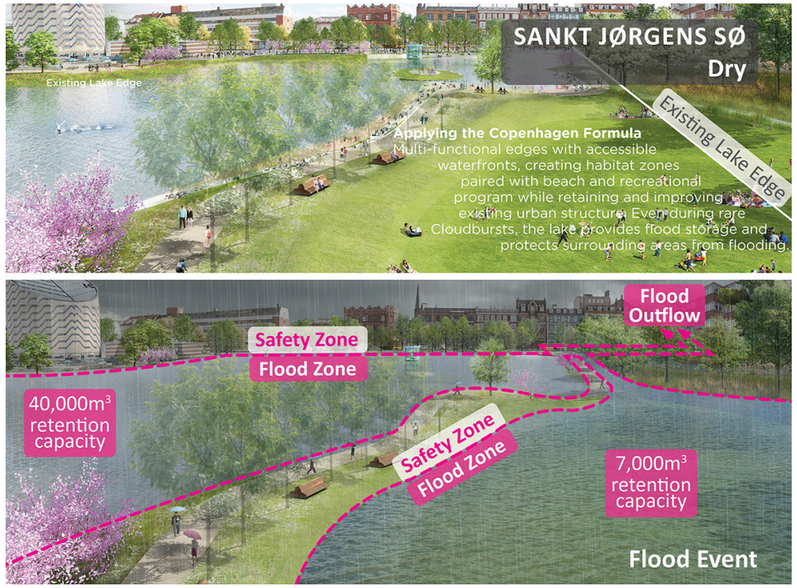


Figure 1.
Sankt Jørgens, Copenhagen, Denmark waterfront design. Reconnecting land with waterbodies through multifunctional edges creates spaces that provide habitat, recreation, and flood protection (Source: Ramboll & Ramboll Studio Dreiseitl, 2016).

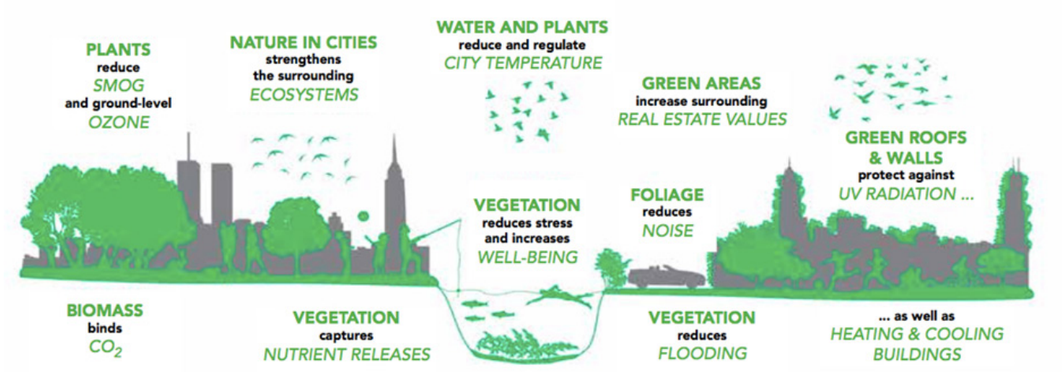


Figure 2.
Examples of ecosystem services provided by natural systems in the urban setting (Source: C/O City, 2020).

Natural systems are uniquely adaptive and can generate many co-benefits, or "ecosystem services" (Figure 2). Ecosystem services describe the various direct and indirect benefits that nature provides to humans and communities. These include opportunities to grow food, improve air quality, mitigate heat island effects, buffer noise, provide recreation, control flooding, and more. Placing green and blue spaces close to where people live and work creates ecosystem services that improve health and quality of life. This guide advocates expanding such services using a "systems approach" to employ nearby nature as a comprehensive component within planning processes. Using this approach can generate advantages that support communities, promote health, address equity, and create high-quality urban living spaces.

Extensive scientific evidence demonstrates that nature exposure in cities positively influences mental, physical, and social well-being—promoting relaxation, reducing stress, and fostering better community interactions. A holistic planning view integrates various city functions and highlights how nature exposure influences human health through physical and mental states, behaviors, and community-level impacts. This guide provides those working in the planning sector with evidence and strategies to more concretely develop plans that include evidence-based design for nature and health.

Chapter 2: Nature and Health Evidence

By Kathleen L. Wolf, Ph.D.

Scientific evidence connecting nature and health has expanded rapidly in recent decades. Early studies indicated mental, physical, and social benefits from nature experience. More recent studies confirm these general findings and point to more specific response patterns. Interpretations by medical providers, public health officials, and researchers have begun to identify pathways to health outcomes. The specific elements of a nature experience, and the moderating states and behaviors that contribute to health outcomes, are now better understood. These mediating conditions and behaviors are the focus of new studies so that planning and programs for nature implementation can be better tailored to local and community contexts, including prevalent health challenges such as healthcare costs. Box 2 explains how exposure to nature may help mitigate healthcare expenses though improving human health.

Box 2. **Economics of Nature and Health**

Annual U.S. healthcare expenditures exceed those of most other developed nations, yet the health of many Americans is of lower quality. National healthcare expenditures grew 4.1% to $4.5 trillion in 2022, or $13,493 per person, and accounted for 17.3% of the nation's Gross Domestic Product (Center for Medicare and Medicaid, 2023). Addressing neighborhood and built environment factors to promote cost-effective healthcare is drawing increasing interest from public health officials and the healthcare industry (Fisher et al., 2021). The extensive research on nature and health in cities highlights nature exposure as a vital social determinant of health, potentially lowering healthcare costs (Chi et al., 2022; Van Den Edden et al., 2022). Several recent articles highlight the economic benefits of nature experiences, drawing on patient healthcare and Medicare data (Becker & Browning, 2021). These benefits are linked to improved health and longevity and reductions in the use of medications. Although environmental economics has assessed the health benefits of urban green spaces, public health economics has largely overlooked this.

2.A. Evidence Overview

The social determinants of health include the conditions in which people are born, grow, live, work, and age. They play a crucial role in shaping health outcomes (Figure 3). The World Health Organization defines social determinants of health as the non-medical factors that influence health outcomes: the conditions and systems that shape daily life (WHO, 2024). Determinants include access to quality housing, employment, education, and outdoor environments. Some versions do not include, or do not clearly identify, nature and green space as a determinant of health (Braveman, et al., 2011; USHHS, n.d.). Other versions expand the definition of the "environment" that influences health to include nature (e.g., Barton & Grant, 2006 "Health Map").

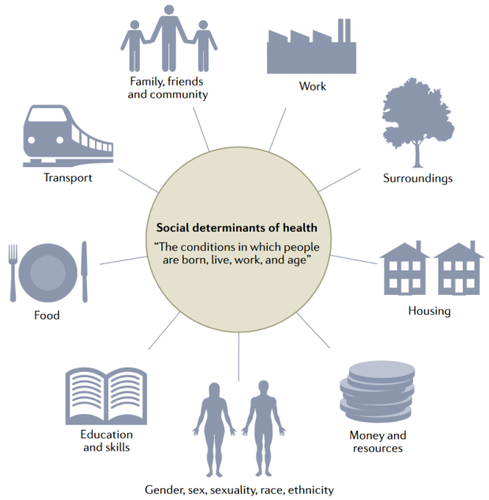


Figure 3.
Social determinants of health (Source: Dobson et al., 2022).

Community responses during the 2020 pandemic heightened recognition of the importance of nature in communities. Challenges in the U.S. healthcare system were featured in headlines, and the pandemic highlighted the indirect influences of nature on physical wellness and mental well-being. Widespread demand for access to outdoor spaces confirmed the importance of nature exposure, especially for mental health and restorative experiences. Cities responded remarkably fast to expand outdoor access, creating Open Streets (the partial or complete restriction of vehicles in neighborhood streets), repurposing parking spaces for outdoor micro-parks and dining within commercial districts, and increasing parks programming. Injustices were also exposed, as pre-existing health disparities and inequitable access to nature restricted the opportunities for some people to enjoy outdoor space (Larson et al., 2021).

While the relationship between nature experiences and health has been felt intuitively by people for centuries, the evidence has been building for more than 40 years, with a surge in publication happening within the past decade. Studies ranging from the national to neighborhood scale, have been conducted in nations around the world, and employ a wide range of research designs and methods (Wolf et al., 2020).

Early research revealed broad associations between the presence of nature (such as tree canopies and parks) and public health trends, including benefits for underserved communities (Mitchell & Popham, 2008; Wells, 2021). More recent research delves into the specifics of nature experience such as dosage (Hunter et al., 2019; White et al., 2019; Meredith et al., 2020), gender specificity (Richardson & Mitchell, 2010; Sillman et al., 2022), and nature encounters or experiences such as forest therapy (Rajoo et al., 2020; Antonelli et al., 2021; Stier-Jarmer et al., 2021). In addition to investigating influences on general health and wellness, studies also assess how nature-based interventions can be used in treatment of clinical illness and disorders such as depression (Berman et al., 2012) or attention deficit disorders (Donovan et al., 2019; Thygesen et al., 2019; Yang et al., 2019).

