

WHY BIOPHILIC DESIGN MATTERS

Understanding the human-nature connection
and the built environment

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CAN YOU DESIGN A SPACE TO BE FULL OF LIFE?

IN SHORT, YES.

Biophilia, or "love of life," is our innate need to connect with nature—something we all could use more of. Immersing ourselves in nature has proven biological and emotional benefits; what if our interiors could do the same?

That's where we turn to biophilic design. As a practice, biophilic design has evolved into an industry-wide movement that recognizes the restorative effects of incorporating nature and natural elements into the built space. For example:

- Researchers are studying biophilia and quantifying its various benefits, including stress reduction, enhanced cognitive function, and faster healing.
- Certifications such as LEED, WELL, and the Living Building Challenge are incorporating biophilic design as part of their rating systems.
- Major companies such as Google are adopting biophilic design principles throughout their real estate portfolios.
- Consultants are increasingly able to strategically leverage biophilic design patterns within spaces to deliver particular outcomes for their clients.

There's no question—we need to bring nature inside.

This idea is something we instinctively understand as designers, but first we must overcome the challenges posed by our contemporary built environments. It can be done, but where do you start? By using the following guide on the whats, whys, and hows of biophilic design in the built space.

Read it. Use it. Come back to it over and over again.

Chip DeGrace
Vice President, Workplace Strategies
Interface



BIOPHILIC DESIGN & THE FUTURE OF THE BUILT ENVIRONMENT

As the prevalence, acceptance, and application of biophilic design grows, how well do you understand it? To truly grasp how nature and biophilic design impact well-being, productivity, and creativity—especially in the workplace—it's vital to understand not only the science behind the concept, but also the ways biophilic design can be implemented in your work.

By familiarizing yourself with the ever-growing applications of biophilic design, you'll be better equipped to recognize its potential to change the way the industry approaches spaces and the materials used to create them.

BIOPHILIC DESIGN DEFINED

The linguistic roots of the term biophilia, coined by social psychologist Erich Fromm in the 1970s, reflect the heart of its meaning: love of life, according to the Biophilia Foundation. Biologist and author Edward Osborne Wilson then popularized the term in the 1980s by introducing the biophilic hypothesis in his book Biophilia, which posits the innate human need to connect with nature. Environmental psychology research has indicated that being connected to nature is an adaptive human function that allows for, and assists with, psychological restoration¹. In other words: it's in our DNA that we need exposure to nature to thrive.

Biophilic design—the theory, science, and practice—is the industry's solution. Those who've adopted it are seeking to address how millions of people across the globe can live in urban areas and work in office, retail, or medical settings, and yet enjoy exposure to natural elements that they need to thrive. It touches almost every aspect of the built environment, from overall structure to the texture of finishes.

The term "built environment" itself implies something that is unnatural. For decades that had been the case with the proliferation of massive office buildings filled with windowless corridors and claustrophobic cubicles. A review of more than 50 empirical studies cited in Interface's study, "Human Spaces: The Global Impact of Biophilic Design in the Workplace" concluded: "An environment devoid of nature may create discord, meaning that such environments can have a negative effect on health and well-being."² Millions of people globally work in spaces that are the antithesis of natural—and surveys reveal that they want and are demanding more.

KEY FINDINGS FROM INTERFACE'S RESEARCH UNCOVERED

47% of office workers worldwide report having no natural light in their office—with the U.S. and U.K. well above average at 64% and 66%, respectively.

58% say their offices have no live plants.

67% report feeling happy when walking into bright office environments accented with green, yellow, or blue colors.

33% say that the design of an office would affect their decision to work at a company.

28% say they don't have a quiet place to work in their office.

The global study asked workers what they most wanted in an office environment. The top three elements cited were:

1 Natural Light—44%

2 Indoor Plants—20%

3 Quiet Working Space—19%

The design industry, in conjunction with forward-thinking clients looking to meet the demands of an increasingly wellness-minded workforce, are beginning to make biophilic design a pre-requisite for any new spaces they commission.

THE RISE OF BIOPHILIC DESIGN

Biophilic design goes beyond aesthetics—it produces real benefits backed by science. In many workplaces, stress and anxiety are widespread epidemics, which impact employee performance and business success. As scientists increasingly examine the impact of everyday stressors by measuring heart rate, blood pressure, and cortisol levels, they're unearthing that exposure to nature promotes fuller psychological restoration and greater attention spans.

There's mounting evidence that nature-inspired spaces enable employees to focus more easily, which may restore—rather than deplete—mental energy and enhance creativity. One explanation is the Attention Restoration Theory, which posits that viewing and experiencing nature engages a different part of the brain than the part used for short bursts of focus, giving the brain an opportunity to reset³.

