Nature-Based Play and Learning

A Literature Review
2024 Update

PEER Associates, Inc.

Primary authors: Amy Powers, Andrew Powers, and Qing Ren

Why Care About Nature-Based Play and Learning?


Hudson Highlands Nature Museum, Michael Adamovic

"Students at our school develop their character, refuel their attention, and build their knowledge through the wonder and awe of nature play in the woods behind our school.

As the Principal of the Prosper Valley School, it warms my heart to watch them build forts from fallen branches, and turn over rocks and logs looking for worms and insects. I hear their vocabularies blossom as richly as the wildflowers and invasive plants they discover along the banks of Barnard Brook and Cloudland Brook. I see their curiosity and respect for the environment (and each other) grow as excited groups of students lick maple sap from their finger tips, or scramble about to examine a moth, grasshopper, or frog.

The outdoors is the most important classroom our students have."

-- Aaron Cinquemani

This review is an updated version of an original document published in 2018 as an extension of a larger program evaluation project completed by PEER Associates for Four Winds Nature Institute (FWNI). PEER works closely with organizations large and small to help them use evaluation processes, data, and mindsets to better achieve their missions. PEER specializes in place-based, environmental, and informal science education programming. FWNI is a non-profit organization advancing the understanding, appreciation, and protection of the environment through community-based natural science education and research.

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Cover: Mount Lebanon Elementary School (top); Four Winds Nature Institute (bottom).

Everyone wants to see children becoming joyful, engaged learners who actively seek out knowledge with curiosity and enthusiasm. We also want them to continue growing into well-adjusted individuals who can thrive in school and in the complex, problem-saturated world we all face. They need to be equipped with the social-emotional skills to confidently express themselves, focus on learning and critical thinking, get along with classmates from diverse backgrounds, regulate their emotions in age-appropriate ways, and tackle new experiences with flexibility and an open heart and mind.

Much of today's early childhood education system places an ever-growing emphasis on narrowly defined academic standards and technology, rather than focusing on the developmental needs of young children and on the communities that they need in order to thrive.

More time learning and playing in nature can help prepare our youngest students for the


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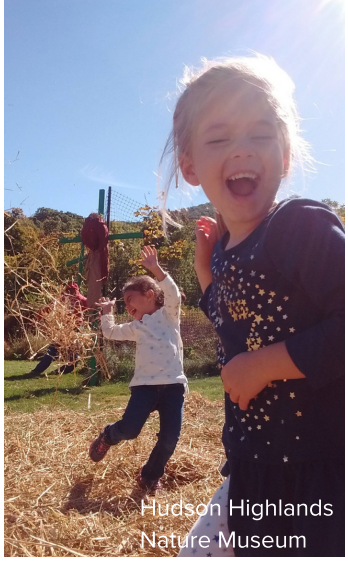
complex future they will face. Research cited in this review demonstrates that nature-based play and learning can:

- improve children's social-emotional skills;
- reduce stress;
- boost physical health through increased activity;
- enhance cognitive development and academic performance; and
- lay the groundwork for a sense of stewardship for the environment.

Together, we need to move early childhood education toward more joyful learning that integrates socio-emotional and academic learning. School leaders are uniquely positioned to shape this future by creating policies and school cultures that promote increased outdoor play and learning. Caregivers and educators can advocate for providing more access to nature play and learning activities in their home, school, and community. Families can applaud schools for designating outdoor time for unstructured nature play, creating natural play areas, and incorporating nature-based lessons.

This literature review provides evidence to guide and inspire such action.

Research Highlights


Hudson Highlands Nature Museum

Learning outdoors has been shown to provide **ACADEMIC BENEFITS** both during and after lessons. Students participating in a nature-based learning program consistently outperformed the control group in knowledge of science and overall academic performance (Kroencke et al., 2015; Mann et al., 2022; Wu et al., 2014).

Play and learning activities in nature and naturalized settings have been shown to provide opportunities for improved **SOCIAL RELATIONS** among children, between students and teachers, and across school communities as a whole (Bates et al., 2018; Pollin & Retzlaff-Fürst, 2021; Skar et al., 2016).


Four Winds Nature Center, Mike Clough

Activities offered in natural settings provided greater **MENTAL AND EMOTIONAL HEALTH** benefits by promoting concentration and relieving stress. Children and adolescents with proximity to green space had fewer emotional and mental health problems, fewer aggressive behaviors, and higher emotional resilience (Dadvand et al., 2015; Dankiw et al., 2020; Flouri et al., 2014).