While some studies address benefits of time in wilderness, such as hiking and camping, this guide focuses on nearby nature experiences—that is, the encounters of even small bits of nature near one's home or within one's community. This guide also focuses on the community level or citywide scale of health reporting, often represented by cross-sectional studies or natural experiments. Scientific reviews and peer-reviewed publications report that nearby nature offers a wide array of health benefits. Some examples include:

- Exposure to natural environments is associated with stress reduction, measured using physiological indicators such as salivary cortisol levels, blood pressure, and heart rate variability for adults. *(31 studies – Yao et al., 2021).*
- Forest-based interventions (such as forest therapy/bathing) generated beneficial therapeutic effects in adults for hypertension, stress, and mental health disorders, such as depression and anxiety. *(131 studies – Stier-Jarmer et al., 2021).*
- Confirming similar physiological outcomes, forest exposure is related to positive mental and emotional responses, including improvements on indicators of anger, confusion, depression, fatigue, and vigor. *(40 studies – Cheng et al., 2021).*
- Effects of nature exposure on immune system health include positive anti-inflammatory, anti-allergy, and anti-asthma outcomes, as well as increased NK (natural killer) cell activity. *(33 studies – Andersen et al., 2021).*
- Addressing childhood mental health and development, satellite measures of the type and density of vegetation within buffers of 100, 250, and 500 meters were positively related to emotional and behavioral well-being. *(45 studies – Davis et al., 2021).*
- Studies also show that green space can be used to advance health equity. Lower socioeconomic status groups experience more beneficial effects than affluent populations and, generally, public green spaces and parks are more beneficial than general tree or vegetation cover. Health protective effects are similar across racial/ethnic groups. *(90 studies – Rigolon et al., 2021).*

2.B. Evidence Pathways

Nature-based aesthetics and beautification are widely recognized by urban residents as an element of good quality of life. Some people may recognize the restorative or healing potential of nature experiences, but the public often attributes such benefits to nature experiences away from and outside the city (Lindland et al., 2017). Even so, brief encounters with nature within one's community generate substantial benefits.

Representing thousands of studies, Figure 4 outlines generally accepted pathways of physical/mental states and behavioral responses that lead to positive health outcomes. In other words, there are subtle changes in body and mind as we spend time in nature—some we may sense, and others are below consciousness. None of the pathways are a total solution or resolution of health challenges. There are many other social determinants of health—from individual behaviors to community conditions and context—yet the presence of nearby nature is an integral influence on wellness and quality of life.

Nature Exposure Elements

There are many potential expressions of nature across the various landscapes within a local government jurisdiction. Horticultural landscapes are introduced in many built settings for aesthetics or land use buffering. Preserved or conserved wild landscapes protect local ecosystems. In other settings, ecological functions

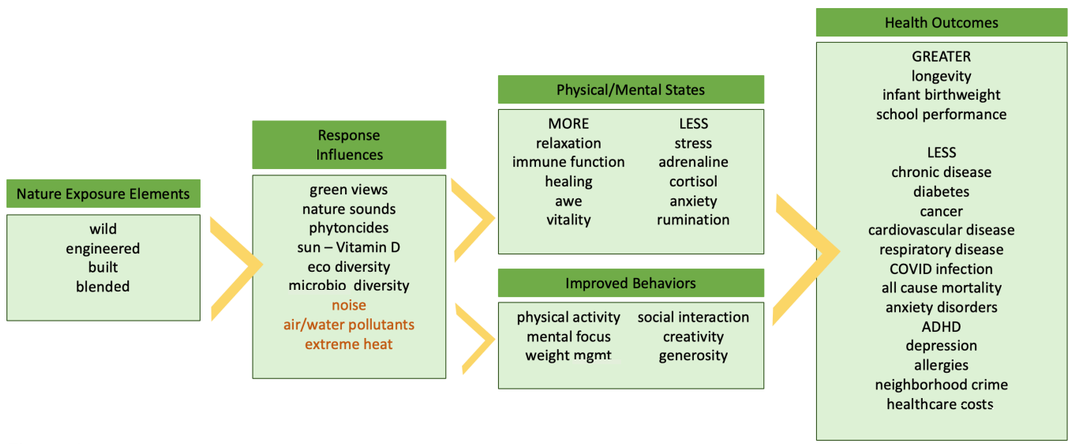


Figure 4.

Nature and health pathways summarized from thousands of research articles reveal the mechanisms of nature and human health response. Exposure to nature elements includes various influences—many positive and some negative (orange text)—that activate response states and behaviors, leading to an array of health outcomes (Adapted from Kuo, 2015; Bratman et al., 2019).

are engineered or constructed to meet regulatory requirements (such as green stormwater infrastructure) or adhere to best planning practices (such as restrictions on developing steep slopes).

Response Influences

A person may experience potential external influences within green or blue spaces in cities. People rely on all their senses to constantly take in information about their environments for low-key evaluations and response. Some inputs, such as noise and the presence of pollutants and excessive heat, may be directly felt and uncomfortable. Countering conditions include pleasant sounds, the body's generation of vitamin D from sun exposure, and the general intake of beneficial soil particles, fresh air, or food that help shape a healthy microbiome. All are subtle yet important influences in connection with the environment.

Physical/Mental States

There are physical and mental conditions and responses that can promote or improve health on their own. They may also lead to additional health benefits. For example, the "more" or "less" of the physical and mental states induced by nature exposure can help elevate positive or diminish negative responses, resulting in greater relaxation and vitality, healing, and even improved immune function. Nature responses also promote states of less stress (revealed by lower cortisol levels), anxiety, and obsession with negative thoughts (termed rumination by psychologists).

Improved Behaviors

Studies show health-affecting behavior changes associated with nature exposure. Higher rates of physical activity are observed with increased access to nature, and exercising in nature has greater benefits than exercising in other settings. Positive effects include reducing chronic disease and improving weight management. Other responses, such as mental focus and creativity, can contribute to success in our everyday lives and influence how we perform in school and work. Public health officials are concerned about how reduced social interactions impact health (Holt-Lunstad, 2015; Bower et al., 2023). Loneliness is associated with mortality rates on par with smoking and chronic alcohol use, and is further related to cardiovascular disease, immune deficiency, and psychological impacts such as depression, suicide, and cognitive decline. Providing community green space is associated with greater social cohesion and social interaction—antidotes to loneliness.

Health Outcomes

Extensive positive health outcomes flow from the pathways of nature exposure, response influences, and health states and behaviors. Nature experiences contribute to health conditions that span the human life cycle, confirming that time with nearby nature is valuable for people of all ages—from infants to elders. For example, nature experiences contribute to greater infant birth weight and longevity as we age. Figure 4 exemplifies the complexity of how our bodies respond to time outdoors. Exposure to external influences initiates internal states and behaviors that reduce the expression of multiple physical diseases, particularly as humans age. Across studies, mental health improvements are some of the most consistent and robust of outcomes. These include reduced depression and anxiety as well as responses that appear to relate to a person's inclination to commit crimes.

Chapter 3: Plan-Making

By Sagar Shah, Ph.D., AICP

Using nature across a city to improve health requires integration with other planning goals. It is often more practical and effective to incorporate health and nature initiatives within the existing frameworks of a local government's mission and goals as established by the local planning process. By aligning these efforts, resources can be optimized to ensure a smoother integration of health and nature initiatives within the community. Figure 5 summarizes the shared priorities of planning and public health, highlighting the importance of nature in achieving these priorities (APA, 2022).

Local plans drive the vision for a community and the interventions to achieve specific goals within that vision. With the increasing understanding of the environmental, social, and health benefits of urban nature systems, the opportunity to explicitly plan for nature to impact the long-term health and well-being of a community has never been more pertinent. When the contribution of natural assets to a community's health is highlighted and integrated into plans, planners demonstrate not only the value of nature, but also a commitment to create a rich nature system in pursuit of a healthier community. This commitment requires planners to embed health and nature into all local plans as a community value that informs decision-making.

Figure 5.
Social, environmental, and economic goals of planning and public health (Source: APA, 2022).

Shared Priorities: Planning and Public Health

Social components, including impacts to community health.

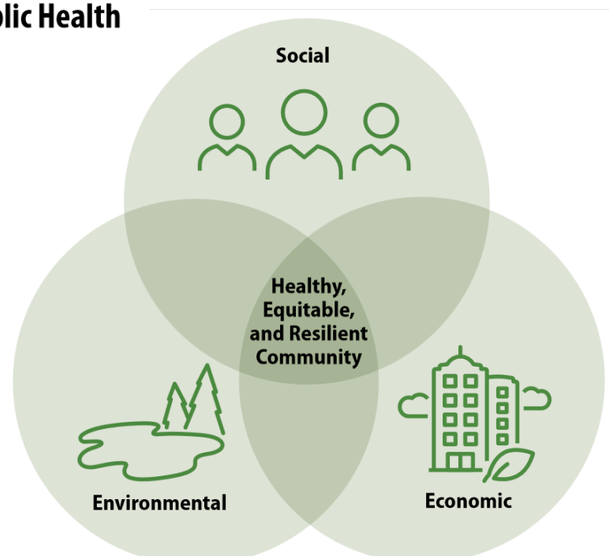
- Public engagement
- Social cohesion
- Safe, affordable housing
- High-quality, affordable education

Environmental components, including the built environment.

