



# Biophilic Design

CREATING NATURE-INSPIRED SPACES FOR STUDENTS

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## Introduction

In recent years, biophilic design has received widespread attention in school architecture in response to the substantial reductions in opportunities for most students, especially in densely populated areas, to have contact with high-quality natural environments. Significant research on the topic of biophilia in education illustrates that a strong connection to nature can enhance a student's cognitive and social development and have positive psychological and physiological effects.

Biophilic design suggests that incorporating characteristics that are rich in nature and nature-inspired features into the physical learning environment can have positive impacts on students' well-being. Despite all the research and findings demonstrating the need for a strong connection with students and nature, it remains a challenge for most school districts to incorporate natural outdoor spaces in their programs.

Today's common habitat is largely a built environment where we spend approximately 90% of our time indoors. Biophilic design in schools is now a necessity.

**Welcome to biophilia, the love for nature in all her manifestations, from the tiniest organism to the greatest red giant floating in the farthest realm of the universe. With biophilia comes a restless curiosity, an urge to investigate and discover the elusive places where we meet nature, where she plays on our senses with colours and forms, perfumes and smells.**

– Sir David Attenborough



**Providing students areas with access to nature has been shown to offer mental restoration, better behavior, and enhanced focus.**





**Integrating biophilia in educational spaces improves the performance of children in studying and increasing their creativity.**

## What is Biophilia?

Biophilia, a term coined by social psychologist Erich Fromm (1964) translated to “love of life,” is the inherent human inclination to affiliate and connect with nature, especially life and life-like features of the nonhuman environment (Kellert, 2008). Today, we are seeing biophilic design more often as an approach to designing schools that seeks to connect the need of students and teachers more closely to nature’s forms and processes by replicating experiences of nature in the design of schools. Unlike biomimicry, which recognizes the innovation potential of life’s tested-and-true technologies, biophilia recognizes the health and wellness benefits of our biological connectivity with nature.

## Why Biophilic Design?

Our appreciation and desire for nature has been exceedingly dampened, if not replaced, with pressing societal goals, growing urbanization, capitalistic conception, the celebration of urban and contemporary architectural forms, and technology, all of which significantly weaken opportunities for students to encounter healthy and abundant natural systems. With the ever-changing urban environment that we live in, and the dismantling of the natural world around it, biophilic design seeks to counter the adverse health effects of this rapid urbanization.

We have begun to realize the importance and benefits of biophilia and how it can support learning and student wellness in schools.

People’s dependence on contact with nature reflects the reality of having evolved in a largely natural, not artificial or constructed, world (Kellert, 2008). We need that ongoing connection with the natural world just as we need our exercise and healthy foods to flourish. Since the beginning of time, humans have been living with and evolving with nature and we have an inherent human affinity to affiliate with natural systems. Being surrounded by nature is in our DNA.



## Biophilic Design for Students

**Childhood is considered as the time when experiencing nature is most essential to human physical and mental development (Kellert, 2005).**

What better way to help educate students about the most pressing problems of our time than by adopting strategies of nature-inspired designs in our schools to help reestablish the beneficial experience of nature in the modern built environment.

Maybe you, like me, remember a time in your childhood that brought you joy. Maybe that moment was climbing the towering tree in the backyard or hiding behind the bushes playing hide and seek. When we integrate biophilic strategies into our schools, whether big or small, we see the joy students gain from it and the multiple benefits that it brings to their quality of life and experience of school.

Children experience connections and the joy of nature in a variety of ways. The experiences can include direct contacts with nature such as spontaneous play in the backyard or neighborhood park, exploring in a nearby creek, or a garden; indirect experiences that are more managed and scheduled that might include school trips to the zoo, aquariums, botanical gardens, nature centers and science museums; and symbolic or metaphorical experiences through books, film and architectural shapes and forms depicting nature. When coupled with direct contact and immersion in nearby nature, symbolic encounters provide extraordinary opportunities for psychological growth and development (Kahn & Keller, 2002).

