Environmental Design for Health

A Framework and Visual Guide

Edited by
Xuemei Zhu, Mardelle McCuskey Shepley, and Zhipeng Lu

ROUTLEDGE

Environmental Design for Health

This book provides a user-friendly guide to the impact of environmental design on individual and population health, as well as the relevant roles of social and behavioral factors. It explores how architecture, interior design, landscape architecture, and urban planning can contribute to a healthier, more equitable, and more resilient society. Employing an evidence-based and solution-oriented approach, it provides a much-needed textbook for environmental designers and public health professionals.

Written by a team of established experts, this book includes:

- An introduction to the concept of environmental design for health and the relevant roles of social and behavioral factors.
- An overview of important theories about human-environment relationships; environmental assessment, perception, and cognition; and health behavior.
- Discussions of how to design for physical, mental, and social health, covering various design disciplines and environmental scales.
- Overviews of more specialized topics, such as design for healing, design for active living, design for environmental justice, and design across the lifespan.
- Case studies involving a range of physical environments, including interiors and buildings, parks, urban spaces, and residential communities.
- A timely focus on emerging technology that affects design for health.
- An overview of integrating design and research for a healthier future.

It is essential reading for all environmental designers and public health professionals.

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CHAPTER 1

Introduction to Environmental Design for Health

Xuemei Zhu

> We ought to plan the ideal of our city with an eye to four considerations. The first, as being the most indispensable, is health.
>
> —Aristotle, *Politics* (ca. 350 BC)

Learning Objectives

After reviewing this chapter, readers should be able to:

- Understand what "environmental design" and "health" mean.
- Explain the conceptual framework of environmental design for health and why relevant disciplines such as architecture, interior design, landscape architecture, and urban planning are important to individual and population health.
- Understand the importance of addressing social and behavioral factors in environmental design for health.

1.1 Why Environmental Design for Health?

Good health is a fundamental goal in people's lives and a prerequisite for enjoying life and everyday activities. Environmental design plays a role in good health as it shapes the places in which people live, work, study, and play, serving functional, social-behavioral, and aesthetic goals (Figure 1.1). Acknowledging the strong ties between human health and design is a priority for current and future societies.

1.1.1 What Is Environmental Design?

Environmental design deals with the design and planning of human-built environments, reflecting a delicate balance between art and science. In ancient times, the role of designing and constructing important buildings and towns was often reserved for master builders, and design service was only provided for the rich and powerful (1). As human dwellings and settlements became increasingly complex, more specialized disciplines such as architecture, interior design, landscape architecture, and urban planning were formalized, developing their respective professional standards and serving the broader population. These disciplines now shape most of our everyday environments, intertwined with social, political, economic, cultural, and scientific and technological aspects of our society. The social responsibility of environmental design has been increasingly emphasized. One recurring theme in the history and social responsibility of these disciplines is the linkage between the physical environment and human health and well-being.

The architecture profession focuses on the art and science of designing buildings and fulfilling corresponding functional, social-behavioral, and expressive needs. The earliest forms of architecture can be found in primitive human shelters such as caves, tents, and primitive

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◂ **Figure 1.1**

Environmental design shapes the places in which we live, work, study, and play, and thus also affects our health.

Source: (Upper left and lower left) Thomas McConnell Photography, Mueller community in Austin, Texas, US; (upper right) Jack Hobhouse, Here + Now Building in Reading, UK; (lower right) Kevin Scott, Blakely Elementary School in Wenatchee, Washington, US.

huts, which were intended to protect their inhabitants from the elements of nature and meet their essential health and safety needs. In ancient Egypt, the prototypical architect and statesman Imhotep was also revered as a great healer and was later deified (1). In the 19th and 20th centuries, architectural education and practice were formalized, and architecture emerged as a distinct discipline. In its modern form, the profession of architecture recognizes its social responsibility to protect the health, safety, and welfare of the public and employs a series of health considerations in its professional standards (e.g., building codes) (2). Recently, the International Union of Architects (UIA) declared the year 2022 as the "UIA Year of Design for Health" (3). Further, in 2024, the delegates of the American Institute of Architects (AIA) approved Resolution 1: AIA Health and Wellbeing Policy (4). These developments further highlight architecture's social responsibility in safeguarding and promoting population health.

