

# Nature-Based Learning as a Strategy to Enhance Education & Create Green Communities

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**Children and Nature Network**

**Science of Nature-based Learning  
Collaborative Research Network –  
National Science Foundation  
9/2015-8/2018**

## NBLR Collaborative objectives and outcomes:

- Definition of NBL
- Literature review
- A research agenda to advance the field
- Collaborative research projects
- Publications, including a special section of *Frontiers in Psychology*

Three convenings of 18 invited Network members plus 5 representatives of grantee institutions

- November 2015 – three-day retreat
- November 2016 – three-day retreat
- June 2018 – gathering during Children & Nature Network Leadership Summit

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**educational science**

**early childhood education**

**environmental education**

**developmental psychology**

**environmental psychology**

**ecopsychology**

**neuroscience**

**cognitive science**

**stress neurobiology**

**environmental design**

**landscape architecture**

# **nature-based learning**

**an educational approach that utilizes the natural environment as the content or context for learning**



## nature-based learning

- It occurs where nature is present, outdoors or indoors.
- It involves learning with exposure to nature, as the focus of nature-based activities or in the background.
- It includes learning about the natural world, but extends to engagement in any subject, skill or interest while in natural surroundings.

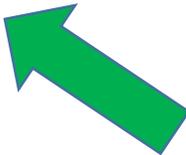
## nature-based learning

- It involves the development of knowledge, skills, values, attitudes and behaviors in the realms of academic achievement, personal development, environmental stewardship and more
- It can occur with varying degrees of guidance or structure, during informal, nonformal and formal education, across the age span, and in urban, suburban, rural and wilderness settings