Biophilic design is about connecting people to nature. Studies have found that students in schools that emphasize and incorporate natural materials, natural lighting, interior plants, and exposure to natural environments have higher test scores, as well as improved attendance and motivation; teachers and other staff, too, have better performance, morale, recruitment, and retention (Kellert, 2018). Furthermore, children with greater exposure to nature reported greater physical strength and coordination, better self-esteem and self-confidence, an enhanced ability to cope with challenge and adversity, and higher critical-thinking, problem-solving, and creative abilities (Kellert, 2018).

Redbud Elementary School - main corridor from second floor, Round Rock, Texas →  
Photograph by Wade Griffith



**The benefits of biophilia include improved stress recovery rates, lower blood pressure, improved cognitive functions, enhanced mental stamina and focus, decreased violence and criminal activity, elevated moods, and increased learning rates.**

Kellert (2005), one of the pioneers of biophilic design, summarizes the following findings worth noting:

**Contact with nature has been found to enhance healing and recovery from illness, including direct contact, as well as representational and symbolic depictions of nature.**

**Experiencing natural processes and diversity is critical to human material and mental well-being.**

**Childhood is considered as the time when experiencing nature is most essential to human physical and mental maturation.**

**Young people need to engage the natural world repeatedly and in multiple ways to mature effectively.**

**The human brain responds functionally to sensory patterns and cues emanating from the natural environment.**

↓ Redbud Elementary School - 'Tree of Hands' graphic, Round Rock, Texas  
Photograph by PBK Architects





**A pilot study conducted in 2019 in collaboration of Craig Gauden Davis, Morgan State University, The Salk Institute for Biological Studies and Terrapin Bright Green (Determan, 2019) had the following findings:**

Students felt significantly more positive in the biophilic classroom when compared to the control classroom regarding physical space, their enjoyment of math lessons, and their level of involvement.

**35%** of students in a biophilic classroom perceived their stress to be high compared to **67%** of students in the control room.

**7.2%** more students tested at grade level in the biophilic classroom

The average test score gain was

**3.3x**

higher in a biophilic classroom



## Patterns of Biophilic Design

How do we bring these beneficial experiences of nature into the design of contemporary school environments? Research has yielded three basic elements to biophilic design that represent fundamental ways that people experience nature.

### Nature in the Space: A direct experience with the natural world

This involves actual contact with environmental features in the natural environment including natural light, air, plants, animals, water, and landscapes. The awareness of natural light can facilitate movement and wayfinding which contributes to student comfort and satisfaction. The smells and sounds of a flowering garden or dropping hydroponic farm can relieve stress and improve moods and productivity. Contacts with animal life can be achieved through such design strategies as bird feeders, green roofs, gardens, and aquariums. Where possible, the site of water can be visually appealing and capable of engaging a wide variety of senses including sound, movement, touch, taste, and smell.

### Natural Analogues: Indirect representations of the natural world

The use of natural patterns, objects, shapes, materials, and textures can immerse students in a natural-feeling environment. The occurrence of naturalistic shapes and forms can transform a static space into one that possesses the dynamic and ambient qualities of a living system. Natural shapes and forms are among the most enduring and powerful ways of bringing nature into the built environment. Representational expressions of nature should be repeated and thematic throughout the school. Mimicry of shells, leaves, furniture with organic shapes, and natural materials, each provide an indirect connection with nature. The use of colors found in nature such as greens and blues create a sense of calmness, tranquility and have been shown to lower stress levels.

### Nature of the Space: A dimensional experience of space and place

Nature of the Space addresses the three-dimensional experience of the space that overwhelms, inspires, and leads us to feel humble. The strongest Nature of the Space experiences are achieved through the creation of deliberate and engaging spatial configurations commingled with patterns of Nature in the Space and Natural Analogues. This includes partially obscured views or other sensory devices that entice the individual to travel deeper into the space, places of refuge to withdraw from the main flow of activity, and the idea of prospect in the space with unimpeded views over a distance.





CASE STUDY

## REDBUD ELEMENTARY SCHOOL

Round Rock, Texas

**R**edbud Elementary School, a fitting name for a school designed around the concept of a magnificent tree. Featuring organic forms, natural hues and abundant sunlight, the new Redbud Elementary School in Round Rock, Texas is designed with specific biophilic principles in mind and demonstrates potential ways in which beneficial aspects and forms of nature can be integrated into educational spaces. Biophilic design is woven throughout the school and creates a sense of calm, emotional safety, and wellness for the students while at the same time allowing them a sense of discovery and anticipation to explore and have fun while learning.