Closely related to architecture, interior design is the art and science of designing the interior of buildings to meet functional, social-behavioral, and aesthetic needs. Its origin can be found in the ancient world based on archeological evidence of prehistoric interiors from the first permanent human settlements in Mesopotamia, pre-Columbian America, and ancient Egypt, as well as in the classical civilizations of Greece and Rome (5). In the modern era, interior design was defined by important movements such as Art Nouveau, which emerged in Europe in the late 19th century and featured the use of long, sinuous, organic lines, and the Arts and Crafts movement, which began in early 1900s England and emphasized the use of natural and untreated materials (5). Later, in the early 20th century, interior design became a distinct profession. Throughout its evolution, health and wellness have always been an essential focus of interior design and were recently identified as one of the most significant directions of the field (6).

Moving to the outdoors, landscape architecture focuses on outdoor spaces and various forms of natural or built elements within these spaces to achieve desired functional, social-behavioral, and aesthetic outcomes. Its emergence is partly rooted in the desire to bring nature back into people's everyday lives, helping mitigate the challenges and stress of increasing development and urbanization, thereby protecting and promoting human health

and well-being. Early evidence of the landscape-health linkage can be traced to the Hanging Gardens of Babylon in ancient Iraq (although the actual existence of the garden remains a mystery) and healthy landscapes in ancient Greece and Rome (7). With its history tied to landscape gardening and architecture, the professional title of "landscape architect" was first used in 1863 by the Board of Central Park Commissioners in New York City to describe the profession of designing a composition of planting, landform, water, paving, and other structures (8). In recent years, the importance of landscape architecture for population health has been increasingly recognized, as highlighted by professional organizations across different countries (9).

On a larger spatial scale, urban planning is a technical and political process involving the design and regulation of the uses of space as related to the physical form, economic functions, and social impacts, as well as social-behavioral activities within urban environments. One unique characteristic of urban planning is that it often involves envisioning alternative futures for an urban area, setting goals, and formulating implementation strategies. Like other environmental design disciplines, early evidence of city and town planning, along with its linkage to health considerations, can be found in the ruins of early civilizations spanning from India to Rome and from Greece to Egypt and South America (10). The modern profession of urban planning emerged as a direct response to the widespread health and environmental challenges of industrialized cities, when improvement in sanitation and housing and separation of housing from industrial pollution helped curb infectious disease outbreaks (10). Nowadays, urban planning remains an active and indispensable component to the prevention of disease and illness, promotion of health, provision of healthcare, and protection of healthy ecological systems (11).

1.1.2 What Is Health?

Parallel to the development of these disciplines in environmental design, how we define and address health has also evolved over time. The most widely adopted concept was proposed by the World Health Organization (WHO) in 1948, which defines health as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity" (12 p1). This was a groundbreaking concept for the time, as it broadened the traditional and narrower focus on the absence of diseases. It also emphasized that physical, mental, and social forms of well-being are interconnected and that they are all critical components of overall health and well-being.

More recently, various proposals have been made to adapt the WHO's definition of health, stemming from the concern that a "complete" state of well-being is impractical and thus impossible to operationalize or measure. The nature of diseases affecting the world population has also shifted since 1948: acute diseases are no longer the main burden of illness, as chronic diseases have become the leading cause of early death (13). In 2011, Huber et al. advised that the emphasis on defining health should shift toward the *ability to adapt and self-manage* in the face of physical, social, and emotional challenges (13). Consequently, this book adopts the WHO's definition of health while also integrating the newly proposed emphasis on resilience (i.e., the ability to adapt and self-manage) to identify dynamic features that can be measured and targeted in health promotion. We also refer to both individual and population health in our discussions and emphasize the social responsibility of environmental designers to address health and well-being not only on the individual level (e.g., for specific users of the designed space) but also on the population level, when applicable (e.g., for public schools, community centers, urban parks, and other settings that may affect a large portion of the population).