garden-based  
educational  
research

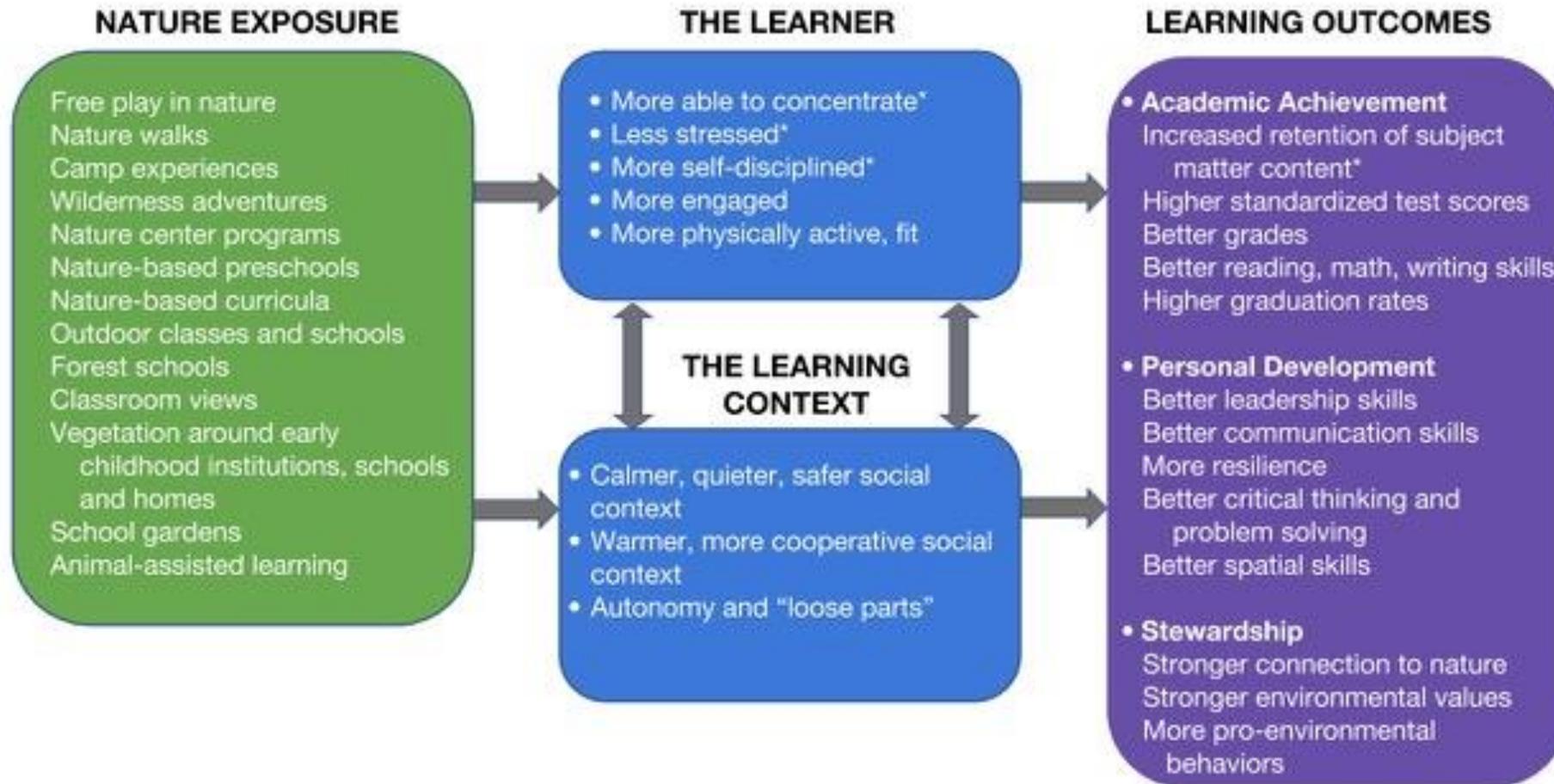


**NBL**



environmental  
education  
research

nature-based  
public health  
research



Kuo, M., Barnes, M., & Jordan, C. 2019. Do experiences with nature promote learning? Converging evidence of a cause-and-effect relationship. *Frontiers in Psychology*, 10:305.

## natural surroundings as the context for learning in school

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In public high schools in Michigan with more natural features such as trees and shrubs close to classroom and cafeteria windows, students had significantly:

- higher standardized test scores
- higher graduation rates
- greater percentages of students planning to attend college
- lower rates of criminal behavior

Matsuoka, R. H. 2010. Student performance and high school landscapes. *Landscape and Urban Planning*, 97, 273-282.

## natural surroundings as the context for learning in school



photo courtesy Karen Malone

**Third graders in Chicago public schools with more tree cover on school grounds performed significantly better on standardized tests of math and marginally better on tests of reading.**

**The most disadvantaged schools had half the tree cover of the least disadvantaged schools.**

Kuo, M. et al. 2018. Might school performance grow on trees? Examining the link between “greenness” and academic achievement in urban, high-poverty schools. *Frontiers in Psychology*, 9, 1669.

## natural surroundings as the context for learning in school

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- **Higher levels of greenness surrounding Massachusetts schools were associated with lower absenteeism, independent of air pollution**

MacNaughton, P., et al. 2017. Impact of particulate matter exposure and surrounding “greenness” on chronic absenteeism in Massachusetts public schools. *International Journal of Environmental Research and Public Health*, 14(2)

- **Primary school students in Barcelona with more surrounding greenness at home, school and during commuting had greater 12-month gains in working memory and reduction in inattentiveness—partly mediated by reduced exposure to air pollution.**

Dadvand, P. et al. 2016. Green spaces and cognitive development in primary schoolchildren. *PNAS* 112(26): 7937-7942.

## natural surroundings as the context for learning in school

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**In a true experiment, high school students with windows that overlooked a green space (versus a built space or no windows), performed better on tests of attention and recovered more quickly from stressful experiences**

Li, D. & Sullivan, W. C. 2016. Impacts of views to school landscapes on recovery from stress and mental fatigue. *Landscape and Urban Planning*, 148,

## natural surroundings as the context for learning in school

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- **When six plants were placed in the back of a junior high school classroom in Taiwan, the treatment class immediately and significantly reported stronger feelings of preference, comfort and friendliness for their class compared to a control class.**
- **They also had significantly less absence and punishment records.**

Han, K-T. 2009. Influence of limitedly visible leafy indoor plants on the psychology, behavior, and health of students at a junior high school in Taiwan. *Environment & Behavior*, 41(5), 658-692.  
14(2)