Stronger **CLASSROOM ENGAGEMENT** was observed after lessons in nature than after their matched indoor counterparts (Cameron-Faulkner et al., 2018; Kuo, M., Matthew, H. E., & Penner, 2018; Roe & Aspinall, 2011).

Over the past decade, the **DECLINE OF OUTDOOR TIME** and unstructured play in young children's lives in the US and other countries has been well documented in both the scientific literature and the popular press (Hofferth & Sandberg, 2001; Hofferth, 2009; Louv, 2008).
In response to this trend, many organizations have sought to **INCREASE ACCESS** to nature play in childhood. For example, the number of nature preschools and kindergartens in the US reached 250 in 2017 (Boldemann et al., 2006; NAAEE, 2017).


Hudson Highlands Nature Museum, Michael Adamovic


Retribe Forest School, Shem Roose

Outdoor educational settings have provided a powerful context for young children to explore, develop, and hone **MATH SKILLS** (Chawla & Derr, 2012; Maxwell et al., 2008; Roe & Aspinall, 2011).

Nature play has been shown to influence children's **COGNITIVE DEVELOPMENT** by promoting attention skills and short-term memory, and to help children replenish depleted attention systems and protect them against inattention-hyperactivity symptoms (Dadvand et al., 2015; Wu et al., 2013; Younan et al., 2016).

Nature can provide opportunities for **FREE AND SPONTANEOUS PLAY** and for more dramatic social play, which helps children to develop peer relationships as they learn social skills (Drown & Christensen, 2014; Howes et al., 1988; Skar et al., 2016).

Natural outdoor classrooms have enhanced children's **CREATIVITY AND IMAGINATION** by providing opportunities to discriminate between, identify, and classify objects. Predictable spaces, ample and consistent time, open-ended materials, and caring, observant adults who support creative play and learning were key factors (Finch & Loza, 2015; Fjørtoft, 2004; Kiewra & Veselack, 2016).

Natural components in school environments can contribute to children's **PHYSICAL HEALTH**. Natural playgrounds and loose materials were shown to enable children to engage in moderate-to-vigorous physical activity (MVPA) and improve their motor fitness (Coe et al., 2014; Maxwell et al., 2008; Skar et al., 2016).

Nature play could also increase sun exposure and synthesis of **VITAMIN D**. Children who spend more time outdoors at school were less likely to be, or to become, nearsighted (French et al., 2013; Knippenberg et al., 2013; Wu et al., 2015).

Nature play and learning can have a profound influence on children's values toward nature and **PRO-ENVIRONMENTAL BEHAVIOR**. Positive experiences in nature, specifically psychological restoration (being away from everyday worries and distractions), have acted as a motivational factor enhancing children's pro-environmental behavior. This influence could also last through their adult life (Chawla, 2013; Gibson, 2011; Prévot et al., 2016).

Research Details

Nature-based play and learning encompasses a spectrum of intentional outdoor activity, from child-led unstructured play to adult-led structured lessons with specific learning goals. This can include general exposure to natural settings, active participation in outdoor activities, and garden-based learning. The research summarized here examines the many benefits of this diversity of nature-based activities for young children.

The decline of outdoor time and unstructured play in childhood has been well documented (Louv, 2008). The outdoor time among children under the age of 13 generally decreased between 1981 and 2003 (Hofferth, 2009; Hofferth & Sandberg, 2001). In response, scholarship on and programs providing nature play have blossomed, yielding a growing body of evidence on positive impacts. This review briefly summarizes findings on nature play benefits including: social-emotional skills, reduced stress, physical health, cognitive and academic gains, and environmental stewardship. The range of these benefits highlights the multifaceted value of nature-based approaches for the development of the whole child.

A goal of this review was to add to the existing body of work summarizing the benefits of children's engagement with nature. The selected citations are from recent research as much as possible. Older, foundational research in the field is cited where newer studies were not available.

Nature play can improve children's social development and promote social harmony

Play and learning activities in nature and naturalized settings have been shown to provide opportunities for improved social relations among children, students, teachers, and their school communities.