- Clean air, water, and soil
- Climate adaptation and mitigation
- Access to parks, trails, and green spaces

Economic components, including activities that lead to prosperity.

- Stable, living wage jobs
- High-quality goods and services
- Economic vitality



3.A. Public Engagement

The connection between public health and nature is often ill-defined and underemphasized within the planning arena. Public engagement is a critical tool for better understanding and characterizing this connection at a local level and bringing nature-based solutions for improved health to the forefront of community conversations. Planners can play a key role in initiating discussions about the value of nature for health-related outcomes. They can help establish a vision based on community needs and priorities and work alongside community members to jointly define baseline health concerns and carry out a sustained agenda to enhance nature systems.

Understanding Existing Conditions

Public engagement is key to understanding a community's needs and establishing a foundation upon which a shared vision can be created. Input from community members can be used to identify what health- or nature-related concerns are a priority, where there are gaps in access to nature (particularly for vulnerable and underrepresented populations), and how health and nature issues converge at a local level.

As planners explore conditions related to access to nature, it is critical that the definition of "access" does not simply refer to the presence of, or proximity to, green space. Social and access barriers, such as perception of safety, traffic, walkability, and quality of green space impact how community members interact with spaces (Sefcik et al., 2019). These barriers differ with age, gender, and other characteristics. Therefore, input from a range of residents is necessary to understand the spectrum of nature experiences and how to create safe, comfortable, and plentiful nature spaces for all.

When paired with data, public engagement can build a strong case for investing in interventions at the nexus of public health and nature to address gaps, such as inequitable distribution of nature and disparate health outcomes. The City of Portland adopted a racial equity approach to planning parks and natural areas in its *Connect with Nature* resource guide (Box 3).

Box 3. **Connect with Nature, Portland, Oregon**

Connect with Nature is a partnership between Metro (Portland's metropolitan planning organization) and community members that seeks to improve how Metro engages with people of color in nature and parks planning. While developing two new nature parks, the partnership used a series of workshops to understand the experiences and values of people of color when it comes to nature, parks, and the outdoors. Through these workshops, planners gained valuable insight into the needs of communities of color and the barriers some people face in accessing nature, such as transportation, lack of information in different languages, and feelings of discomfort or lack of safety in parks or natural areas. This community-led approach offered a launch pad for planning and designing parks and natural areas that met the needs of communities of color and sought to address these access issues (Metro, 2019).

Building Awareness and Support

Planners can facilitate public discussions and use education to generate awareness about the value of nature and its relationship to health. Too often this connection is not explicitly conveyed by planners and may remain unclear or unrecognized among community members. Fostering such an awareness better prepares stakeholders to participate in the planning process and exchange ideas related to health and nature goals.

Further, a shared appreciation of the role of nature in a community's health garners sustained political and civic support for nature-related investments. This support can manifest itself in the form of community ownership and maintenance of natural assets, such as public parks, trees, and gardens. For example, volunteer programs are a vital component of preservation and advocacy efforts related to green space for many cities. The City of Edmonton's Natural Connections Strategic Plan (Box 4) is deeply rooted in stakeholder input and support.

***Box 4.* Natural Connections Strategic Plan, Edmonton, Canada**

The City of Edmonton's Natural Connections Strategic Plan is rooted in strengthening connections between natural areas and people. Connection with people is defined by the formation of community partnerships that empower local stakeholders to cooperatively protect and sustain the city's natural systems. In pursuit of this connection, the City works to engage community partners involved in conservation efforts to enhance information sharing and improve organizational capacity among community members. Educational programs have also been developed with conservation organizations to increase the community's recognition and awareness of the value of the city's natural areas (City of Edmonton, 2007).

3.B. Integrating Nature Within the Plan-Making Process

A typical planning process includes gathering data on existing conditions to create a baseline understanding of the community and establishing goals and objectives to achieve the community's vision. Planners can integrate nature into these steps.

Data Collection for Existing Conditions

Before embarking upon planning for health through nature, planners should begin by understanding the existing conditions related to community health and current access to nature. High-quality data is a critical element for analyzing existing conditions and ensuring that interventions match community needs.

Health and equity priorities are a useful starting point and should be a precursor for linking planning policy to local health issues. Health priorities can be generated at a county level through a Community Health Needs Assessment (CHNA) or Community Health Improvement Plan (CHIP). These resources can be used to identify potential opportunities for nature or green infrastructure to address health needs. However, planners should be cautious not to rely heavily on county (or larger scale) data where health and nature inequities are aggregate measures and not clearly delineated. Community engagement and localized data

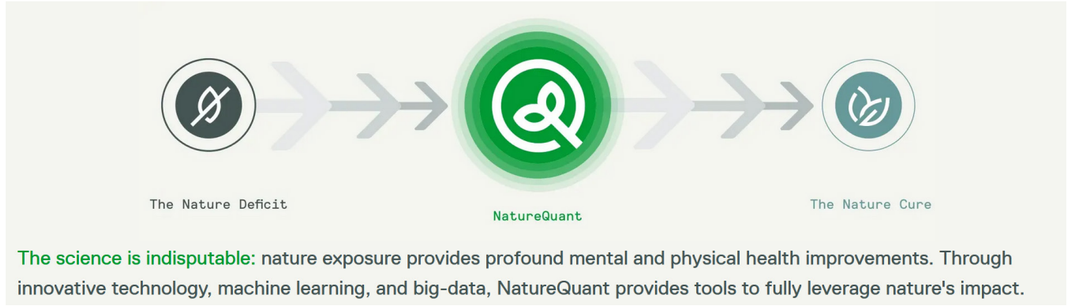


Figure 6.

NatureQuant was formed to create a suite of technologies that enhance the health impact of nature on humanity. NatureQuant's innovative tools quantify the natural elements for a static location (yielding a "NatureScore®") and track an individual's nature exposure over time (providing a "NatureDose®"). The tool offers challenges such as seeing if you can reach a 120 minute NatureDose in one week. For more information, go to the NatureQuant website.

should be used to evaluate community conditions at a more granular level and to better contextualize conditions.

Many tools are available to assess nature conditions and indicators at this level. These tools can also be used to measure conditions over time (Brown & Fink, 2022):

- EPA's EnviroAtlas Analytical Tools Interface for Landscape Assessments GIS toolbox includes landscape characteristic metrics (e.g., percent forest cover, number and size of forest patches) related to population, roads, and the built environment (e.g., population change, road/stream crossings). It also includes metrics related to land cover adjacent to streams and lowlands (e.g., percent of crop land within 30 meters of streams).
- iTree is a suite of free peer-reviewed tree benefits tools from the U.S. Department of Agriculture Forest Service. iTree helps planners observe where tree planting can be prioritized and quantifies forest structure to estimate the environmental benefits trees provide.
- NatureScore is a product of NatureQuant (Figure 6), which analyzes and blends various datasets and processed information within a given radius, including satellite infrared measurements; geographic information systems and land classifications; park data and features; tree canopies; air, noise and light pollution; and computer vision elements.
- ParkScore by the Trust for Public Land ranks 100 of the most populous U.S. cities by comparing five categories: equity, access, investment, amenities, and acreage. This is a way to see how green space may be measured and quantified, providing a methodology for the comparison of green space.

Establishing Goals and Objectives

Interventions to improve human health through nature-based solutions should be a constitutive part of a city's vision rather than serving as a one-off or secondary

goal, as is often current practice. This could be achieved by creating a health or nature element within the comprehensive plan or, better yet, including health and nature considerations across all areas of the plan.

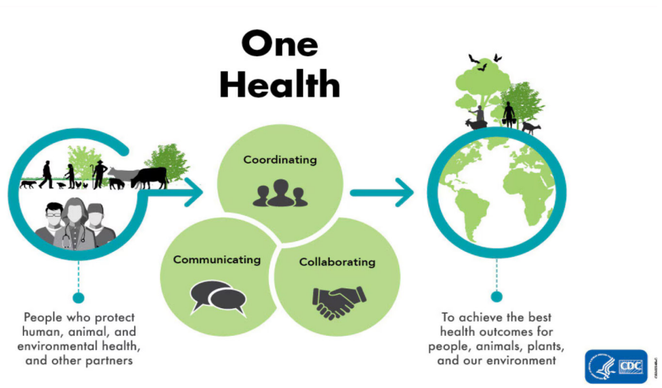
Within the realm of health and nature, a key question among researchers is “how much nature is enough” to yield improved health outcomes. Emerging research shows that the “3-30-300" green space rule improves mental health outcomes, offering an evidence-based goal for cities to work toward. It suggests that every person should see at least three trees from their home, have at least 30 percent tree canopy in their neighborhood, and live no further than 300 meters away from a park or green space (Nieuwenhuijsen, 2022).

3.C. Cross-Sector Collaboration

Planners are already adept at cross-sector collaboration. They are also integral in affecting community health outcomes as part of the planning process. In other words, planners already think and plan for health. What is lacking is a systems approach to nature and health. Addressing health concerns within the context of natural systems requires building new partnerships and collaboration. As described in Box 5, One Health is one such systems approach that can help achieve optimal health outcomes (CDC, n.d.).

***Box 5.* One Health**

One Health is a collaborative and interdisciplinary approach that functions across different scales, ranging from local to global, and engages various sectors. Its aim is to achieve optimal health outcomes by recognizing the complex interconnections among humans, animals, plants, and their shared environment. For more information, go to the CDC website.