Redbud Elementary was designed to inspire and bring joy to students. The nature inspired design of the school was maintained from design conception through construction. The school's 123,000 square feet serves 900 students in grades PreK-5 in a variety of fun and creative spaces.

From the onset, students are introduced to the importance of the natural environment and its connection to their healthy development. Here, students relate to nature through abundant natural light, views to the outside, organic geometries, materials, and color selections.

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← **Redbud Elementary School - parent drop-off and main entry**, Round Rock, Texas  
Photograph by Wade Griffith



## The Natural Experience

The biophilic theme is incorporated into the design of the building in a variety of ways. The experience of the building and the biophilic design starts at the entry, with a roof resembling the wings of a playful butterfly landing to welcome the students as they enter the school.

As you enter, symbolic references to nature represented by patterns and textures in the materials and natural forms immerse the students in a natural-feeling environment and entices them to travel deeper into the school; the corridor mimics walking through the woods along a wood deck with grass and stone borders along its sides.

Down the main spine of the school, a tree, with a broad base supporting progressively narrower, higher levels and a canopy of leaf-shaped ceiling clouds creates a sense of warmth and protection of being under the cover of a living organism. The tree serves as the hub of campus activity. Every student passes by it. It is the gathering place where teachers hold group meetings, students learn on their devices and read books inside its trunk.

These repetitive natural forms connect the students to features and patterns found in nature that allow them to recharge and improve their ability to focus throughout the day. In the library, students can gather in a leaf-shaped table, huddle over a book on a carpet with a grass-like texture or climb onto a wood bench that surrounds the tree structure.



Reconnecting with nature has been recognized as one of the most urgent challenges in contemporary urban architecture.

(Beatley, 2017)

One child, one teacher,





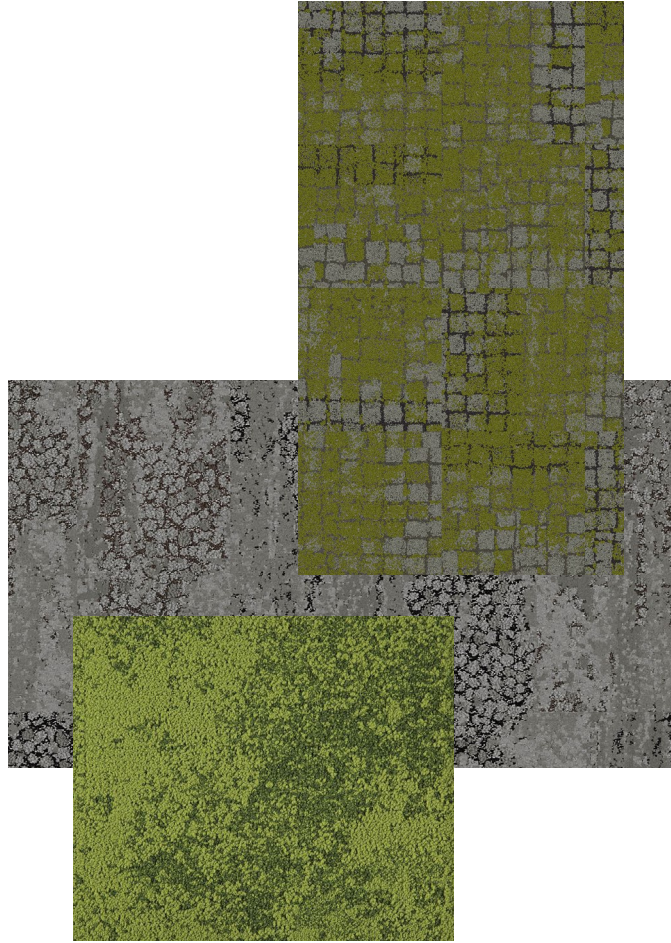
## Nature of the Space

The school plays with light, space, and hierarchy to create both a sense of place and movement throughout the building. The orientation and flow of the school allow it to be flooded with natural light and numerous visual connections to the outdoors. The high ceilings and proportions of the main spine create a sense of spaciousness, where the focus becomes the natural forms of the ceiling clouds and the main tree located in the heart of the school. This lightness and wonder of the space contrast with the more intimate low ceiling classroom wings which helps to create a progressive hierarchy through the school. The shapes and forms throughout the school are inspired by nature, especially living organisms, and are imaginative and creative, rather than exact replicas of those encountered in the natural world.