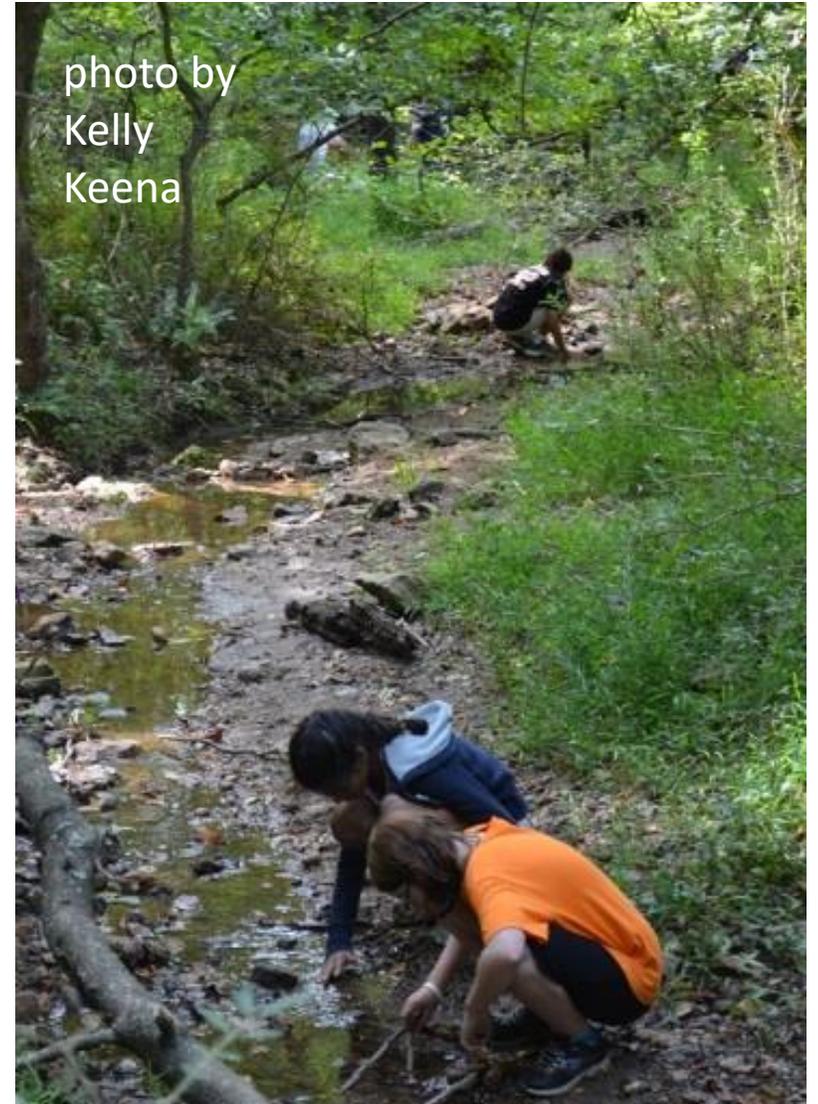
## natural surroundings as the context for learning

**Scottish students (mean age 11) completed questionnaires in a school setting prior to being taken to a forest school or conventional classrooms, and completed post-tests at the end of the day. After a day in the forest, students reported:**

- **greater energy and a happier mood**
- **reduced stress and anger**

**Students classified for bad behavior showed the greatest positive changes.**

Roe, J. & Aspinall, P. 2011. The restorative outcomes of forest school and conventional school in young people with good and poor behavior. *Urban Forestry & Urban Greening*, 10(3), 205-212.



## garden-based learning

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**In 33 out of 40 school garden studies conducted between 1990 and 2010, students showed improved outcomes in science, math or language arts through participation in school garden programs v. conventional classrooms.**

Williams, D. & Dixon, W. 2012. Impact of garden-based learning on academic outcomes in schools. *Review of Educational Research*, 83(2), 211-235.



photo by Angela Myers

## the natural environment as an Integrated Context (EIC) for learning

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**Over three years, student performance in three Louisiana elementary schools (80% African-American, 85% free or reduced lunch) was compared with district and state averages when their schools adopted an EIC approach focused on local natural resources.**

**Gaps of 10.7% and 15.6% in math and social studies at the beginning of Year 1 were reduced to 0.2% and 7.5% by end of Year 3.**

Emekauwa, E. 2004. *They remember what they touch*. Washington, DC: Rural School and Community Trust.

# natural surroundings as the context for social-emotional development

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**On naturalized playgrounds, students play more creatively and cooperatively.**

Chawla, L. 2015. Benefits of nature contact for children. *Journal of Planning Literature*, 30(4), 433-452.



photos  
by Emily  
Stanley

# natural surroundings as the context for psychological health

More neighborhood green space is associated with fewer emotional problems in young children from socially disadvantaged families.

- 3-5 year olds in poverty

Flouri, Midouhas & Joshi. 2014. The role of urban neighbourhood green space in children's emotional and behavioral resilience. *Journal of Environmental Psychology*, 40: 179-186.

- 4-6 year olds of mothers with low levels of education

Balsevicene et al. 2014. Impacts of residential greenness on preschool children's emotional and behavioral problems. *International Journal of Environmental Research & Public Health*, 11: 6757-70.





photo by Karen Malone

## natural settings as the context for general development & well-being

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1-3 year olds were compared in nursery schools which emphasized outdoor play and learning (primarily in school garden) versus traditional nursery schools (76 v. 84 toddlers). Teachers evaluated each child in January and again in June.

Outdoor toddlers showed significantly greater improvement in cognitive, emotional, social, and fine motor skill development and awareness of their environment.

Monti, F. et al.. 2017. The role of outdoor education in child development in Italian nursery schools. *Early Child Development and Care*, published online 11 July, DOI: [10.1080/03004430.2017.1345896](https://doi.org/10.1080/03004430.2017.1345896).