Research shows a clear link between productivity and office design, according to the Human Spaces report. In the report, Sir Cary Cooper, a professor of organizational psychology and health at Lancaster University, noted, "For the organizations that focus on their spaces, and work hard to deliver meaningful, inspiring workplaces, the dividends are made clear..." He went on to say, "Performance jumps, as does creativity. Yet, there are no off-the-shelf templates for the utopian work environment. Incorporate biophilia, yes, but listen to your people to make sure their preferences and ideals are reflected too."

As another example, the Human Spaces report notes that environments designed with depth and randomness in mind—mimicking the mystery and disarray of natural settings—are known to stimulate reward signals in the brain and lead to increased cognitive activity.

Environmental strategist Bill Browning and his team at Terrapin Bright Green are leading the categorization of key elements in biophilic design by creating a definitive list of 14 patterns. And since publishing the study, "14 Patterns of Biophilic Design: Improving Health and Well-Being in the Built Environment," the team now has enough research to identify a 15th pattern—awe. This knowledge is powerful for designers.

THE FINANCIAL BENEFITS OF BIOPHILIC DESIGN

Biophilic design is good for the bottom line. There's a common misconception that biophilic design is a luxury—accessible only to those with deep pockets. But small shifts in built environments, such as incorporating plants into a space in good proportion, can lead to a significant return on investment. Companies that prioritize employee engagement and wellness tend to outperform those that don't by an average of 10%, according to studies cited in the report "Creating Positive Spaces: Using the Well Building Standard™."

So how exactly does adding greenery yield financial benefits? To start, studies show that productivity costs in industries such as hospitals and corporate offices are 112 times greater than energy costs. If nearly 90% of costs per square foot in a workplace are set aside for employee salaries, as findings from the U.S. Department of Labor suggest, then it's smart business to invest in employee well-being.

One way to appraise biophilic design is with lighting, which has an integral effect on wellness due to its link to our bodies' natural circadian rhythms. Natural lighting solutions can cut costs by about \$2,000 per employee each year and in hospitals, adequate access to daylight and windows with views of nature reduces healthcare costs by more than \$93 million⁴.

Measurable indicators of productivity, such as illness, absenteeism, staff retention, and job performance can all be translated into dollars lost or gained. In a study of university administrative employees, researchers attributed 10% of employee absences to an environment devoid of nature. Employees with a view overlooking trees took less days off than those with a street view or no outside view⁵. Biophilic design also alleviates "presenteeism"—the act of working while not fully engaged. According to the Foresight study of mental capital and well-being, presenteeism costs U.S. companies more than \$200 billion annually⁶.

¹ Van den Berg, A. E., Hartig, T., & Staats, H. (2007). Preference for nature in urbanized societies: Stress, restoration, and the pursuit of sustainability. *Journal of Social Issues*, 63(1), 79-96.

² Grinde, B., & Patil, G. G. (2009). Biophilia: does visual contact with nature impact on health and wellbeing?. *International Journal of Environmental Research and Public Health*, 6(9), 2332-2343

³ Kaplan, S. (2001). Meditation, restoration, and the management of mental fatigue. *Environment and Behavior*, 33(4), 480-506.

⁴ Browning, B. et al. (2012). Why Designing with Nature in Mind Makes Financial Sense. From http://www.terrapinbrightgreen.com/wp-content/uploads/2012/06/The-Economics-of-Biophilia_Terrapin-Bright-Green-2012e.pdf

⁵ Elzeyadi, I. "Daylighting-Bias and Biophilia: Quantifying the Impacts of Daylight on Occupants Health." In: *Thought and Leadership in Green Buildings Research*. Greenbuild 2011 Proceedings. Washington, DC: USGBC Press. 2011.

⁶ Klachefsky, M. (2012). Understanding Presenteeism. Retrieved February 2, 2015, from http://workplacepossibilities.com/wp-content/uploads/Productivity_Insight_3_Understanding_Presenteeism.pdf



NBBJ; The Spheres, Seattle, WA; Photography: Bruce Damonte.

BEYOND THE BUZZWORD: HOW TO APPLY BIOPHILIC DESIGN

The benefits of biophilic design are clear. Focusing on scientifically-backed ways to apply its principles to contemporary spaces is the next logical step.