**Biophilic design can reduce stress, enhance creativity and clarity of thought, improve our well-being, and expedite healing (Browning, 2014).**







Carpets Inspired by Nature

## Materiality

The design includes widespread use of natural like materials, natural colors and textures, organic shapes and forms, various points of prospect and refuge, transitional spaces, and the integration of tree-like forms that creates a heart-like setting within the school.







**“Study nature, love nature,  
stay close to nature. It will  
never fail you.”**

-Frank Lloyd Wright

## Natural Analogues

All through the school, you see colors that are prevalent in the natural world. Blue hues familiarize the students with clear skies, clean water, and even winter. After blue, green, the second most prevalent color in the natural world, a color we associate with forests, fields, fertile landscapes and suggestions of flowering plants, summer, and spring brings joy to the students.

Green is a color we find comfortable to live with; scientists believe that, because our eyes, in daylight, detect wavelengths corresponding with the color green more readily than any other color, our brain and nervous systems feel calm when we look at green. Research has shown that we're predisposed to like the natural greens associated with plant life and exposure to green spaces lifts our mood and sense of wellbeing. Earth tones that fill our natural landscape are also prevalent in the school. The gentle browns of the wood grains, the grays in the tiles, and stone and sandy hues are characteristic of the rocks, pebbles and woodlands found in nature.





## Colors from Nature

Each wing of the school is designed around the seasons, with lime greens that come in spring, the dark greens of summer, the cold blues and whites of winter, and the vibrant oranges of fall.

Classrooms are designed to be flexible in layout, with visually and physically integrated access to flex areas and small group rooms allowing for collaborative and individual learning as well as other various learning opportunities throughout the day. Operable sliding glass walls in every classroom and flexible furniture allow each space to adapt to individual, group, or multi-classroom formats.





← Redbud Elementary School - outdoor learning opportunities, Round Rock, Texas

## Nature in the Space

The most successful projects address biophilic design through a mix of direct and indirect connections to a building's setting and place. Redbud Elementary fosters positive, everyday interactions and relationships with the environment through a series of outdoor pockets for play, exploration, and outdoor learning. Students can see and smell a flowering garden in one of the central courtyards or have an outdoor class lesson under a leaf-shaped canopy. There are also opportunities to experience wildflowers and butterfly gardens growing along a meandering gravel path leading to a series of limestone benches for outdoor learning.



**“It seems to me that the natural world is the greatest source of excitement; the greatest source of visual beauty; the greatest source of intellectual interest.”**

-Frank Lloyd Wright

## Final Thoughts

It cannot be denied that there exists a significant gap between the natural and built worlds. Biophilic design concepts create an opportunity to drastically improve student experiences and bridge this gap. School buildings have great potential to help reconnect students to nature and foster positive connections between them and their natural environment.

Research shows that there exists a critical and irreplaceable role of nature for all children. As school designers, we must bring the multitude of opportunities for engagement, discovery, creativity, joy, wonder and adventure not just outside the building but within the fabric and structure of the interior spaces students use throughout their entire experience in school. And although some biophilic concepts are visual and sensory in nature, they help shift environmental awareness in the value of the relationship between humans and nature.

Biophilic design can celebrate, protect, restore flora, fauna, and the local ecosystem while taking every opportunity to integrate forms from nature within the built environment. Biophilic design in schools offers us hope, by promoting student health and wellbeing and helping us find new ways to define, inspire and bring joy to students in the school environment.



**The team has “created an extraordinary elementary school with biophilic vernacular and detailing that is truly beautiful, inspirational and functional.”**

- Round Rock ISD Chief Operating Officer, Terry Worcester A.I.A.





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