A study conducted among English students who regularly attended forest school found that it improved children's social skills (O'Brien and Murray, 2006). Students demonstrated an increased awareness of the consequences of their actions on others, including both peers and adults. This heightened awareness translated into an enhanced ability to engage collaboratively in activities, whether it was sharing tools, completing tasks, or participating in cooperative play. In a related vein, research from low-income Chicago communities revealed that the greening of schoolyards was associated with sustained

Amy Powers

improvements in prosocial behaviors like conflict resolution, emotional regulation, and perspective-taking among K-8 students (Bates, A.J., Bohnert, A.M., & Gerstein, D.E., 2018).

Compared to indoor school settings, nature can provide opportunities for more dramatic social play (Drown & Christensen, 2014), which helps children to develop peer relationships as they learn social skills such as collaboration, altruistic behavior, and self-control (Gifford & Chen, 2016; Howes, 1988; Howes & Matheson, 1992). In addition, free and spontaneous play may be more effective than planned activities in promoting children's interactions with each other and nature. Skar et al. (2016) explained that when adults moved into the background and let children's play develop on its own terms and in one place for a longer period of time, children came closer to both the natural environment and to each other.

A systematic review by Ardoin and Bowers (2020) of research on early childhood environmental education found consistent benefits in the area of social-emotional development, including improvements in young children's social skills, self-regulation abilities such as emotional and behavioral control, and increases in emotional understanding and empathy.

Another systematic review by Johnstone et al. (2022) found that children who participated in nature-based Early Childhood Education (ECE) exhibited improvements in self-regulation, social skills, and overall social and emotional development.


Hartland Elementary School

Qualitative insights from the review highlighted that nature-based ECE provided children with diverse opportunities for play, fostering imagination, creativity, and prosocial interactions compared to traditional ECE settings. The review suggests that the dynamic and varied affordances in nature-based ECE might facilitate a broader range of play types, integral to social and emotional development.

Practitioners of outdoor learning have described how it can create school unity by contributing to an increased quality of relationships across all members of a school community -- student to student, teacher to teacher, and student to teacher. The effects included cross-grade collaboration and connections, as well as more constructive relationships in which students and teachers acted in a family-like way, displaying responsibility and caring (Bjorge et al 2017; Broda, 2011; Gibson, 2011).

Research has shown that the teacher-student relationship in early childhood education can influence academic performance and engagement through eighth grade, especially for students with marginalized performance and behavior problems (Hamre & Pianta, 2001; Roorda, Jak, Zee, Oort, & Koomen, 2017). Using outdoor learning strategies to promote social cohesion throughout the school community may pay longer-term dividends across many dimensions of the educational experience. Furthermore, research by Cameron-Faulkner et al. (2018) highlighted that natural environments can significantly enhance parent-child communication, suggesting that such environments foster more responsive, connected interactions.

Other researchers have found that certain elements of natural play and learning environments create a setting conducive to building social harmony within and beyond school. For instance, a study on preschool children from multiple U.S. states concluded that abundant natural materials and outdoor play space reduced competition and conflicts among children and encouraged generosity toward others (Dennis et al. 2014).

Nature immersion can benefit children's mental and emotional health

Recent research paints a concerning picture of the decline in children's mental health. For instance, one study highlighted a 29% increase in diagnosed anxiety and a 27% rise in depression among US children and adolescents from 2016 to 2019 (Lebrun-Harris et al., 2022). Notably, these figures were recorded before the onset of the COVID 19 pandemic, which introduced additional stressors. While schools may find it challenging to address broader societal factors such as social media use and family stress, they can proactively introduce nature play and learning interventions that can serve as protective strategies to enhance children's mental well-being.

A systematic review by Lee et al (2020) found that unstructured play, particularly in natural settings, had a positive effect on reducing young children's symptoms of stress, anxiety, and depression. Looking more broadly at the relationship between nature and children's health, a systematic

Boston Nature Center

review conducted by Fyfe-Johnson et al. (2021) found that nature exposure was consistently linked to improved mental well-being in children, with specific benefits including reduced anxiety and enhanced mood.

Dopko et al. (2019) investigated the psychological and social benefits of nature experiences for children. The study revealed that children who engaged in nature activities displayed improved mood, increased social connection, and a heightened sense of belonging.

