



CHILDREN'S CONTACT WITH THE OUTDOORS AND NATURE: A FOCUS ON EDUCATORS AND EDUCATIONAL SETTINGS

NOTE: The following are taken from four volumes of research developed by the Children & Nature Network (C&NN) and available at www.childrenandnature.org. These C&NN Annotated Bibliographies of Research and Studies were written by Cheryl Charles, Ph.D., President, Children & Nature Network and Alicia Senauer, Yale University.

Benefits to children from contact with the outdoors and nature

This section reviews research focused on the physical, mental, and social benefits that contact with the outdoors and nature provides to children. Research is grouped into several main focal areas.

Focus: Literature Reviews & Overview Documents

These articles and documents synthesize the literature related to children's contact with the outdoors and nature and, in many cases, highlight children's contact as it relates to educational settings.

Time spent outdoors supports many aspects of children's health

In this report, Muñoz reviews literature concerning the linkage between spending time outdoors and health, with a primary emphasis on research related to children. She reviews research and policy related to outdoor use and health more generally and then takes an in-depth look at topics related to children's use of the outdoors and relationships to their health. Specific topics Muñoz examines include research linking children's time spent outdoors to increased physical activity, healthy development, and overall well-being. She also examines research related to the design of children's play spaces, access to natural spaces, the use of outdoors in children's education, and research related to people and factors that constrain and enable children's outdoor play. Finally, in concluding her literature review, Muñoz identifies methodological considerations, research gaps, and provides suggestions for advancing knowledge in this area.

Author Affiliation: Muñoz is with the Sustainable Development Research Centre in Scotland.

Muñoz, S. A. (2009). **Children in the outdoors: a literature review.** Sustainable Development Research Centre. This report is available online at: <http://www.countrysiderecreation.org.uk/Children%20Outdoors.pdf> (Volume 4)

Children's play in natural settings provides a suite of benefits

In this report, Stuart Lester and Martin Maudsley provide an extensive review of the literature related to children's natural play. The authors begin by examining the human relationship with the natural world and the importance of play and direct interaction with the physical environment to children. Lester and Maudsley then review the important opportunities that natural play provides, such as the creation of special places, and the numerous documented and potential benefits of children's play in natural settings, including the development of a sense of self and independence. The authors discuss evidence demonstrating a decline in children's access and opportunities to play in natural spaces and provide a range of suggestions to support children's opportunities to play in natural settings, such as through the design of effective playgrounds, school grounds, and environmental play projects, as well as ensuring adequate access to parks and nature reserves.

Lester, S., & Maudsley, M. (2006). *"Play, naturally: A review of children's natural play."* Children's Play Council. This report is available online at: <http://www.playday.org.uk/PDF/play-naturally-a-review-of-childrens-natural%20play.pdf> (Volume 3)

The importance of designing spaces that support children's contact with nature

In this book chapter, Robin Moore and Clare Cooper Marcus review health threats that face many of today's children, including sedentary behavior and attention deficit disorder; the benefits that contact with nature provides to children's mental, social, and physical health; and current barriers limiting children's access to nature. The authors provide examples of designed environments, specifically in urban areas, that support children's contact with nature, including examples of innovative childcare centers and preschools, school grounds, neighborhood parks, and community institutions. Moore and Marcus emphasize the importance of the residential environment and the need to understand and incorporate children's ideas and preferences into the planning and design of spaces. The authors discuss four models of child-friendly residential neighborhood layouts with specific national and international case studies, including clustered housing and shared outdoor space, cul-de-sacs and greenways, alleys, and home zones. Moore and Marcus conclude by providing a number of key recommendations to help ensure children's access to nature in residential environments.