While there is not yet a universal approach to creating a biophilic space, these three design concepts offer a solid starting point:

- 1. Nature in the Space** integrating plants and water
- 2. Natural Analogues** specifying materials and patterns that evoke nature
- 3. Nature of the Space** designing configurations for depth, openness, and refuge

12 WAYS TO INCORPORATE ELEMENTS OF BIOPHILIC DESIGN INTO A SPACE

1. Green roofs, terraces, and living walls
2. Natural light or lighting that mimics it, with varying intensities of brightness
3. Subtle, pleasant natural aromas
4. Indoor water features
5. Plant installations in common areas
6. Accent colors, primarily greens, blues, and browns
7. Use of minimally processed materials, like wood and stone
8. Ventilation systems that enable air to circulate freely
9. Textured fabrics with patterns similar to those found in nature
10. Established places of refuge (think: Google nap pods)
11. Unimpeded views that spark the imagination
12. Temperature controls that account for humidity and airflow across skin

When in doubt, consider the range of sensations you experience in any natural environment, such as a forest. During a walk in the woods your feet will encounter hard and soft surfaces, such as dried leaves and matted dirt; your eyes will fixate on shifts in light and shadow, as well as height and depth; your nose will take in a variety of scents, such as fresh pine and eucalyptus; and your hands will touch a range of textures, from rough tree bark to velvety moss. Sensations in natural ecosystems are limitless. Why not create a similar range of possibilities in the built environment?

CERTIFICATION 101

Here's how biophilic design is integrated into three green building certification programs.

WELL

Five of the WELL Building Standard's seven concepts directly incorporate biophilia.

AIR Ensure quality levels to support well-being, including optimizing natural and mechanical ventilation

LIGHT Minimize disruptions to circadian rhythms via access to daylight, preferably with a view to nature

MIND Incorporate plants, green roofs, breakout areas, and social spaces

COMFORT Create quiet zones, reduce acoustic disruption, and establish proper thermal controls

NOURISHMENT Offer the space and tools to grow vegetables

LEED

Buildings seeking LEED certification must use at least five qualitative and quantitative biophilic design strategies.

- Provide regular access to Nature in the Space
- Design with Natural Analogues (nature-inspired shapes and forms)
- Include spatial properties that align with Nature of the Space
- Connect to locale, climate, and culture through indigenous materials or spirit of place
- Create sufficient opportunities for human-nature interaction

LIVING BUILDING CHALLENGE

The International Living Future Institute, which launched a Biophilic Design Initiative to increase awareness and foster broad adoption, sponsors the Living Building Challenge consisting of seven "Petals"—Place, Water, Energy, Health & Happiness, Materials, Equity and Beauty—with biophilic design key to three.

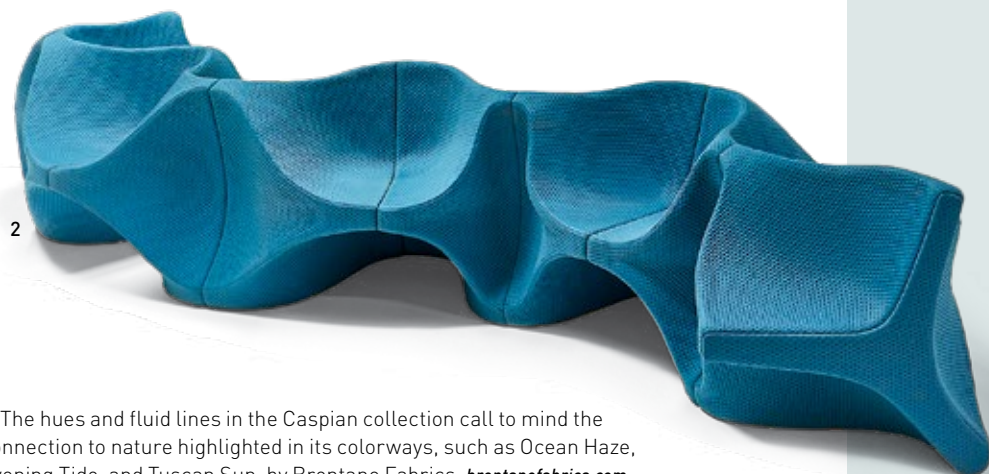
PLACE Requires that the built environment relate to its surrounding nature

HEALTH & HAPPINESS Promotes good indoor air quality and elements that nurture the human-nature connection

MATERIALS Encourages the use of natural, non-toxic, ecologically restorative materials, 50% of which must be sourced from within 1,000 kilometers of the site



1



2

1. The hues and fluid lines in the Caspian collection call to mind the connection to nature highlighted in its colorways, such as Ocean Haze, Evening Tide, and Tuscan Sun, by Brentano Fabrics. brentanofabrics.com