## natural settings for physical activity and physical fitness

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photo by  
Eva  
Anggård

Children are more physically active on green schoolgrounds, & young children who play on natural terrains perform better on tests of balance & motor coordination than children who play on traditional playgrounds. [Dyment & Bell, 2008; Fjortoft 2001, Grahn et al. 1997; McCurdy et al., 2010 in Chawla \(2015\).](#)

## the development of care for the natural world

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Strong predictors of lifelong active care for the natural world include:

- routine childhood play and exploration in nature



boys in water corridor that runs through Orchard Grove trailer park, Boulder, CO  
photo by Richard T. Carey

Chawla & Derr. 2012. The development of conservation behavior in childhood and youth. In S. Clayton (Ed.), *Oxford Handbook of Environmental and Conservation Psychology* (pp. 527-555). New York: Oxford University Press.



photo by  
Illene Pevac

- opportunities to learn how to take action for nature from family members or in schools or out-of-school programs

youth community service gardening  
with 2-5 year olds in Casa Cuna,  
a free day care center in Puebla, Mexico



- supportive family members, teachers, mentors or friends

Roaring Fork Valley H.S. community garden  
Valley Settlement Program for immigrant families  
photo by Genevieve Villamizar



## Three Categories of Research Agenda Questions

- learning outcomes and differential effects
- mechanisms of influence
- implications for policy and practice

Jordan, C. & Chawla, L. 2019. A coordinated research agenda for nature-based learning. *Frontiers in Psychology*, 10:766.

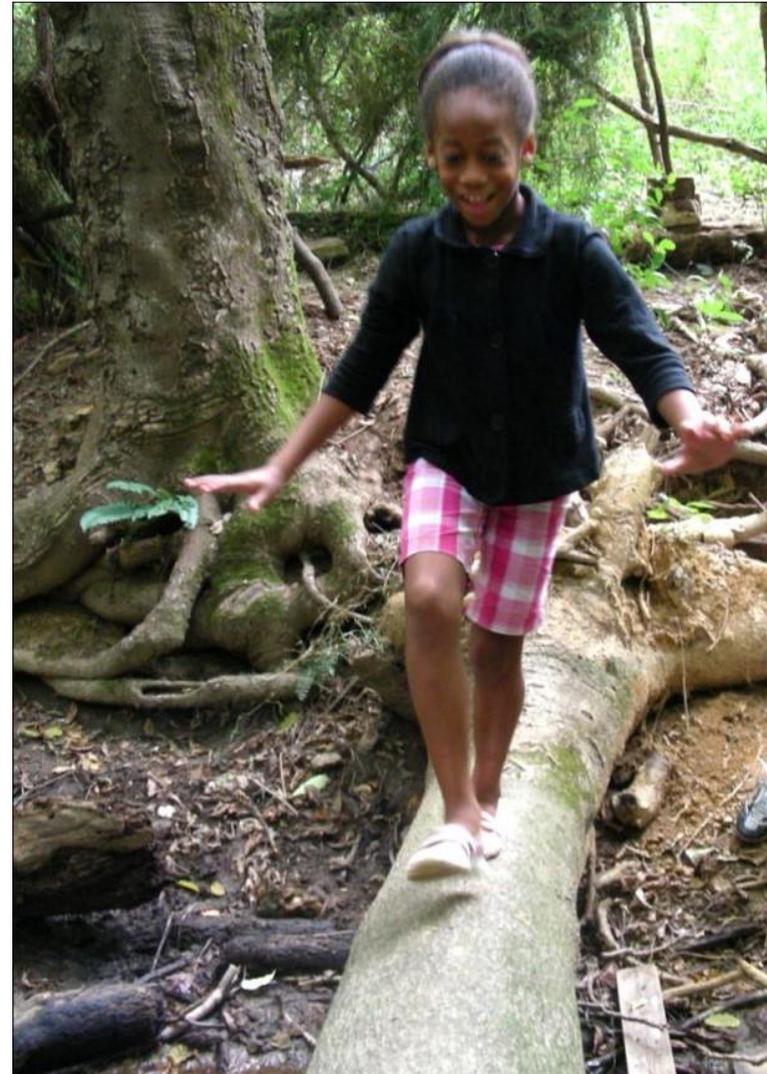


photo by Emily Stanley

## Game Changing Questions

research questions that are most likely to yield critical information for practice and policy



©Thorne Nature Experience

How does nature affect the learning of children with special needs as a result of:

- physical health
- mental health
- cognitive conditions, such as ADHD
- learning differences
- educational disadvantages due to low income



photos courtesy Janet Loebach



elementary school ground in London, Ontario before and after participatory redesign for nature play and learning