Successful collaboration begins with identifying shared community health concerns, determining baseline health in collaboration with health partners, developing shared goals that promote nature and health, and engaging a spectrum of organizations, professionals, and municipal departments when a new opportunity to collaborate arises. Moreover, international and national

organizations have endorsed collaboration between different sectors, noting that partnerships and cross-sectoral cooperation are necessary for efficient regulatory, policy, and strategic implementation (WHO, 2015). Plans should be created in collaboration with other local agencies and organizations, and the strategies identified should highlight the role of cross-sectoral and cross-departmental collaboration to enhance natural systems and work toward healthier communities.

For example, a concerted effort to expand urban forests and tree canopy coverage will have far reaching implications for land use patterns, infrastructure, housing costs, and other considerations, and requires collaboration between these sectors. As such, plans should cross-reference health and nature goals and strategies within various policy areas. A University of Minnesota and Blue Cross Blue Shield collaboration offered guidance for including nature and health strategies in various stages of the urban planning process (Box 6).

***Box 6.* University of Minnesota and Blue Cross Blue Shield of Minnesota**

Opportunities to build cross-sector partnerships and implement new nature and health strategies arise at different stages in urban planning. The University of Minnesota Planning Information Sheet: Integrating Health into Comprehensive Planning and the Design for Health *was a collaboration between the University of Minnesota and Blue Cross and Blue Shield of Minnesota. The guidance was created to “bridge the gap between the emerging research base on community design and healthy living with the every-day realities of local government planning” (UMN, 2007). It offers recommended stages to link nature and health:*

1. *A plan update;*
2. *Corrective/selective amendments;*
3. *Revised codes or ordinances;*
4. *Incorporation of planning language in separate health-related plans (see the Baton Rouge Health District); and*
5. *Reaching out to public health professionals.*

It is imperative that planners collaborate with sectors such as public health, public utilities, urban forestry, parks and recreation, developers, and landscape architects to create plans that integrate nature for better health outcomes. By working together for the public good, including improved health, these professionals can create a greater impact and achieve desired goals. To work effectively together, it is important to collaboratively design goals that fulfill each sector's priorities, ensuring all are aligned in achieving these objectives. Planners can act as conveners by conducting outreach and bringing these groups together to build consensus around nature and health initiatives.

As described in Box 7, *planNorfolk 2030* was developed by the Norfolk City Planning Commission in collaboration with a series of technical advisory teams, composed of city staff and other technical experts. The plan was completed with the input of over 150 community members through open house meetings and online forums.

Box 7. planNorfolk 2030

As part of the planNorfolk 2030 *comprehensive plan, the City of Norfolk, Virginia created a green infrastructure plan to advance environmental outcomes, protect critical infrastructure, and improve community health. Co-benefits such as improvement of air and water quality were included within several goals; however, the plan also defined health-related goals, such as providing "adequate open space access to ensure a healthful city for residents and visitors." This plan demonstrates the intersectionality of health and nature with environmental and quality of life goals and how both comprehensive and functional plans can cut across these priorities. For more information, go to the City of Norfolk's website.*

Examples of outputs that solidify the agreement to work across sectors and across disciplines toward nature and health outcomes may include the following:

- Agreements (e.g., memoranda of understanding) established between planners, other government departments, and community-based organizations, outlining specific roles and responsibilities related to protecting health.
- Policies and strategies from health-determining sectors that reflect health considerations.
- Health Impact Assessments (HIAs) for plans, projects, and programs.
- Jointly developed guidelines and best practices for integrating nature into urban planning.
- Community engagement initiatives to gather input and support for nature and health projects.
- Regular intersectoral meetings and reporting to track progress and adapt strategies as needed.
- Shared databases and information systems to facilitate data exchange and monitoring of health outcomes.
- Funding proposals and grant applications submitted jointly by multiple sectors for nature and health projects.
- Performance metrics and evaluation reports demonstrating the impact of collaborative efforts on health outcomes.

In these and other ways, planners can work with their counterparts in other agencies to address nature and health throughout the plan-making process.

Chapter 4: Nature Systems Planning

By Kathleen L. Wolf, Ph.D.

Planning for urban systems arose from the gradual, evolved visions of how to promote human welfare through innovations and new technologies. Planning takes the ideas that work well and uses them to promote broader implementation and supportive infrastructure. For example, mature systems, such as transportation and utilities infrastructure, are constructed using widely accepted guidelines and specifications. These standards were once local adaptive installations to remedy public challenges or needs and, in time, the best innovations became recognized and formalized into best practices or even regulatory code.

4.A. Evolving Systems

For most urban systems, emergent approaches gain community and political support and become recognized as essential. Many standard urban systems such as water delivery, sanitary sewer, and road systems were once nonexistent or of limited range in cities. As their public welfare importance became understood, they were more broadly installed, standardized, and regulated as they became the expectation for any ongoing urban development. Costs of implementation by the private sector and new development were justified by disease reduction, public safety, and associated economic benefits. While there have been some unintended negative consequences—such as comprehensive road systems that exclude walking and cycling, or have bifurcated communities of color—for the most part, urban systems address the important, primary needs of city residents.

There can be a variety of ways to encounter and experience nature in urban settings. The opportunities entail different degrees of human influence and design—from conservation easements in more natural settings to more formal and engineered infrastructure across the city fabric. The potential range of experience can inform how planners implement greening and open space. The locations and connections of nature elements influence the amount of time individuals are immersed in nature and the quality of experiences while moving across the urban continuum.

Strategies that address nature and health in communities can be integrated at multiple scales, ranging from single buildings or neighborhoods to entire cities or regions. These scales influence the nature elements that can be implemented. For example, policies related to the incorporation of nature at a building level may focus on green infrastructure such as green roofs and rain gardens. Meanwhile, regional strategies such as parks, green infrastructure, open space, and biodiversity plans can strengthen entire ecological networks (Santiago-Ramos & Hurtado-Rodriguez, 2020). While policies and strategies can be contained within a comprehensive plan, functional plans can offer more detail and may be more appropriate to promote specific strategies for fulfilling nature and health goals.

Planners may enhance residents' passive interactions with nature by integrating more natural elements into the urban environment. In addition, community-focused programming is important for making nature spaces more welcoming and promoting nature interactions for populations with barriers to access. *Health Parks, Healthy People* (Box 8) is one such program designed to promote parks and public land as a health resource to promote physical activity and improve mental, spiritual, and social well-being.

> ***Box 8.*** **Healthy Parks, Healthy People**
>
> *The Healthy Parks, Healthy People initiative from the National Park Service highlights the role of parks as a social determinant of health. It brings together park agencies, public health professionals, and community organizations to develop programs that promote parks use for first-time or infrequent park users, healthcare patients, and other community members. The purpose of the initiative is to improve community health and build connections between public health and park sectors. For more information, go to the NPS's webpage for Healthy Parks, Healthy People.*

4.B. Nature Elements

Urban systems are composed of functional elements—the spatial and activated components that make a system integrated and accessible. For many systems, these elements are intentionally designed and constructed. They have adaptively changed over time based on additional functional needs and better materials technology. For instance, roads have evolved from compacted gravel lanes to broad swaths of traffic surfaced using the latest paving technologies. Water delivery systems have evolved from hollowed log conveyance to pipes of various flow capacities and safer materials. Envisioning a nature-based system that is intended to promote health, as well as provide other solutions, involves optimization of existing nature features in the landscape, as well as incorporating constructed landscape amenities and green infrastructure technologies.

Table 1 is an interpretive classification of the nature elements found across cities that can provide nature exposure opportunities for residents. While some elements may serve another functional purpose, a modest change in design or implementation can provide increased access to nature. Multiple elements can be combined and strategically integrated, either through conservation efforts or new design and construction, to build out systems of green and blue spaces that promote health. They can be bundled both within and across parcels to generate seamless nature systems that offer individuals, households, and communities frequent and readily accessible contact with nature. Experiences can range from ambient nature that facilitates passive encounters (such as views from one's home or while driving) to those that promote linkages that enable physical activity (such as walking to school or enjoying a run for exercise).

Table 1. *Nature elements.*

Naturalistic	Engineered	Developed/Built	Blended
natural area/reserve critical area floodplain riparian buffer wetland shoreline	street/boulevard complete/green street green roof green wall green stormwater infrastructure gray/brownfield remediation transit stations	courtyard residential entries civic center school work campus hospital/clinic streetscape vacant lot cemetery	formal park community garden food forests/orchard waterfront utility corridor urban civic space green schoolyard playground

Naturalistic Elements

Some nature elements have a more naturalistic or even wild character. These landscapes may be the result of policy intentions to maintain biodiversity (such as wildlife habitat) and may include programs of ecological restoration. They may be ecological systems that are protected by policy or law (such as delineated wetlands or floodplains), or they may be a result of regulatory restrictions that limit development on a parcel due to enhanced or potential risk to buildings and their occupants—often termed critical areas (such as steep slopes). Such sites are often designated as development set-asides that have restrictions concerning improvements and development activity.