Moore, R. C., & Cooper Marcus, C. (2008). "Healthy planet, healthy children: Designing nature into the daily spaces of childhood." In S. Kellert, J. Heerwagen & M. Mador (Eds.), *Biophilic design: Theory, science and practice*. Hoboken, NJ: John Wiley & Sons, Inc. This book chapter is available online at: http://www.naturalearning.org/docs/MooreCooperMarcus_Healthy.pdf (Volume 3)

Direct experience in nature is critical and diminishing

Nature is important to children's development in every major way — intellectually, emotionally, socially, spiritually, and physically. In one of his newest books, *Building for Life: Designing and Understanding the Human-Nature Connection* (Island Press, 2005), Dr. Stephen R. Kellert of Yale

University devotes a chapter to the subject of “Nature and Childhood Development.” Combining his original research with well-documented references to the research of others, this chapter is a powerful synthesis of what we know, and what we do not know, about the importance of nature to children’s healthy development. Kellert states, “Play in nature, particularly during the critical period of middle childhood, appears to be an especially important time for developing the capacities for creativity, problem-solving, and emotional and intellectual development.” He includes research to indicate optimal learning opportunities at age-appropriate times and differentiates between indirect, vicarious, and direct experiences with nature — with the latter less and less available to children. He urges designers, developers, educators, political leaders and citizens throughout society to make changes in our modern built environments to provide children with positive contact with nature — where children live, play, and learn. (Original Research and Synthesis)

Kellert, Stephen R. “Nature and Childhood Development.” In *Building for Life: Designing and Understanding the Human-Nature Connection*. Washington, D.C.: Island Press, 2005. Full book available via Amazon.com and other commercial sources. http://www.cnaturenet.org/02_rsrch_studies/PDFs/Kellert_BuildingforLife.pdf (Chapter 3). (Volume 1)

Contact with nature is important for children

Andrea Faber Taylor and Frances E. Kuo have contributed important research to the understanding of the impact of nature on people’s lives, and specifically to the well-being of children. This particular article is a recent review of the literature and establishes what is known, and what is still missing, about the effects of contact with nature on children’s lives. While the evidence is growing, this article is an important call to action for further research.

Taylor, Andrea Faber; and Frances E. Kuo. “Is Contact with Nature Important for Healthy Child Development? State of the Evidence.” In Spencer, C. & Blades, M. (Eds.), *Children and Their Environments: Learning, Using and Designing Spaces*. Cambridge, UK: Cambridge University Press, 2006. <http://www.lhhl.uiuc.edu/documents/Faber2006Iscontactwithnature.pdf> (Volume 1)

Schoolyard habitat projects bring natural benefits to school and students

This brief article by Mary Rivkin is an important reminder of the importance of bringing natural habitats to school grounds as places for natural learning. When the article was written in 1997, there was a burgeoning movement in the U.S. to have schoolyard habitat projects — places of natural and rich learning, integral to the curriculum, and a respite for teachers, students and the community overall. We’ve literally lost ground in this respect. The concept remains accessible, important, and healthy. This article is a short, succinct summary of the natural benefits afforded from schoolyard habitat projects. (Synthesis)

Rivkin, Mary. “The Schoolyard Habitat Movement: What It Is and Why Children Need It.” *Early Childhood Education Journal*. Volume 25, No. 1, 1997. <http://www.nwf.org/schoolyard/movement.cfm> (Volume 1)

There are more benefits from naturalized playgrounds and school grounds — and ways to achieve them

Randy White offers a variety of resources, articles, and recommendations for designing school grounds and playgrounds to optimize the benefits to children’s development. One of his many excellent articles is “Young Children’s Relationship with Nature: Its Importance to Children’s

Development & the Earth's Future.” In addition to citing references and providing a succinct summary of the many benefits of informal and unstructured natural play environments for children, he distills the findings into a list of beneficial elements of naturalized play environments that any of us can use, from back yards to school grounds to neighborhood parks. Visit Randy White's Web site for additional resources and information at www.whitehutchinson.com. (Synthesis)

White, Randy. “Young Children's Relationship with Nature: Its Importance to Children's Development & the Earth's Future.”

http://www.cnaturenet.org/02_rsrch_studies/PDFs/White_YoungChildren.pdf (Volume 1)

City parks offer a sense of place

This brief article draws on solid research, some of which is independently referenced elsewhere in this list. Among the points made are that city parks offer a sense of place, opportunity for daily experience with nature, experiences that enhance school achievement, and antidotes to alienation. This American Planning Association City Parks Forum Briefing Paper is largely inspired by the work of Robin Moore, noted and pioneering landscape designer with a commitment to creating learning landscapes that optimize children's learning. “Natural spaces and materials stimulate children's limitless imaginations and serve as the medium of inventiveness and creativity,” says Moore. Readers will find tangible reasons for the benefits associated with using city parks as places for learning as well as community-based examples and resources. (Synthesis)

“How Cities Use Parks to . . . Help Children Learn,” Chicago, IL: American Planning Association, 2003.