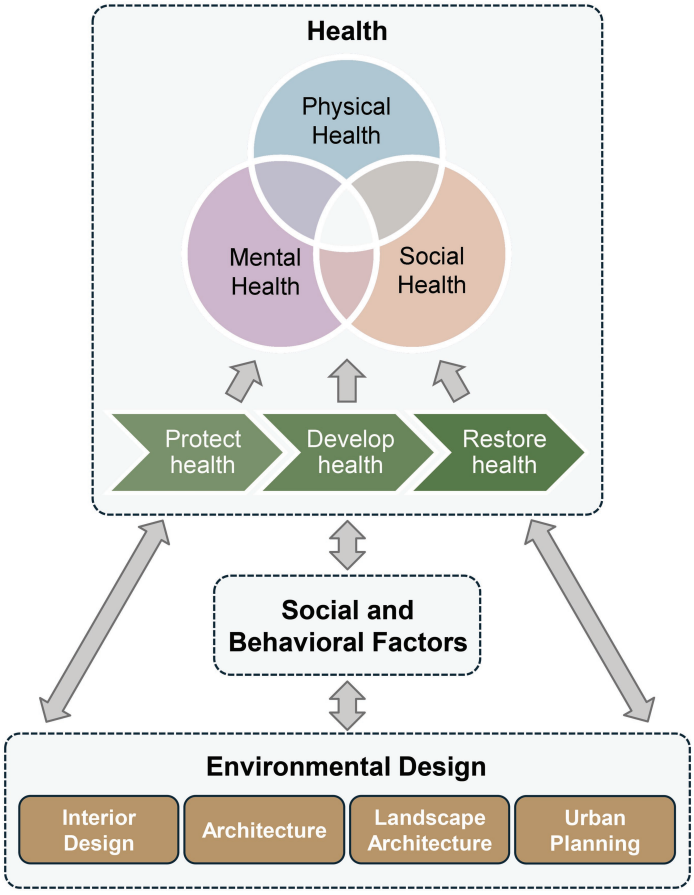
In line with this comprehensive definition of health and the increased emphasis on resilience, there has been a paradigm shift in the approach to health and healthcare from a narrow, reactive, and curative perspective to a more comprehensive, proactive, and preventive approach. Such a shift responds to the fact that noncommunicable, chronic illnesses (e.g., heart diseases and stroke) have become leading public health challenges and that the frequency of mental and social health crises has also risen (14). In addition, our understanding of health and approaches to health promotion have also shifted from more individual-focused approaches to system-focused strategies, recognizing the broader system people live in and its impact on

people's health (15). These shifts echo the suggestion made by Hippocrates almost 2,500 years ago: "The function of protecting and developing health must rank even above that of restoring it when it is impaired" (16 p6).

1.1.3 Environmental Design for Health

With these paradigm shifts, the responsibility of individual and population health lies not only in healthcare but also in the environmental design disciplines that shape people's everyday environments, which can offer or limit opportunities for healthy living (17). This book focuses on the concept of environmental design for health. As illustrated in our conceptual framework (Figure 1.2), we examine various pathways through which the physical environment can help protect, develop, and restore health. Within this proposed framework, we emphasize several key perspectives of design-health relationships.

First, everyday environments are part of the ecosystem for health. Health problems are extremely complex and require multidisciplinary approaches and solutions. Day-to-day environments directly and indirectly impact people's health and well-being. In fact, they are important components of social determinants of health, which refer to the conditions of environments in which people are born, live, work, play, worship, and age (15, 18). These social determinants have significant impacts on a wide range of health, functioning, and quality-of-life outcomes, as well as on social equity (Figure 1.3). According to the WHO, various studies have suggested that social determinants of health account for about 30–55% of our health outcomes (15). Neighborhoods and built environments represent a significant domain that directly affects health on both individual and population levels. It also indirectly affects health by shaping the physical environment for other domains and may further affect related access and equity issues.