Engineered Elements

Engineered elements are facilities within and around built parcels that provide specified environmental or sustainability functions such as stormwater management, remediated environmental hazards, or complete streets. While addressing a primary functional goal or outcome, these elements (due to policy or budget mandate) may or may not facilitate intentional integration of nature for health. These parcels and features often must adhere to evidence-based best practices to achieve their primary goals and functions but have the potential to integrate co-design for co-benefits to facilitate nature contact, perhaps being envisioned as micro-parks.

Developed/Built Elements

Developed and built parcels are typically regulated by zoning codes, which often include requirements for landscaping. The codes may specify vegetation retention (such as existing trees on a site) or prescribe landscape quantities, planting buffers, or plant lists. These elements originated to buffer incompatible land uses from residential or high-occupancy land uses (such as schools or hospitals). These landscapes become the fine-grain elements of nature experience as they are located near building entries, affect streetscapes, and provide shared green space within larger developments. Often these plantings meet landscape code, but their design and layout do not integrate the latest evidence and theory about how to optimize health. They could be enhanced to enable deeper health benefits, such as stress reduction and fostering social connections.

Blended Elements

Blended landscapes and facilities are ever more common in urban design and planning. As demand for nature in cities has expanded in recognition of nature-based solutions, more parcels and facilities in the public realm are being designed to provide community benefit. These quasi-public sites house a stacked program of activity and accessibility. They may include public civic spaces (such as libraries or performance venues) or private spaces that serve public roles (such as campuses or office parks). Expanded accessibility for diverse audiences and programs are considered. For instance, large parks, once focused on active recreation planning, now include expanded programs such as community gardens and walking loops. Transit stations include tree shading and landscape to provide a more comfortable experience while riders wait. Schools are removing pavement to create outdoor classrooms and nature-based green schoolyards that can double as community parks.

4.C. Activating Nature Elements

The collection of nature experience elements can be viewed as a palette of potential. They can be envisioned as a flexible assemblage of nature components that may be designed to address specific functions but can be further planned, designed, and budgeted to incorporate health response. Some assemblages may be networks that resemble naturalistic places, evoked by the processes of ecology or ecosystems. They can also be synthesized into more formal built settings such as ornamental gardens but include the intention to facilitate restorative and healing experiences. Evidence-based guidance for how to implement nature elements is presented below.

Dosage

Recent research extends the broad understanding of correlations between nature exposure or experience and a health outcome. Newer research explores dosage—that is, how much, how often, and what type of nature is best, and is it different for different people at different times? The notion of dosage is not unlike a medical prescription in which a healthcare provider will specify the amount of a drug, how often it is taken, and how long the treatment continues.

While there is not complete consistency in the findings, it appears that 20 to 30 minutes of nature exposure is quite valuable for a positive health response—and an optimal amount of time to fit into busy schedules (Hunter et al., 2019). Some studies have shown benefit after as little as five minutes, but such effects may not be as durable. Other studies have investigated response after 60 to 90 minutes of time outdoors in natural settings, particularly valuable for more therapeutic sessions. As with medical treatments, one dose is rarely enough; multiple sessions per week, totaling 120 minutes, is the recommended nature dosage (White et al., 2019). Nature elements should be placed and linked to optimize available spaces for time outdoors.

Active Lifestyles

Opportunities for physical activity have long been at the center of parks and recreation planning. While dedicated spaces and facilities for physical activity are important, there can be other informal spaces in and around communities that support passive activity and transit. Spaces that are safe and clearly marked enable people to get outside and enjoy movement and nature experiences near their homes, schools, and workplaces.

Active lifestyles are important in addressing multiple health situations, such as cardiovascular and respiratory health, weight management, and responses that can boost the immune system and reduce chronic disease. Moderate activities, such as walking and bicycling, offer physiological and mental health benefits. Engaging with natural environments even of small sizes can help to reduce stress and anxiety, reduce symptoms associated with depression, improve children's ADHD symptoms, and may even reduce the risk of dementia. Overall, routine outdoor activity can be an important boost for both mental and physical health.

Dosage recommendations also apply to activity. The U.S. Centers for Disease Control and Prevention promotes a weekly total of 150 minutes for adults. Research suggests that doing equivalent physical activity in outdoor versus indoor spaces generates greater benefits, such as better mood and increased satisfaction. Planning for ubiquitous green spaces with thoughtful linkages creates situations where people can readily pursue convenient nature encounters that meet daily and weekly dosage recommendations.

Attention Restoration

Modern lifestyles include extensive amounts of time spent on focused tasks, time in front of screens, and complex scheduling. This balancing of multiple mental demands is new in the span of human history. The ongoing effort to maintain focus and avoid distractions can take a toll on one's mental capacities. Attention fatigue makes it more difficult to focus and effectively process information, leading to frustration and anxiety. Long term, attention fatigue can lead to making bad choices and even acting aggressively toward others. Attention Restoration Theory (ART) describes how even brief times spent in nature can help to restore cognitive capacity (Liu et al., 2024). One doesn't have to take a vacation or spend long hours away in a dramatic or far-away landscape; a matter of minutes within a nearby nature setting can recharge mental processing.

Site design can help boost the restorative potential of an outdoor space. Fine-scale guidelines may not be directly incorporated into planning or policy, yet these evidence-based principles reinforce the need for greater attention to how nature is incorporated into built environments. The first is that the nature spot is a *space* away—it can even be quite small, but it must be removed from the setting of attention demand. *Extent* is a sense of adequate space to move about and not feel constrained. *Compatibility* describes safe and supportive features, such as comfortable seating, options to be in the sun or shade, and suitable walking surfaces. Finally, some elements of nature can draw our attention without effort so that people are able to focus in ways that don't cause fatigue. These *soft fascination* features may include views of wildlife, cloud formations, flowers, different foliage textures, or a water feature in a small space.

Biodiversity Benefit

The research on nature and health has attracted the attention of scientists beyond the health and social sciences. Ecologists are ever more interested in understanding how conservation and naturalized areas—those having greater biodiversity—can offer health benefits. A more biodiverse green space has a higher number of species and more structure—meaning more layers of vegetation—from trees down to shrub layers and groundcover. Such spaces, ranging from large areas to biotopes (environments of multiple biotic communities), are functionally more complex and provide more animal habitat and life niches. Patches of biodiverse landscapes within cities also generate ecosystem services, such as stormwater management, air quality improvement, and reduced urban heat island temperatures. These ecosystem services provide obvious secondary human health benefits.

As mentioned previously, time spent in nature provides mental health benefits. Interestingly, there may be an additional margin of psychological benefit associated with experiences of more naturalistic landscapes. Time in urban landscapes with greater richness of plant and animal species and noticeable bird sounds leads to better mental and cognitive recovery. Ecological conservation and restoration in cities can also be important for sustainability, resilience, and education. Often such places are intentionally not welcoming to the public as ecologists pursue biophysical outcomes. Yet naturalistic places can be designed with "cues to care" that signal that public access is welcomed while also protecting ecological integrity (Nassauer, 1995).

Noise Reduction and Natural Sounds

To protect our hearing, we are advised to limit headphone volume and avoid loud noises. However, the constant background noises of urban environments can affect our ability to hear and have lasting effects on other systems in our body (Karlamangla, 2023). If someone lives near constant or loud noises, they may feel that they have adapted to the intrusion and no longer notice the recurring sounds; however, excessive noise can generate a cascade of negative effects, which may not be obvious (Vivanco-Hidalgo et al., 2019). Unpleasant and excessively loud sounds can trigger stress response in the brain in a center called the amygdala. If the amygdala is repeatedly overactivated, the body responds in harmful ways. Endocrine systems respond, releasing cortisol, adrenaline, and other stress chemicals. At the same time, the sympathetic nervous system stimulates a faster heart rate and higher blood pressure. The cumulative effect of ongoing noise exposure can be hypertension and greater risk of heart disease and stroke. Ongoing noise can also reduce the amount and quality of sleep. Sleep disturbance is related to a range of mental and physical health problems, such as depression, anxiety, headache, and heart problems (Sivertsen et al., 2014).

The type and character of surrounding plants influences how sound is received and perceived (Maksymenko et al., 2021; Zhao et al., 2021). Road traffic is often a major source of noise. One green solution is to plant dense trees and lower vegetation belts near roadsides as "acoustical landscaping" (Van Renterghem et al., 2020). Having greenery around one's home also decreases reports of annoyance with road traffic and railway noise (Schaffer et al., 2020).

While science is limited, multiple studies indicate that the experience of natural sounds can reduce stress, pain, and disease precursors, while improving mood and mental performance (Largo-Wight et al., 2016; Buxton et al., 2021; Voss et al., 2021). Some communities have found that introducing natural soundscapes, including bird song, helps to abate the perceptions of noise in urban places (Van Renterghem et al., 2020). The presence of nearby vegetation and natural sounds can physically screen unpleasant or excessive noise and reduce perceptions of the prominence or unpleasantness of noise.

4.D. Existing Opportunities

While some of the nature elements in Table 1 are created by policies for new development, others exist because of legacy development or regulatory requirements. Extant nature may have been created or protected to serve a specific purpose or population, removing it from consideration as a nature for health opportunity. A broader systems approach can include an assessment of existing amenities and how they can be repurposed to address gaps.