Available on line at www.naturalearning.org and www.planning.org. Texas (Volume 1)

Focus: School Performance & Learning

These articles examine relationships between children's outdoor-related behavior and their school performance and learning.

Children's classroom behavior is better if they have recess

Recess provides one of the few opportunities for children to engage in free play and physical activity at school and to potentially be outdoors. Barros and colleagues investigated the amount of recess 8- to 9-year-old children have in the U.S. and compared the classroom behavior of children who receive and do not receive daily recess. The researchers analyzed data from a nationally representative sample of over 10,000 third-grade children in public and private schools. As part of this study, a wide range of data were collected, including interviews with children and surveys of teachers, parents, and school administrators. In analyzing the data, Barros and colleagues found that 30% of children had no recess at all or less than a 15 minute daily break. The researchers found that children with less than 15 minutes of recess a day were significantly more likely to be black or Hispanic, live in a large- or medium-sized city, live in the South, attend public school, and come from families with lower income and less parental education. In examining school behavior, Barros and colleagues found that teachers' rating of overall classroom behavior was better for children with some recess as compared to those with none/minimal break, however, the frequency and amount of recess was not significant. While data from teachers could be biased due to their feelings about recess, this study provides valuable information about the amount of recess 8- to 9-year-old children receive and relationships to classroom behavior.

Author Affiliation: The authors are with the Children's Hospital at Montefiore and Rose F. Kennedy Center in New York.

Barros, R. M., Silver, E. J., & Stein, R. E. K. (2009). School recess and group classroom behavior. *Pediatrics*, 123(2), 431-436. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.jpeds.com/> (Volume 4)

Allocating time to physical activity in school does not negatively impact academic achievement

Over the years, there has been much discussion about the benefits and drawbacks of allocating time to physical activity in schools. In this article, Trudeau and Shepherd review the literature with regard to the relationships between physical education, school-based physical activity, school sports, and academic performance. Based on their review of a number of quasi-experimental and cross-sectional studies, the authors conclude that physical activity can be added to the school curriculum without negatively impacting children's academic achievement. The authors highlight literature which indicates that additional time spent in physical activity may in fact result in small increases in students' grade point averages and more efficient learning in the classroom. In addition, Trudeau and Shepherd summarize studies that have found positive associations between physical activity in school and children's physical fitness, concentration, memory, behavior, and school satisfaction. The authors summarize supporting mechanistic evidence from the neurosciences and highlight the need for additional research to further clarify relationships between academic performance and school-based physical activity.

Author Affiliation: Trudeau is with the Université du Québec à Trois-Rivières in Canada. Shephard is with the University of Toronto in Canada.

Trudeau, F., & Shephard, R. J. (2008). Physical education, school physical activity, school sports and academic performance. *International Journal of Behavioral Nutrition and Physical Activity*, 5, 12. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.ijbnpa.org/> (Volume 4)

School gardens positively impact children's learning and behavior

Gardening takes place in many schools throughout the nation. Blair reviews research in the U.S. on school gardening and its relationship to children's learning and behavior. She begins her review by highlighting the range of reasons why school gardens exist, which include providing children experiences with natural ecosystems, enhancing children's understanding of food systems, helping children develop environmental attitudes and behaviors, and serving as a basis for experiential learning. Blair then reviews quantitative and qualitative studies on the impact of school gardening on children's learning and behavior. Of the 12 quantitative studies reviewed, she found that 9 of the 12 studies found significant and positive impacts of gardening with regard to test measures, which included children's science achievement and food consumption behavior. Of the 7 qualitative studies reviewed, Blair found a number of commonalities among study findings, including that students enjoyed and were highly motivated by gardening; students demonstrated improved school attitude and pride in the garden; and gardening enhanced student bonding, teamwork, and learning opportunities. In addition, she reviewed studies that evaluated principals' and teachers' opinions about school gardens. Based on her review of the literature, Blair determined that, overall, current research indicates that gardening can have a positive impact on student achievement and behavior.