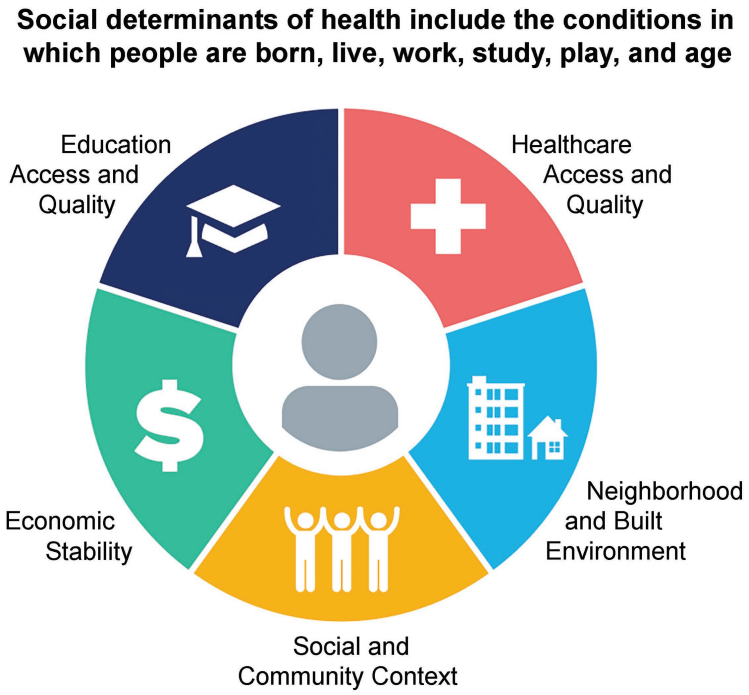
◄ **Figure 1.2**

Conceptual framework of environmental design for health.

▶ **Figure 1.3**

Social determinants of health.

Source: Healthy People 2030, US Department of Health and Human Services, Office of Disease Prevention and Health Promotion. Retrieved March 12, 2025, from https://odphp.health.gov/healthypeople/objectives-and-data/social-determinants-health.



Second, environmental design can be utilized as an effective intervention strategy for health promotion, particularly in settings such as schools, workplaces, and urban parks, which impact a significant portion of the population. This is not to say that environmental design alone can address existing health problems. However, it can play a substantial and active role in health promotion through collaborations with other stakeholders. Environmental designers should develop their designs with people's health and well-being in mind and provide environmental support in the face of health challenges.

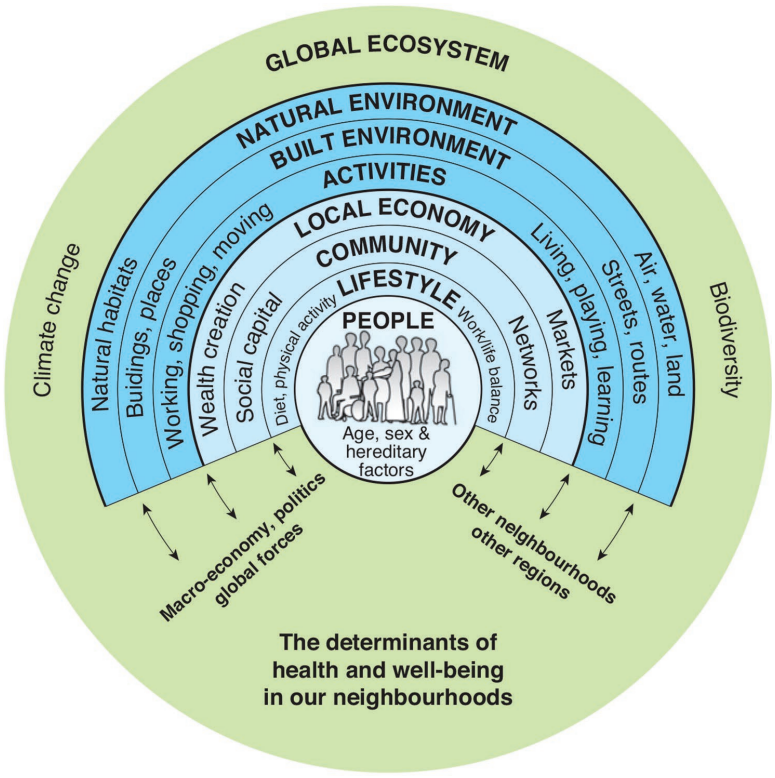
Third, human-centered and outcome-driven approaches are crucial for health promotion. Environmental design and health promotion professionals share a common interest in using such approaches in their professional practice. This provides a solid foundation for environmental designers and public health professionals to collaborate on health promotion at the population level.

1.2 Why Social and Behavioral Factors?

If environmental design is about *where* people live, social and behavioral factors are related to *how* people live. As such, social and behavioral factors interact with both environmental design and health. They provide identifiable and modifiable targets for design interventions and public health interventions to work together to promote healthy lifestyles and population health more effectively.

Environmental design is embedded in social-behavioral contexts, including behavioral preferences and social norms specific to a particular context or population group. The design of any physical environment is intended to accommodate specific behavioral needs and social structures; meanwhile, people may also adjust their environments to meet their own unique social and behavioral needs. A better understanding of social and behavioral factors can help designers provide a wide range of healthy places to better support people's everyday activities.