2. Karim Rashid's Heartbeat sofa for Nienkämper takes on a biomorphic form that mimics the ebb and flow of blood moving freely in the body. nienkamper.com

3. Human Connections, a carpet collection designed by David Oakey Designs exclusively for Interface, takes a cue from natural elements, calling to mind moss between stone pavers. interface.com

4. Rios Clementi Hale Studios designed their Rio bench for Janus et Cie as a tribute to the curves and contours of a flowing river. janusetcie.com

5. Metamorphic wall covering evokes the layered patterns found in the strata of sedimentary rock, by Anthology, through Style Library. stylelibrary.com

6. The complex linear patterning in Interface's Drawn Lines LVT tile, designed by Kari Pei, reflects the fractal geometries found in nature. interface.com

7. Naava's One Slim brings nature into any space with an air-purifying living green wall, through Teknion. teknion.com

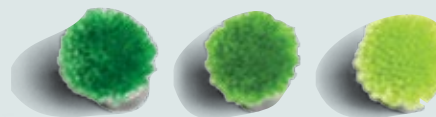
8. Reindeer moss wall panels absorb sound while adding textures found in nature to a space, by Nordgröna, through Scandinavian Spaces. scandinavianspaces.com

DRAWN TO NATURE

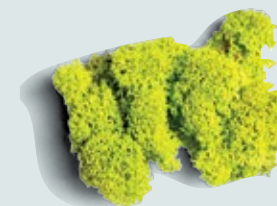
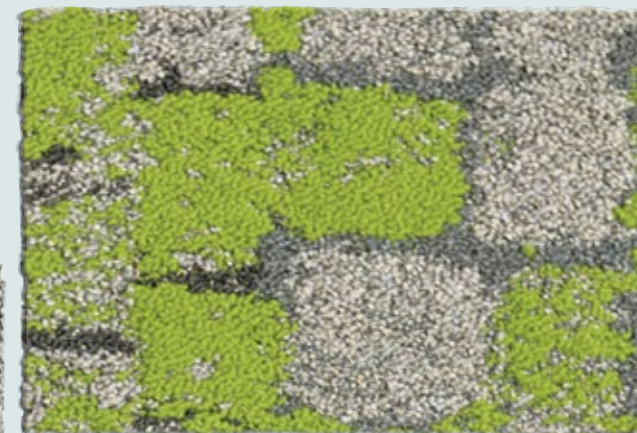


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Complexity and Order, two concepts that may seem at odds on the page, are quite harmonious in nature. Intelligent interior design and, more importantly, selection of products and materials can mimic the appeal of nature's organized chaos. These fractal-patterned flooring options, non-linear furnishings, aqueous prints, and natural materials exemplify the best of biophilic design.



3



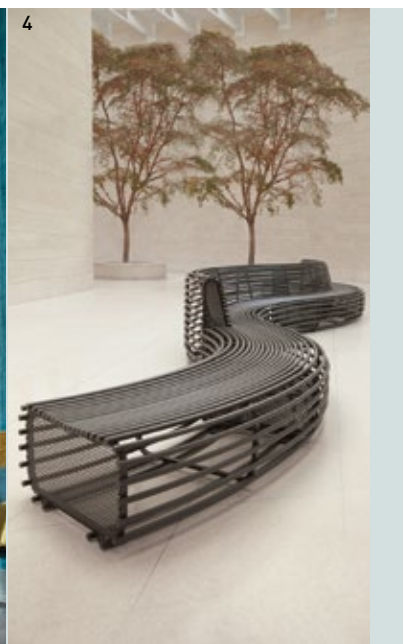
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4

BIOPHILIC PATTERNS FOR THE BUILT ENVIRONMENT

Beyond sunlight and garden views, patterns that mimic those found in nature have also been found to reduce stress, improve creativity, and foster a healthier work environment.

not always the physical or material expression of nature that the term implies. They are also subliminal cognitive stimuli that humans in the built environment can benefit from without consciously realizing their effects. The foundational paper explored the science behind 14 specific patterns—developed through extensive interdisciplinary research involving more than 500 publications on biophilic responses and supported by empirical evidence—and how to best incorporate them into your work.

Here are the 14 original patterns that Terrapin Bright Green detailed within three distinct groups plus a new 15th yet-to-be-published pattern from their evolving research.

NATURE IN THE SPACE

When nature itself—plants, water, soothing sounds, fresh air—are present in an indoor space, the human body reacts in positive ways.

VISUAL CONNECTION WITH NATURE

Windows or outdoor spaces with views of nature, such as a garden, park or body of water, are fundamental. They help reduce stress, improve concentration, and convey a sense of time and weather. While this is often dependent on location, a visual connection with nature can also be established via atrium gardens, aquariums, or green walls. Artwork or video screens with visuals of nature can serve as substitutes.