She also discusses the methodological limitations of current studies and provides recommendations for future research.

Author Affiliation: Blair is with Penn State University.

Blair, D. (2009). *The child in the garden: an evaluative review of the benefits of school gardening.* *Journal of Environmental Education*, 40(2), 15-38. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.heldref.org/pubs/jee/about.html> (Volume 4)

Natural views from high school positively impact students' academic achievement and behavior

Matsuoka examined the relationship between views of nature and high school students' academic achievement and behavior. To investigate this relationship, he inventoried the landscape features of 101 high school campuses in southeastern Michigan and assessed student access to these features via building characteristics and school policies (e.g., through window size and the ability to eat lunch outdoors). Matsuoka also gathered information about each school's student academic achievement and conduct (e.g., the percentage of merit award winners and graduation rates). In analyzing the data, he found that landscape and access characteristics were significantly associated with student academic achievement and behavior. For example, Matsuoka found that schools with larger windows and more views of natural elements had students with higher standardized test scores, higher graduation rates, and a greater percentage of students planning to attend college, as well as fewer reports of criminal behavior. He also found that schools that allowed students to eat outside or off campus had higher test scores and a greater percentage of students planning to attend college. In examining specific landscape features, Matsuoka found that trees and shrubs needed to be relatively close to the students to provide academic achievement and behavior benefits. Importantly, Matsuoka controlled for a number of socio-demographic and general school characteristics in his analyses. While this study may be limited due to its cross-sectional design and focus on school-level information, it provides valuable insight into the benefits of natural views to high school students with implications for school design and policy.

Author Affiliation: Matsuoka is with the University of Michigan.

Matsuoka, R. H. (2008). *High school landscapes and student performance.* University of Michigan, Ann Arbor. This study is available online at: <http://hdl.handle.net/2027.42/61641> (Volume 4)

Real field trips provide better overall learning environments than virtual field trips

Learning today often involves the use of technology. In this study, Harrington compares 12 nine- to eleven-year-old students' experiences on a real and virtual field trip. Two groups of students (6 each) from a Pittsburgh public elementary school went on a real and virtual field trip to a local wildflower reserve. Data were gathered from knowledge tests, video and audiotape recordings, photographs, interviews, surveys, and observations. In analyzing the data, Harrington found that while more students preferred the virtual field trip, students felt that they learned more from the real field trip. In examining the field trips with regard to curriculum learning impact, however, she found no differences between the two trips in terms of children's performance on a specific knowledge post-test. In terms of participants' views, Harrington found that students' reported that the real field trip was better than the virtual field trip with regard to learning, inquiry, and presence. With regard to the other dimensions examined—exploration, desire to create, sense of excitement, level of curiosity,

desire to re-experience, sense of calm, desire to share, awe and wonder, assessment of beauty, level of frustration, and disinterest—she found no statistical difference in student ratings between the real and virtual field trips. Many students reported that they liked “spotting plants” or “being in the context of the environment” on the real field trip, while students reported that they liked the “ability to fly” or “use their imagination” on the virtual field trip. Overall, Harrington found that the real field trip provided a chance for students to use all their senses and for spontaneous events to occur and instigate investigation and learning (e.g., finding a salamander), while the virtual field trip provided students with new views of the environment and enabled individual exploration. As a result of this study, Harrington concluded that a virtual field trip can be used successfully as part of a curriculum, but that a real trip provides a superior learning environment that goes beyond specific curriculum-based learning. While this study may be limited due to its small sample size, it provides important insight into the complementary value of real and virtual-based learning opportunities, as well as ideas on how to improve both types of experiences for students.