Retrofit and Infill

In many cities, the historic legacy of regarding nature as an ornament of beautification has meant that nature elements are dispersed across a city in almost random fashion. While some parks departments have comprehensively planned park systems that include ball fields and more formal landscapes to natural areas and habitat preserves, many cities have a dispersed distribution pattern for their parks and green spaces due to historic budgets and land acquisition opportunities. Similarly, in urban forestry, some cities have deliberate, comprehensive planting plans while others have little guidance for how trees have been introduced into the public realm.

This has led to equity consequences where there are disparities in the distribution and quality of trees, parks, and gardens. More affluent communities often have greater quantity and better quality of nature elements. In addition, Euclidean zoning—a fundamental twentieth-century practice of urban planning—

Figure 7.
An example of a successful green schoolyard. Green Schoolyards America is an organization that transforms traditional asphalt-covered school grounds back into usable green spaces (Source: Green Schoolyards America, 2024).

served to separate incompatible land uses, particularly if industrial development posed health risks to residential neighborhoods. Attention to environmental justice has revealed that such separation policies were not equally applied, with certain sociocultural groups bearing the brunt of pollution and toxins within their communities. Various agencies now focus on remedies for these historic injustices and pursue equitable policies.

As more comprehensive systems planning for nature proceeds, it is important to take stock of what is already in place, to envision how a systems approach can fill in gaps, and to particularly note areas of nature deprivation. A gap analysis can be conducted using spatial analysis tools such as GIS to guide where strategic programs of land acquisition for parks, conservation easements, community garden and food forest development, and other initiatives should take place. The analysis can include larger quasi-public spaces that may offer connector and consolidation opportunities, such as public gardens or brownfield reclamation. For example, green schoolyards initiatives (Figure 7) are transforming school campuses into community parks, expanding community use to after-hours and weekends. Overall, a process of cataloging existing assets, and then analyzing where new green spaces are needed, will promote nature infill that is coherent and supports a system build-out.

Co-Design for Co-Benefits

As urban planning moves forward to introduce more nature into communities—including places in a state of nature deprivation—a co-design for co-benefits outlook is also important. In many cities, vacant land may not be available or is not affordable for the creation of new parks. Yet urban landscapes are often designed or engineered in both private and public development to include nature-based solutions and to generate environmental services. For instance, rain gardens and bioswales are becoming increasingly common as a strategy to manage stormwater runoff, and large detention areas are used to handle larger volumes of water and prevent flooding. With more design intention, these elements can serve secondary functions as health-promoting elements. Green stormwater infrastructure can be envisioned as micro-parks, tucked into communities to promote microscale nature experiences. Utility corridors (particularly electrical line rights of way) are often linear bits of landscape that can be designed to include trails, offering space for physical activity and achieving connectivity across broader landscapes. Transit stations can include small gardens that support restorative experiences while people wait for their rides.

Chapter 5: Perception and Experience

By Kathleen L. Wolf, Ph.D.

This guide offers recommendations for reimagining the role and functions of nature in cities in ways that align with goals of the Biophilic Cities movement (see Box 1). While research has revealed the direct connections between nature experiences and physical or psychological health response, more interpretive research has explored how people perceive and engage with their lived environments. Nature encounters involve all the human senses—sight, sound, smell, and tactile inputs.

This chapter offers a discussion on concepts that may not be readily translated to policy or code but can be used to prompt discussions about how nature elements are integrated within other urban systems (such as transportation and housing) to create more welcoming and meaningful places for people.

5.A. Understanding and Wayfinding

Some of the nature and health research explores and measures how people interact with their surroundings in positive ways. *With People in Mind: Design and Management of Everyday Nature* (Kaplan et al., 1998) offers many interpretations of theory to create supportive human habitat. Some examples from the book are detailed in the following two paragraphs.

People seek information to help understand their surroundings. If information about the physical space that surrounds them is lacking or confusing—that is, if people cannot make sense of their surroundings—they may experience fear and feel uncomfortable. Those negative emotions lead to people avoiding such places. The notion of wayfinding describes the intuitive and formal guidance that can be introduced into a place to help people navigate. Opportunities to access longer views and vistas are preferred by people as they help a person to orient within a larger space and support a sense of direction.

Urban green spaces can range from large parks to smaller pocket parks or green streetscapes. Across all these spaces, there are useful principles of spatial definition or articulation that can be implemented. First, *gateways* indicate both transition and arrival, ensuring that a person is negotiating a space safely. Very large spaces can be uncomfortable, so *partitioning a space* into multiple smaller "rooms," each perhaps with a distinctive character, is more comfortable and can signal location (Figure 8). Clear connections between spaces, such as trails and paths, offer *directional guidance* and can also have surfaces that offer subtle wayfinding.

Figure 8.

An illustrated plan of a park sequence in Portland, Oregon that successfully partitions and sequences outdoor space. For more views and details of this project, please see the original source. (Source: ASLA, 2021).

5.B. Mental Patterns

Kevin Lynch, an urban planner who studied how residents spatially interact with their environment, authored the well-known book, *Image of the City* (1960), which connects the everyday of place to planning. Lynch described how people organize their mental map of a city—even one that they may know quite well—as a set of *perceptual units*. People personally visualize a city using mental models of paths, edges, districts, nodes, and landmarks. With growing familiarity as they encounter urban spaces, people mentally assemble the elements into functional systems of meaning and navigation. Another early work, *A Pattern Language* (Alexander et al., 1977), offers a scaled catalog of living spaces that are compatible with human needs and function. The patterns include facets of home, neighborhoods, and entire cities. Patterns describe networks of functional units that promote livability by emphasizing spatial relationships with a focus on human scale.

Building on these legacy publications, *Sites to Systems* (Wolf & Brinkley, 2016) expands on the perceptions that people can use to negotiate built spaces to access nearby nature. Graphics propose spatial arrangements of nature elements to generate the cognitive maps that people develop for place. In other words, while a person may encounter a single nature element while outside, there can be cues within that space and its surroundings that suggest spatial linkages to more extended nature encounters. Figure 9 illustrates perceptual arrangements that can reinforce the intuitive connections that people form as they navigate urban spaces.

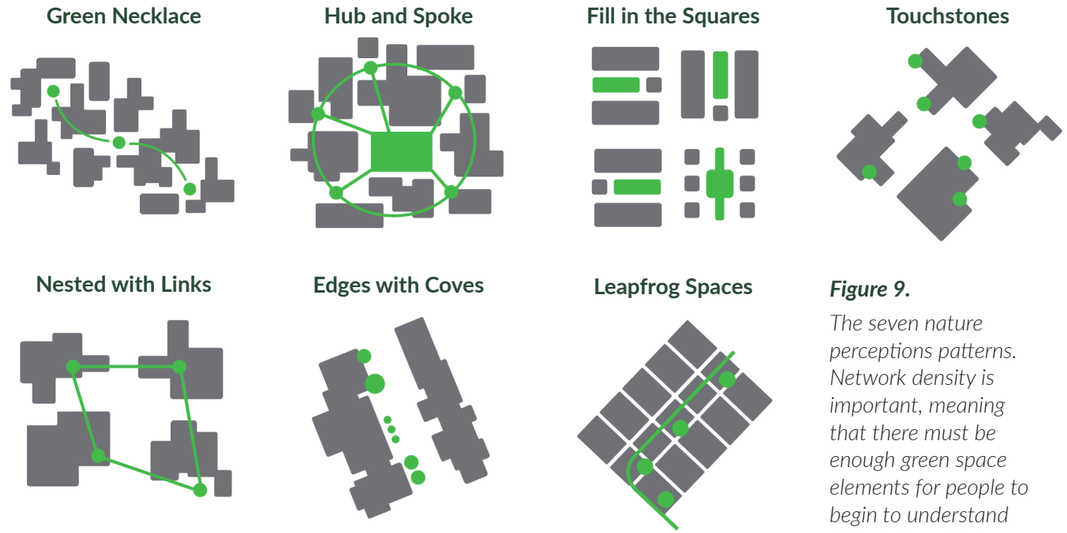


Figure 9.

The seven nature perceptions patterns. Network density is important, meaning that there must be enough green space elements for people to begin to understand the relational linkages and build a "mind's eye" understanding of nature presence and access (Source: Wolf & Brinkley, 2016).

5.C. Safety and Security

A common complaint about the presence of green space within communities is the potential for unwanted social behavior and criminal acts. One claim is that vegetation can becomes a screen that can reduce visibility into spaces and the unwanted activities within, or that individuals with negative intent can lurk within or behind the screen of vegetation. Careful management of plants and landscapes is indeed necessary to prevent negative behaviors, yet wholesale removal or restriction of plant material removes the potential for the many health benefits described here.

The principles of Crime Prevention Through Environmental Design (CPTED) are a starting place for solutions. CPTED recommends combined physical design and social engagement within communities to reduce the situations that support potential crime. Studies show that landscapes can be designed to reduce concealment, thus reducing hiding places and perceptions of crime threat (Lis et al., 2019; Lis et al., 2021).

A key idea, first promoted in *The Death and Life of Great American Cities* (Jacobs, 1961), is the importance of social dynamics to promote safe and secure places—termed "informal social control." A well-planned city could have the quantity and character of spaces that encourage social presence. Places that are barren and unwelcoming will have few people within, and without some level of social watchfulness, such places can become unsafe. Policies that promote thoughtful landscapes and appealing spaces can generate a level of social density that may prevent unwanted behaviors. Interestingly, recent studies show that creating and having public green spaces within a community (such as cleaning up vacant lots) can contribute to reduced crime (Shepley et al., 2019). Though

the causal pathways are not well understood, studies increasingly observe connections between nearby nature and both physical and property crime reductions.