In addition, the social-behavioral activities people engage in directly impact their health, while their health status may also influence their behavior and social activities. For example, unhealthy lifestyles and high-risk behavior such as lack of physical activity and an energy-dense, micronutrient-poor diet increase the risk of specific health conditions (e.g., obesity, diabetes, and cardiovascular diseases), which have become leading public health challenges.



◄ **Figure 1.4**

The health map illustrates complex determinants of health and well-being in human habitation.

Source: Barton H, Grant M. A health map for the local human habitat. JRSH. 2006;126(6):252–253. Copyright © 2006 by The Royal Society for the Promotion of Health. Reprinted by Permission of Sage Publications.

Severe levels of obesity, diabetes, or cardiovascular diseases may, in turn, impose limitations on people's activity choices in daily routines and compromise their quality of life.

The health map above depicts the complex ecosystem of health and well-being (Figure 1.4). It illustrates the interconnected relationships between our social and behavioral factors (e.g., lifestyle, activities, and the community's social capital and networks), day-to-day environments (built and natural), and health and well-being. Effective design and public health interventions require thoughtful consideration of these multilevel factors and their interactions.

1.3 Intent and Organization of the Book

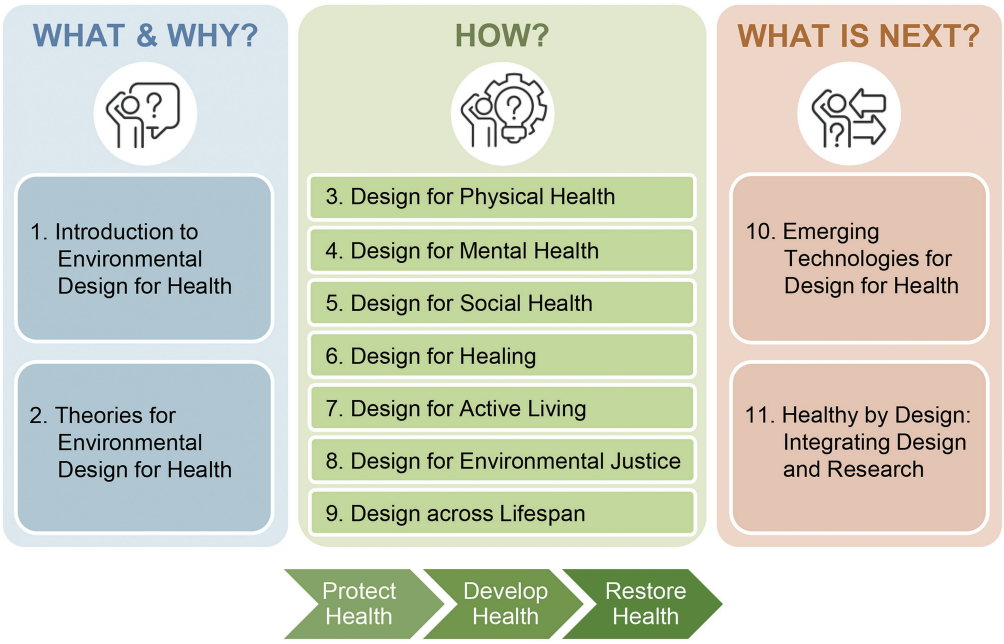
1.3.1 How This Book Benefits You as a Designer or Nondesigner

This book provides a user-friendly guide to the impact of environmental design on individual and population health, as well as the relevant roles of social and behavioral factors. The intended audience includes environmental design students in architecture, interior design, landscape architecture, or urban planning; professional environmental designers seeking extra training or a quick reference guide; and nondesigners such as public health students and professionals or members of the public who are interested in physical environments' role in health promotion.

By employing a human-centered, evidence-based, and solution-oriented approach, this book fills several critical gaps in the current literature on environmental design and public health. First, it addresses the lack of a comprehensive textbook on the intersection of environmental design and public health using the three-tiered concept of providing environments that protect, develop, and restore health. Second, it provides an illustrated and easy-to-use tool for beginning students and professionals alike in fields related to design and health. Third, this book reviews the rapidly advancing technologies that impact environmental design for health.

▶ Figure 1.5

Structure of the book.



In addition, we present and evaluate relevant theories, review the latest state of knowledge and practice, and showcase the application of the latest knowledge through case studies and illustrated design concepts.

1.3.2 Structure of this Book

This book is organized into three sections (Figure 1.5). In the first section, Chapter 1 introduces the concept of environmental design for health and why social and behavioral factors are important in this design-health linkage, followed by an overview of this book's structure. Chapter 2 introduces and evaluates relevant theories about human-environment relationships; environmental assessment, perception, and cognition; and health behavior.