NON-VISUAL CONNECTION WITH NATURE

The benefits of interacting with nature go beyond what we see. Cues that are olfactory (calming and energizing scents found in nature), auditory (the sound of trickling water or gently chirping birds), haptic (involving the sense of touch with fabrics that emulate natural textures), and gustatory (keeping a rooftop apiary for fresh honey) play a role in biophilic design. Research shows they reduce cognitive fatigue and improve motivation.

NON-RHYTHMIC SENSORY STIMULI

These are randomly occurring elements that establish connections with nature: visual, auditory, or olfactory distractions (e.g. fabric billowing overhead, shadows cast against a wall, plant oils released into the air) that cue one to look up from a computer screen to relieve eye strain.

In “14 Patterns of Biophilic Design: Improving Health and Well-Being in the Built Environment,” environmental consulting and strategic planning firm Terrapin Bright Green detailed the relationship between patterns in nature and their benefits to well-being. These patterns are

4 THERMAL & AIRFLOW VARIABILITY

Natural environments are not hermetically sealed. Factors such as subtle changes in air temperature, humidity, and flow that mimic being outdoors are ideal, whether mechanically created or via operable windows offering cross ventilation.

5 PRESENCE OF WATER

Seeing, hearing, and touching water—a stream or ocean view, the constant rush of a water feature, or a trickling fountain—increases feelings of tranquility and enhances the positive experience of a place.

6 DYNAMIC & DIFFUSE LIGHT

Light and shadow wane and intensify over time. The human body responds to sunlight’s daily color changes from yellow in the morning to blue at midday to red in the evening. Biophilic design endeavors to recreate and leverage these conditions in the built environment via natural daylight from multiple angles and simulated sources such as color tuning and circadian color reference.

7 CONNECTION WITH NATURAL SYSTEMS

Seasonal and temporal changes occurring in a healthy ecosystem can enhance the workplace environment. This can be accomplished with an outdoor patio or green rooftop that’s available to employees for breaks and showcases seasonal vegetation along with the natural patina of metal and weathering of wood.

NATURAL ANALOGUES

These are more likely what come to mind when thinking of patterns—they are visual, tactile, and tangible elements that help foster a connection with the natural world.

Biomorphic Forms & Patterns

Humans have a visual preference for organic or biomorphic forms—the contours, patterns, textures, and numerical arrangements that persist in nature. Fabrics, carpets, and wallpaper based on the Golden Mean or the Fibonacci sequence along with acoustic paneling and free-standing sculptures encourage comfort and contemplation.

Material Connection with Nature

Spaces built using minimally processed materials, namely woods and stones, that reflect the local ecology or geology create a sense of place. But ratio matters when it comes to wood: too much (90% coverage) decreases brain activity—great for a spa but not for an office.

Complexity & Order

Nature has its own patterns and spatial hierarchy, known as fractal geometries. Biophilic design attempts to replicate this rich sensory information within the patterns of everything from wallpaper and carpet design to exposed mechanical systems and structural exoskeletons.

NATURE OF THE SPACE

The human brain, shaped by evolution, responds to spaces that mimic natural experiences.

Prospect

An unimpeded view over a distance—as in the vastness of the African savanna where humans originated—stimulates the natural urge for surveillance and planning. Design-wise, this translates to elevated positions or views across an expanse, such as balconies, catwalks, and partition heights of less than 42 inches.

Refuge

Humans no longer hide in caves, but when deadline pressures or distractions from open-plan workspaces hinder productivity, a place with lowered ceilings where one can withdraw, such as dining alcove or modular nook—conveying a feeling of protection from above and behind—is beneficial to a healthy office environment.

Mystery

Curiosity is part of human nature and replicating that sense of unknown encourages individuals to travel deeper into an environment with a sense of anticipation. This is accomplished via partially obscured views, peek-a-boo windows, and curved edges that draw people through a space.

Risk/Peril

Combining an identifiable risk with a reliable safeguard triggers short doses of dopamine, which supports motivation, memory, and problem solving. Double-height atriums, infinity edges, architectural cantilevers, and transparent railings or floors impart feelings of exhilaration with reassurances of safety.

COMING SOON: Awe

The emotional response to perceptually vast stimuli that transcend current frames of reference. These spaces or stimuli cause pro-social behavior and generate communal feelings, epitomized by the way grand cathedrals inspire religion. They can be large or small, natural or manmade: works of art or natural wonders such as the Grand Canyon.



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