5.D. Enhancing Place

Planning is a sociocultural activity that shapes potential synergies across a community and evolves to guide infrastructure placement, parcel use, and future development. As people move through space within a community, they do not catalog the parcel-by-parcel changes or distinct built elements. They instead build their sense of place from holistic impressions. Planners must attend to urban necessities that address material and functional needs such as transportation, utilities, and waste management. Other more subtle spatial situations enhance safety and quality of life of residents.

Researchers in the humanities and social sciences have explored how people interpret and make sense of the physical dimensions of their everyday environments. The concepts of perceptions and patterns describe the place continuities that can encourage active use and appreciation of outdoor spaces. These final evidence-based concepts are fundamental to how people can move about within nature systems and extend their encounters as they seek a variety of health benefits.

Connectivity

While many of the precepts of planning apply to defined parcels and properties, greater attention to nature-based solutions requires that planners acknowledge the cross-parcel and multi-jurisdictional dynamics of ecosystem functions. If properly maintained and managed, ecological systems become the green infrastructure that supports the flow of functions and benefits across a region.

Landscape connectivity underpins any efforts to optimize nature-based solutions, as functional systems are more than the sum of multiple small or isolated parts. This applies to human-made systems (such as green stormwater infrastructure) as well as conservation and restoration efforts (such as riparian corridors). As a system takes shape, approaching greater complexity, synergies generate more diverse opportunities to attain a wider range of benefits.

Connectivity is especially important when creating or conserving nature elements, as a connected system offers more people greater opportunities for brief exposure, as well as deeper experiences of nature. Nature systems that are characterized by connectivity offer people more choices and settings for nearby nature experiences. One example of connectivity is trails, which can be centered in public parks and extended beyond boundaries by streetscapes, green alleys, and access easements on private property (Box 9). Furthermore, landscape codes can introduce credits that encourage co-design across private property parcels. Policies for connectivity offer both the potential for nature experience that can be approached within a matter of minutes as well as compatible corridors for more extended physical activity, active transit, and recreational outings.

***Box 9*. Anacostia Tributary Trail System in Prince George's County, Maryland**

Prince George's County, Maryland has a comprehensive pedestrian and bike trail system that runs throughout the northern part of the county, west into Montgomery County, and south into Washington, D.C.. The Anacostia Tributary Trail System consists of separate trails that have been connected over the years to form a complete system that permits safer and greener access to the University of Maryland campus, recreational areas, shopping centers, and more. At various points, trails run through parks, parallel roads, and take advantage of existing infrastructure. For a sense of the full scale of the system, take a look at this online PDF map.

Compatibility

Compatibility is the extent to which a natural space or element is responsive to the safety and comfort of a user. Compatibility has many dimensions. Across a planned nature system intended to promote health, policies should encourage the facilities that support people's safe and comfortable use—whether that use is nearby and short-term or lengthier and of extended time frame. Some examples include the provision of trail restrooms, drinking water stations, and navigational signage.

Research on nature and health shows that people of all ages across the human life cycle gain benefit from nature experiences. People with young children may need appropriate resting spots and play structures. Elderly people may value defined-length walking loops, comfortable seating for rest stops, and spaces that are readily accessed from convenient parking. People who are mobility challenged are supported at a minimum by the provisions of the American Disabilities Act, but planning can go beyond that to welcome people of specific disabilities or needs. Current research is identifying the benefits of nature for people of different abilities, such as gardens designed for those who are visually or hearing impaired.

Increasingly, healthcare providers are recommending "nature prescriptions" for their patients to address clinical diseases and promote general health. These providers will prescribe a certain activity or length of time spent outdoors as part of a treatment plan for a patient. Nature therapy appears to be particularly helpful for mental health challenges. Forest therapy, based on extensive research, is particularly promising as a treatment, but having the green space to encounter trees and nature is important. A feeling of security and safety—as well as the availability of supportive amenities such as restrooms, drinking water, and easily traversed trails—contributes to effective therapy settings.

Chapter 6: Implementation

By Sagar Shah, Ph.D., AICP

Development work, incentives, and investments ensure the implementation of community plans by attracting public and private capital. This capital can be used to fund nature infrastructure, programming, and other costs associated with carrying out nature and health strategies. A key first step for attracting capital is communicating the value of nature to community members and decision-makers, highlighting the far-reaching benefits that will be realized in the long-term and potential returns on investment.

Equity should be at the forefront of all implementation strategies, as investments in natural amenities can drive increases in market demand, leading to displacement of residents who stand to benefit most from nature in terms of health and quality of life. Planners must understand the relationship between nature and economic and social systems and develop policies and programs that equitably distribute the benefits of nature without uprooting communities.

6.A. Public Land

Natural elements can be integrated into public spaces through private improvements or the repurposing of spaces. Given the budget and staffing constraints that cities often have, local governments can encourage private landowners or community groups to transform spaces and incorporate nature into the public landscape.

City-owned vacant or underused lots present a key opportunity for local governments to permit community groups to repurpose these places as community gardens, pollinator habitats, parklets, or other nature-based spaces that enhance health, public safety, and community vibrancy (Brown & Fink, 2022). Effective approaches empower residents and community members to spearhead projects that address gaps in the provision of nature. The Park in a Truck Initiative (Box 10) in Philadelphia facilitates quick, low-cost transformations of vacant lots through urban green projects. Similarly, the Neighbors Naturescaping program and the Anne O'C. Albrecht Nature Playscape in St. Louis (Figure 10) provide tools and supplies to communities to implement nature projects on public land.

Box 10. **Park in a Truck, Philadelphia, Pennsylvania**

Thomas Jefferson University's Park in a Truck Initiative provides an avenue for communities to design, build, and maintain their own green space. The program consists of a toolkit and accompanying workbooks that describe the six steps needed to build your own park: acquiring, organizing, assessing, dreaming, creating, *and* sustaining *your park. For more information, go to Thomas Jefferson University's webpage for their Park in a Truck Initiative.*

Figure 10.
An aerial rendering showing key highlights and the wayfinding signage at St. Louis Anne O'C. Albrecht Nature Playscape (Source: Forest Park Forever, n.d.).

6.B. Regulations

Regulatory mechanisms allow local governments to promote green space development through restrictions and mandates to achieve desired health outcomes. Regulations are complementary to local plans, helping to maintain and promote natural spaces that are defined or identified in plans and carry out implementation strategies.

Regulations used to preserve or expand urban nature systems include zoning, development review processes, and site and building design standards. To be effective at maintaining and preserving natural assets, regulations and ordinances require sustained enforcement and adaptability to meet a community's changing needs. They should be part of an integrated vision that centers nature conservation and human health across all regulatory areas and uses social, economic, health, and nature indicators and objectives to track outcomes.

Zoning

Several zoning tools can be used to integrate nature into urban landscapes with the goal of enhancing human health. *Overlay zoning* can incorporate biophilic standards and goals to enhance existing zoning policies, allowing for additional standards to target environmental or health benefits in specific areas of a city. For example, overlay zoning could facilitate green infrastructure in high-density areas where the urban heat island effect is stronger, with the goal of enhancing cooling effects and reducing heat-related illnesses. *Green space and open space zoning* protects natural areas from development, preserving large swaths of nature that provide greater health-related benefits through more immersive nature experiences. Requiring open space zoning audits can help assess the current state of green infrastructure, and audit information can guide the development of subsequent strategies (NatureScot Nature Agency, 2020). *Performance zoning* can be used to establish standards that promote an end goal, such as increased

tree canopy, while allowing developers flexibility in how that goal is achieved. In Austin, Texas, the city's tree protection regulations (Figure 11) establish a performance standard that requires developers to demonstrate the preservation of "the existing natural character of the landscape, including the retention of trees eight inches or larger in diameter to the extent feasible" (City of Austin, 2023). Lastly, *viewshed protection* has important implications for mental health due to the psychological value of visual access to nature. Vista views create a sense of location and connection to the natural world (Brown & Fink, 2022).

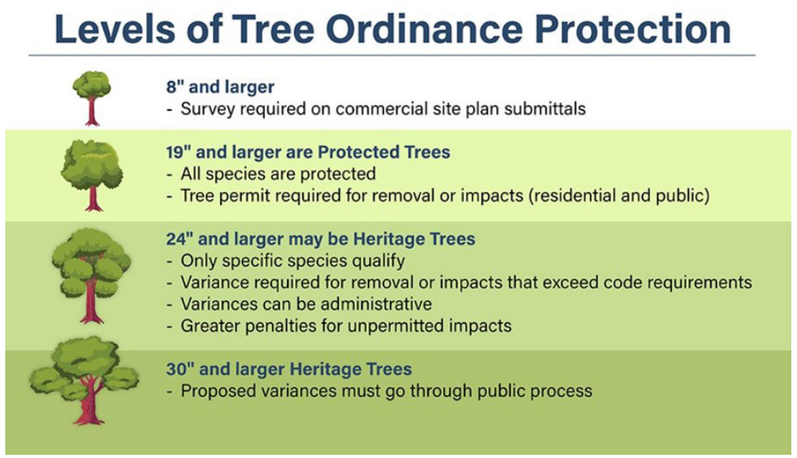


Figure 11.
The City of Austin protects trees on both public and private property. The first version of this ordinance, passed in 1984, was one of the first of its kind in the United States (Source: City of Austin, 2023).