The second section focuses on how to address social and behavioral factors in environmental design for health through specific subtopics. Chapters 3, 4, and 5 discuss design for physical, mental, and social health, respectively, covering various design disciplines and environmental scales. Other chapters in this section delve into more specialized topics, including design for healing (Chapter 6), design for active living (Chapter 7), design for environmental justice (Chapter 8), and design across the lifespan (Chapter 9). Although this book's structure addresses different domains of health (physical, mental, and social) and other subtopics across chapters, it is essential to note that these domains and subtopics are interconnected, as reflected in the complex ecosystem of health (Figure 1.4).

To conclude, the third section focuses on what is next. Chapter 10 addresses emerging technologies, whereas Chapter 11 presents the integration of design and research for a healthier future. We expect that this section will encourage readers to apply the knowledge gained from this book in a forward-looking and proactive manner in health promotion by design.

1.3.3 How to Use This Book as a Tool

Readers can choose to read the whole book from start to finish or select individual chapters based on their areas of interest. The learning objectives presented at the beginning of each chapter outline what the readers can expect to learn. In addition, two appendices are provided at the end of each chapter. The first appendix includes student exercises that could be used as in-class activities or homework. These exercises challenge students to apply the learned content

to critical thinking and analysis, enabling them to better understand the material in an applied context. The second appendix includes a list of key terms, review questions, and relevant tools and databases to help students review the chapter content.

1.4 Summary

In summary, environmental design shapes people's everyday environment and affects their physical, mental, and social health. Social and behavioral factors have an interconnected relationship to both environmental design and health. This book explores how architecture, interior design, landscape architecture, and urban planning affect our physical, mental, and social health, and how these disciplines can contribute to a healthier, more equitable, and more resilient society.

Appendices

Appendix 1.1 Student Exercises

1. **Health and Well-Being in Day-to-Day Environments (individual exercise)**
   Download a Google Map that captures the typical area for your day-to-day activities (i.e., including your home and typical everyday destinations for study, shopping, entertainment, etc.). Convert the map to grayscale with reduced contrast. Use colored markers to identify the places or objects you feel are supportive of or detrimental to your overall health or well-being. Then check these identified items to see if they relate to the disciplines of architecture, interior design, landscape architecture, or urban planning.

2. **Social and Behavioral Factors for Health (individual exercise)**
   Refer to Figures 1.2–1.4 and consider your lifestyle, daily activities, and social relationships. Identify the three most important social and behavioral factors that are supportive of or detrimental to your overall health and well-being. Review these three factors to see if they relate to any elements of everyday environments that you reviewed in the first exercise listed above.

Appendix 1.2 Key Terms, Review Questions, and Relevant Tools and Databases

1. **Key Terms**
   - Environmental design
   - Health
   - Environmental design for health
   - Social determinants of health
2. **Review Questions**
   - What is the World Health Organization (WHO)'s definition of health?
   - Name four disciplines in the field of environmental design and explain their relevance to population health and well-being.
3. **Relevant Tools and Databases**
   - WHO's website about social determinants of health: https://www.who.int/health-topics/social-determinants-of-health#tab=tab_1

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CHAPTER 2

Theories for Environmental Design for Health

Xuemei Zhu, Seokyung Park, and Connie Lin

> Theories are like scaffolding: they are not the house, but you cannot build the house without them.
> —Constance Fenimore Woolson, *Anne* (1892)

Learning Objectives

After reviewing this chapter, readers should be able to:

- Understand what theory is and why it is important and beneficial to use a relevant theoretical framework to guide environmental design for health.
- Identify important theories about human-environment relationships and environmental assessment, perception, and cognition that are highly relevant to environmental design for health.
- Explain important theories about health behavior that are highly relevant to health promotion through environmental changes.
- Describe key constructs and principles of relevant theories and their potential application in environmental design for health.

2.1 Why Are Theories Important in Environmental Design for Health?

Theories provide a systematic approach to understanding the what, why, and how of behaviors, events, and other phenomena. They are typically backed by empirical evidence and predictive of future outcomes in various contexts. Because environmental design aims to achieve specific goals related to human behaviors and experiences within its context, applying relevant theories can inform decision-making and facilitate the development of reasonable predictions for design outcomes. Social and behavioral theories are particularly relevant to environmental design for health because they focus on human behavior and the underlying mechanisms that govern environment-behavior relationships.