A variety of research has shown that activities offered in natural settings provide greater mental and emotional health benefits when compared to similar activities conducted in indoor settings. Children spending time in an outdoor education setting (forest school) versus a conventional indoor school setting reported reduced stress and greater energy and ability to feel pleasure (Roe and Aspinall, 2011). Compared to indoor classrooms, natural areas were shown to promote concentration and relief from stress in a study of students aged 9-13 (Chawla et al., 2013). Students frequently described the natural habitat and gardens as peaceful, calm, and relaxing.

In a study examining the effects of enhancing outdoor play environments at childcare centers with natural materials to promote nature and risky play, Brussoni et al. (2017) found significant reductions in depressed affect and antisocial behavior

Mount Lebanon Elementary School

among 45 children aged 2 to 5. Additionally, early childhood educators observed improvements in children's socialization, problem-solving, focus, self-regulation, and self-confidence, along with decreased stress and boredom.

Cumulative childhood stress can affect cognitive development and trigger mental health issues later in life (Hanson et al., 2016). Therefore, the psychologically restorative outcomes resulting from increased time spent in nature could also have a long-term impact on children’s mental health.

Retribe Forest School

Nature play can enhance children's physical health

An increasingly sedentary lifestyle, spending more time indoors using electronic media, and less time engaged in outdoor unstructured play, are major contributors to the decline in children's health (McCurdy, Winterbottom, Mehta, & Roberts, 2010). The need for greater activity is clear, and school environments present an opportunity to influence activity levels for all children.

Systematic reviews by Dankiw et al. (2020) and Fyfe-Johnson et al. (2021) rigorously analyzed multiple studies and consistently reported that contact with nature and nature play lead to increased physical activity levels in children. Dankiw et al. further highlighted improved motor skills as a benefit of unstructured nature play in early childhood.

Researchers have found that natural components in school environments can contribute to children's physical health. Soderstrom et al. (2013) compared the health of Swedish preschoolers who had high-quality schoolyards with trees and hilly terrain with play structures, versus preschoolers with schoolyards with less nature integration. High-quality outdoor spaces were associated with better physical health outcomes such as longer sleep at night and higher health ratings by parents.

Compared to traditional playgrounds, natural playgrounds were shown to enable children to engage in moderate-to-vigorous physical activity (MVPA) (Boldemann et al., 2006; Coe et al., 2014) and improve their motor fitness (Fjørtoft, 2004). Engelen et al. (2013) found that introducing loose materials (play objects and materials that are open ended and manipulable) to traditional playgrounds significantly increased the amount of MVPA in 5- to 7-year-old children during break times, and the benefits were maintained over a longer time period. Natural playgrounds offer accessible and abundant loose materials from nature (e.g. sand, water, sticks, dirt) and ample space to introduce recyclable and manufactured loose materials for creative and constructive play.

As with any time spent outdoors, nature play also affords increased sun exposure and synthesis of Vitamin D (McCurdy et al., 2010), which is critical to the development of bones, muscles, and neurons, as well as lessening depressive symptoms and increasing feelings of vitality (Knippenberg et al., 2013). Multiple studies have shown that children who spend more time outdoors at school are less likely to be, or to become, nearsighted (French, Ashby, Morgan, & Rose, 2013; He et al., 2015; P.-C. Wu, Tsai, Wu, Yang, & Kuo, 2013).

Nature play and learning can benefit children's cognitive development and academic performance

Cognitive development refers to the growth and refinement of thinking skills, problem-solving, and attention mechanisms, while academic performance specifically measures mastery in subjects like math, science, and language. Research has illuminated the benefits of nature play and learning interventions in enhancing both these crucial areas of a child's development.

A systematic review by Fyfe-Johnson et al. (2021) that included 296 studies found high strength evidence that nature provides cognitive benefits for children, especially for preschool and elementary school-aged children. Both correlational studies on residential greenness and experimental studies of nature-based interventions found that nature exposure enhances attention, memory, creativity, and imagination, and reduces hyperactivity and inattentive symptoms.

A study of Norwegian preschoolers found that the amount of time children spent outdoors in daycare was positively related to attention skills and short-term memory (Ulset et al., 2017). Outdoor time in preschool may also protect children against inattention-hyperactivity symptoms, as interactions with nature were found to be particularly effective in replenishing depleted executive attention systems (Atchley and Strayer, 2012). Dadvand et al. (2015) found a similar beneficial association between exposure to green space and cognitive development among 2,593 7- to 10-year-old Spanish schoolchildren.