Development Planning

Health and nature can be incorporated into the review and approval of development plans to ensure that a community considers health and nature outcomes as part of the decision-making process for its built and natural environments. Criteria or questions to consider in development review might include whether parks and open space opportunities are close to a site location as measured based on distance and connectivity. Planners might also consider whether parks, open space, or other opportunities for nature experiences are incorporated into site design.

Conservation subdivision design can be used in suburban or rural communities to ensure that desirable natural features are protected from future development (Morley, 2019). Two development tools that protect nature in urban spaces—conservation easements and transfer of development rights—are profiled in Box 11. Conservation easements are legal agreements between landowners and qualified conservation organizations or government agencies. They restrict specific land uses on a property to protect its natural, scenic, or historical features, ensuring the land's conservation values are preserved. Transfer of Development Rights, often abbreviated as TDR, is a land use planning tool that allows landowners to sell or transfer the development rights from one parcel of land to another. This mechanism separates the right to develop land from the land itself, allowing for more flexibility in land use planning.

***Box 11.* Useful Tools for Preservation of Green Open Space**

Conservation easements offer a sustainable approach to land use and conservation that balances development needs with environmental protection. Transfer of Development Rights (TDR) incentivizes landowners in "sending zones" to place their land under conservation easements and directs development to "receiving zones." This protects land in the sending zone from development. These approaches not only benefit landowners but also enhance community open spaces, preserve natural resources, and promote sustainable growth patterns. However, successful implementation requires careful consideration of local regulations and legal counsel to ensure that conservation easement and TDR programs align with community goals and values. For more information, see "Land Preservation - An Essential Ingredient in Smart Growth" by Thomas Daniels.

Site Development Standards

Site development standards support the use of small-scale interventions and facilitate the conservation of trees, native species, and other valuable natural assets. They include landscaping standards that provide health benefits, help control pollution, and support biodiversity (Brown & Fink, 2022). Washington, D.C. uses a "green area ratio" to score new developments based on the types of green landscapes and design features used and the area they cover. Developments must exceed a minimum score for approval (McDonald et al., 2017).

Another tool growing in popularity is the "green factor," which requires a minimum area of green landscaping to replace any land lost to new development. This allows cities to increase urban green space and establish performance goals for new development to encourage higher-quality green infrastructure (Juhola, 2018). One example of this is the Seattle Green Factor (Box 12), adopted as part of a landscaping ordinance that dictates the amount of plant coverage and greenery required for a development (Wolf & Brinkley, 2016).

Site development standards have also spun out of urban forest management plans. Long a regulatory tool to preserve urban trees, these management plans have evolved to influence types of tree species and enhance the ecosystem services provided by urban forests (Brown & Fink, 2022). While the benefits trees offer to human health are well understood, planners can better leverage these benefits by taking a more holistic approach to urban forest management that emphasizes the equitable distribution of tree canopy. Such an approach tackles inequities in green space access and ensures the benefits of urban forests reach populations most vulnerable to heat, pollution, and other environmental issues.

***Box 12.* Green Factor Tools**

Seattle was the first U.S. city to adopt a green area ratio (GAR), known there as the Seattle Green Factor (SGF). The city describes the SGF as a "score-based code requirement that increases the amount and improves the quality of landscaping in new development." It aims to manage stormwater runoff, aesthetically enhance neighborhoods, and improve habitat for birds and beneficial insects. For more information, go to the Urban Land Institute's webpage for the Seattle Green Factor.

Building Design Standards

The incorporation of natural elements into building design offers localized health benefits while also enhancing the overall urban ecosystem. Green roofs are perhaps the most popular building design element due to their many benefits, including stormwater capture, contribution to biodiversity, and reduction of urban heat temperatures (Brown & Fink, 2022). However, not all green roofs are equal, and any green roof regulations should ensure that the function, location, and quality of vegetation provides optimal environmental and health benefits. This is true of other green infrastructure implemented at a building scale. Design can also encapsulate streetscapes and sidewalks. For example, the City of San Francisco adopted a sidewalk landscaping permit that allows private landowners to petition for the right to incorporate biophilic landscaping on sidewalk rights-of-way (San Francisco, n.d.). While established with the goal of reducing stormwater flooding, such an ordinance can also be designed to pursue health outcomes that result from increased nature and quality of life.

6.C. Economic Approaches

Economic approaches provide a carrot to the regulatory stick to implement change in urban development practice. Tools to encourage environmentally focused aspects of development projects should align financial incentives with delivering the benefits of a greener, more nature-oriented project. Two options to encourage green development that promote healthy environments for city residents are incentives and financing tools.

Incentives

Incentives are useful to encourage private property owners and developers to use nature-based solutions and biophilic design that contribute to the larger urban ecosystem. Incentive approaches can act as a stepping stone to the wider adoption of strategies to enhance a community's natural environment. They often allow for flexibility in how landowners or developers meet regulatory requirements and may be more politically appetizing in communities that are newly exploring investments in nature.

For developers, incentives could come in the form of density bonuses, expedited review processes, development fee waivers, credit trading, or technical support. For private property owners, incentives might include grants or rebates, property tax reductions, or technical support. The City of Norfolk, Virginia, has adopted an incentive-based strategy to encourage the use of nature-based infrastructure and elements (such as green roofs) into new developments (GIC Inc., 2018). While this policy is aimed at ensuring that development meets climate adaptation requirements established by the city, similar approaches could be adopted to encourage nature elements that are linked to community health goals and objectives.

Financing Tools

To attract investments in nature, planners must demonstrate the value of nature by clearly communicating its purpose, beneficiaries, added value, and how urban issues—including health—can be addressed through nature-based solutions. Unlike traditional infrastructure, the value of nature extends far beyond economic values, providing ecological, health, and social benefits (Brown & Fink, 2022). Expressing these benefits in quantifiable terms allows decision-makers to benchmark the health and social benefits of various projects and better understand the returns on investment.

A community's long-term commitment to investments in nature is reflected in its capital improvement plan (CIP). CIPs should incorporate strategies and projects that support a community's natural capital, prioritizing those projects identified in local plans and through community engagement and participatory processes. Because health outcomes and nature assets are impacted by many types of infrastructure, communities can also adopt evaluation processes that require the consideration or addition of biophilic or nature-based elements for infrastructure proposals (Brown & Fink, 2022).

Financing tools to fund health and nature initiatives might include traditional or innovative fiscal mechanisms such as voter-approved tax measures, green bonds and environmental impact bonds, transfers of development, or stormwater retention credit trading programs. The City of Atlanta used an environmental impact bond to fund the Proctor Creek Greenway Project, which connects underserved communities along a seven-mile stretch of paths and trails to parks, transit, and other services. A voter-approved special purpose transportation sales tax was used in part to fund the greenway, which is part of the larger Proctor Creek Watershed Project—an undertaking to create a network of community-driven parks, sports facilities, and more than 400 acres (about half the area of Central Park in New York City) of green space to promote resident health (Atlanta Beltline, 2018).

In addition, public-private partnerships can be used to encourage nature investments as part of private developments or stewardship of natural assets by private entities on public land (Peña & Shah, 2022). Communities can leverage assistance from the medical community for projects that directly promote health. The Parks and Recreation Department of Little Rock, Arkansas, successfully engaged over two dozen local physicians in assisting with fundraising efforts for the city's Medical Mile Trail, a health-inspired trail built to encourage people to be outside in nature. Over three months, the group fundraised $350,000 in addition to funding from local hospitals, the Arkansas Department of Health, Blue Cross and Blue Shield, and various medical practices (Vibrant Cities Labs, n.d.).

Conclusion

By Jennifer Egan, Ph.D.

The built and natural environments are crucial social determinants of health, and thus should be considered in planning and policy-making processes. Taking a comprehensive approach to designing nearby green spaces for better human health is vital for addressing public health challenges, promoting overall wellness, and achieving urban sustainability and resilience.

This guide presents a robust body of evidence demonstrating the positive connection between access to nature and the health of all people of all ages. Studies show that exposure to natural environments at a variety of scales, ranging from the individual to the whole community and throughout the human lifespan, can have a positive impact on stress reduction, mental health, and overall well-being. Even small nature experiences (20 to 30 minutes a day) can significantly improve health outcomes.

While this document provides evidence-based guidance for integrating health into planning processes, it is important for future research to document specific elements of nature experiences that contribute to health outcomes in order to further tailor planning efforts for equitable nature implementation in various community contexts. Urban planning involves carefully considering nature elements to promote health and well-being within a community. By systematically integrating naturalistic elements into urban settings and recognizing the evolving nature systems, planners can create environments linked to positive health responses. Strategically implementing green and blue spaces across different scales can help cities create seamless nature systems that cater to the diverse needs of individuals, households, and communities. As urban areas continue to develop and expand, this guide can assist planners in integrating nature into urban planning to promote better human health for all.

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