As outlined in Chapter 1, environmental design can impact the protection, development, or restoration of health, both directly and indirectly, by affecting multiple pathways related to social and behavioral factors. This implies a significant social responsibility for environmental designers to support and promote people's health. To promote health effectively, environmental designers must have a solid theoretical framework for understanding the connections among physical environments, the sociocultural context, and people's behaviors, thoughts, emotions, and interactions with their surrounding environments. Furthermore, a solid theoretical framework can inform research on the impact of design projects and guide interventions in using environmental design for health promotion (Figure 2.1). Conversely, environmental design, design research, and design/health inventions can contribute to further development and improvement of the theoretical basis.

This chapter introduces social and behavioral theories related to environmental design for health, providing a theoretical foundation for the more specialized topics discussed in the subsequent chapters. We organize relevant theories into three domains (Figure 2.2). In the

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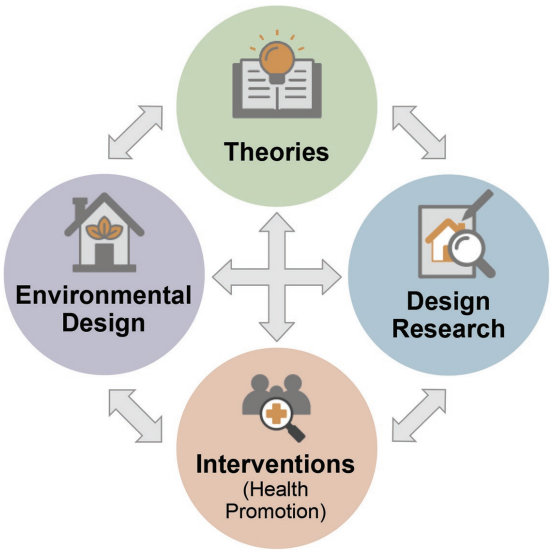
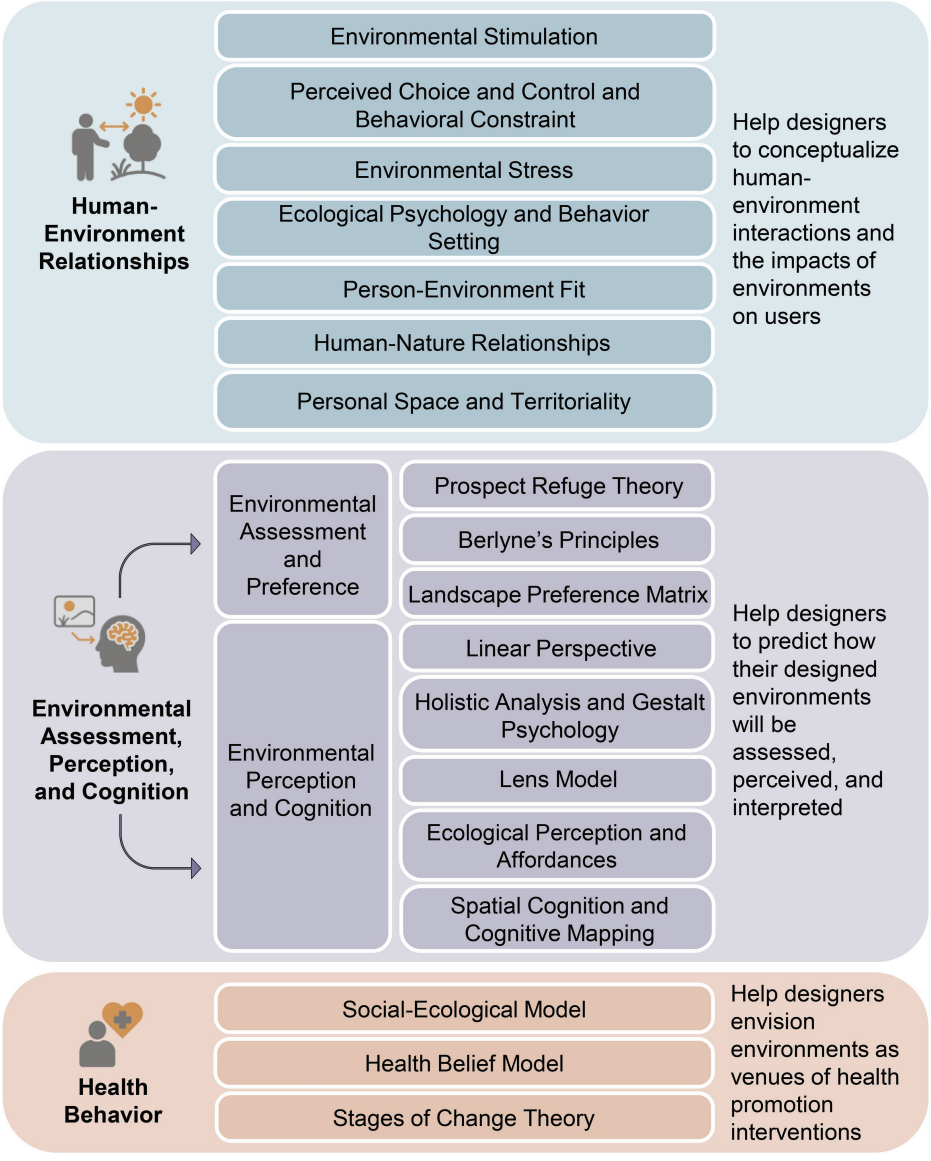
▶ Figure 2.1