A systematic review on Nature-Specific Learning Outside the Classroom has shown positive academic outcomes for primary students, including increased student engagement and ownership of their learning, as well as some evidence of academic improvement (Mann et al., 2022).

Learning outdoors has been shown to provide academic benefits both during and after lessons. Children with lower self-regulation skills in "normal" science classes showed a significantly higher self-regulated learning motivational behavior in the outdoor educational setting (Dettweiler et al., 2015). A study comparing lessons in nature and matched lessons in regular classroom settings found stronger classroom engagement after lessons in nature than after their matched indoor counterparts (Kuo, Browning, and Penner, 2018). The number of "redirects" (the number of times the teacher stopped instruction to direct student attention back to the task at hand) was significantly lower in and after the nature lessons.

The authentic, less stressful learning environment provided by nature may explain the higher academic performance in children learning in nature. A four-year study of elementary school children from disadvantaged backgrounds participating in a nature-based learning program found that the students participating in the program

consistently outperformed the control group in knowledge of science and overall academic performance (Camasso and Jagannathan, 2017).

Miller, Tichota, and White (2014) conducted a case study in Nebraska on how preschoolers learn math in an outdoor environment. They concluded that outdoor classroom environments (and the natural world) provided a powerful context for young children to explore, develop, and hone math skills. The researchers observed and recorded the preschoolers' authentic and meaningful math learning experiences and found that 77% of such experiences were child-initiated activities that emerged during their self-directed play.

Nature play can instill a sense of place and stewardship

Nature play and learning can have a profound influence on children's values toward nature and pro-environmental behaviors. For example, positive experiences in nature, specifically psychological restoration (being away from everyday worries and distractions), have acted as a motivational factor enhancing children's pro-environmental behavior (Collado and Corraliza, 2013). A study conducted on fifth- and sixth-grade students in Milwaukee, WI concluded that children who knew a neighborhood natural area where they could play had a significantly stronger sense of place (Kroencke et al., 2015).

The influence of nature on children could also last through their adult life. A review of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more than thirty studies found that play in nature was an important childhood experience that later influenced adult values and behaviors toward nature (Chawla and Derr, 2012). Asah, Bengston, and Westphal (2011) also found that higher childhood participation in nature-based activities increased motivation to recreate outdoors as well as efforts to overcome barriers in doing so. Prévot et al. (2016) found that the environmental identity formed in childhood influenced students' choice of their college major.

A systematic review by Ernst et al. (2021) highlighted that nature play in early childhood not only nurtures cognitive and developmental skills but also aligns with Education for Sustainability (EfS) benchmarks, emphasizing the cultivation of mindsets conducive to sustainable behaviors and attitudes. These benchmarks, which serve as guidelines for integrating sustainability into education, underscore the importance of fostering stewardship values from a young age, ensuring that children grow up with a deep-seated respect for and commitment to the environment and sustainable practices.

In addition, multiple studies have found that "unstructured, frequent childhood play in wild settings" was identified as the most common influence on the development of lifelong conservation values (Finch & Loza 2015).

Conclusion

The growing body of research describing the many potential benefits of nature-based play and learning suggests that these activities and approaches are worth considering for both formal and non-formal educational settings.

The potential outcomes for cognitive and social development and academic performance demonstrate that outdoor settings can positively contribute to the quality of learning in a variety of ways, and that more time in nature or naturalized settings can have a beneficial impact on the entire school day and larger school culture. Meanwhile, findings related to children's mental and physical health make a compelling case that nature immersion can be a vital part of the antidote to the increasingly sedentary yet stressful world in which many 21st century children dwell.

The literature points to the promises and potential of nature-based play and learning, but, as with any topic, there is much yet to learn. As summarized in Gifford and Chen (2016), more and better research is yet needed to understand questions such as:

- What are the mechanisms of causal relationships between exposure to nature and beneficial outcomes?
- How are the benefits of nature-based play and learning similar to or different from the same benefits from other approaches?
- How do the benefits of naturalized settings compare to truly natural settings?
- What approaches will address inequality of access to nature play and learning?

Practitioners and proponents of nature-based play and learning should use the literature as a guide to inform their practices and their stakeholders, while staying attentive and contributing to the ongoing deepening of knowledge about this field.

Retribe Forest School

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PEERassociates.net
info@PEERassociates.net
603-521-0326