Importance of theories for informed design, rigorous research, and effective interventions for health promotion.



▶ Figure 2.2

Social and behavioral theories are highly relevant to environmental design for health.



first domain, theories regarding human-environment relationships help designers better conceptualize human-environment interactions and the impacts of physical and social environments on people's experiences and behavior. The second domain introduces theories related to environmental assessment, perception, and cognition, which help designers predict how users will evaluate, perceive, and interpret their designs. The third domain focuses on change-related health behavior theories, which empower designers to be effective change-makers in using design interventions for health promotion. As we introduce these theories, we provide examples of actual environments or design applications to help make the content more tangible and relatable. We also discuss how these theories can be applied to guiding environmental design for health.

2.2 Human-Environment Relationships

Various theories have been developed to explain the relationships between humans and their environment. Some of the most influential theories for design for health include those related to (a) environmental stimulation, (b) perceived choice and control and behavioral constraint, (c) environmental stress, (d) ecological psychology and behavior setting, (e) person-environment fit, (f) human-nature relationships, and (g) personal space and territoriality. Although we explain these theories and perspectives individually, no single theory addresses all relevant questions. Some phenomena may be better explained by multiple theories, and specific theories may be more or less suitable depending on the purpose of the application or level of analysis.

2.2.1 Environmental Stimulation

Several theories and perspectives explain human responses to their environments through the level of stimulation introduced by the environment across multiple dimensions, such as visual complexity, crowding, noise, temperature, and air pollution. Understanding the types and levels of stimulation can help designers comprehend how people experience specific environments and seek an optimal level of stimulation in their designs.

The arousal perspective. Exposure to an environment increases arousal, which has corresponding physiological, behavioral, or psychological responses (1). Physiological indicators of arousal include increases in brain activity, heart rate, blood pressure, respiration rate, and adrenaline secretion (1, 2). Arousal can be seen as a continuum of responses, with sleep at one end and excitement or heightened wakeful activity at the other (3). Both positive and negative stimulation can lead to increased arousal. People typically respond by interpreting the nature of arousal while also referring to others' responses and opinions. People's performance tends to vary in response to environmental stimuli, with performance being generally higher under a moderate level of stimulation, but this may vary by the complexity of tasks or individual attributes (1).

Over-, under-, and optimal stimulation. At times, levels of environmental stimulation may be overly high or low, and both extremes may have negative impacts (Figure 2.3). Overstimulation occurs when there is an overload of novel or unwanted stimuli (1). People's responses to overstimulation may include "tunnel vision," which ignores less relevant stimuli, accompanied by an evaluation process and resulting coping strategies. Prolonged overstimulation may lead to attention fatigue, which can, in turn, lead to mental errors, difficulty concentrating, and increased irritability (1). Understanding overstimulation and its consequences can help designers be more mindful of reducing undesirable features and utilizing design strategies (e.g., providing views of nature) to help restore attention and focus.

In today's fast-paced world, overstimulation is a common challenge. Nevertheless, some environments may present too little stimulation. Examples of understimulating environments range from extremely isolated environments, such as the Antarctic, to everyday environments, such as office spaces filled with identical cubicles with no windows or opportunities for