Author Affiliation: Harrington is with the University of Pittsburgh.

Harrington, M. C. R. (2009). An ethnographic comparison of real and virtual reality field trips to Trillium Trail: the salamander find as a salient event. *Children, Youth and Environments*, 19(1), 74-101. This article is available online at: http://www.colorado.edu/journals/cye/index_issues.htm. (Volume 4)

Hands-on outdoor learning benefits students

This report by Janet E. Dymont presents findings from her 2003 study on the impacts of green school ground initiatives at 45 elementary, middle, and high schools in the Toronto District School Board. As part of this study, Dymont surveyed nearly 150 parents, teachers, and principals about the impact of greening initiatives on a variety of outcomes, including curriculum delivery, student learning and academic achievement, teaching practices, and student behavior. The author also conducted in-depth interviews with 21 respondents from 5 schools. Despite the variety of schools studied, Dymont found a number of common benefits of greening initiatives. For example, 90% of respondents reported that student enthusiasm and engagement in learning increased on green school grounds as compared to teaching indoors and 70% of respondents reported that their motivation for teaching increased on green school grounds as compared to teaching indoors. Dymont also questioned participants about key challenges and opportunities for improvement with regard to green school ground initiatives. Commonly identified barriers included availability of funding and adequate logistical support and human resources. Respondents also provided a variety of suggestions for improvement, including professional development and training opportunities, assistance with physical design, and additional funding support for construction and maintenance. Importantly, this study demonstrates that the benefits of school ground greening initiatives are numerous and varied, and can be realized by different schools with a variety of different types of greening projects. Dymont concludes the report by providing a series of high-level policy recommendations to assist schools across Ontario in successfully implementing and realizing the full benefits of school ground greening initiatives.

Dymont, J. (2005). “*Gaining ground: The power and potential of school ground greening in the Toronto District School Board: Evergreen.*” This report was commissioned by Evergreen, a charitable organization focused on bringing communities and nature together and is available online at: http://www.evergreen.ca/en/lg/gaining_ground.pdf (Volume 3)

Nature-smart kids get higher test scores

The American Institutes for Research® conducted a study, submitted to the California Department of Education, of the impact of weeklong residential outdoor education programs. The focus was on at-risk youth, 56% of whom reported never having spent time in a natural setting. Comparing the impact on students who experienced the outdoor education program versus those in a control group who had not had the outdoor learning experience, results were statistically significant. Major findings were: 27% increase in measured mastery of science concepts; enhanced cooperation and conflict resolution skills; gains in self esteem; gains in positive environmental behavior; and gains in problem-solving, motivation to learn, and classroom behavior. (Original Research)

“Effects of Outdoor Education Programs for Children in California.” American Institutes for Research: Palo Alto, CA: 2005. Available on the Sierra Club web site.

http://www.sierraclub.org/youth/california/outdoorschool_finalreport.pdf (Volume 1)

School achievement is enhanced when curricula are environment based

Sponsored by many state departments of education, this 1998 study has an important place in documenting the enhanced school achievement of youth who experience school curricula in which the environment is the principal organizer. This study, completed in 1998, was followed by two related studies, conducted by the State Education and Environment Roundtable (SEER), both of which produced results consistent with this original study. (Original Research)

Lieberman, Gerald A.; and Linda L. Hoody. “Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning.” SEER: Poway, CA, 1998. “California Student Assessment Project.” SEER: Poway, CA, 2000. The third and most recent of the SEER studies we are featuring is described below. Available on the Web site of the State Education and Environment Roundtable (SEER) at www.seer.org (Volume 1)

More evidence corroborates environment-based school achievement

This study provides further evidence to support the positive benefits on school achievement from environment-based study in schools. This 2005 study is consistent with the results of two precursor studies, cited above, “Closing the Achievement Gap” (1998) and the “California Student Assessment Project” (2000). Students in environment-based instructional programs score as well or better on standardized measures in four basic subject areas — reading, math, language and spelling. The environment-based programs also foster cooperative learning and civic responsibility, using the natural characteristics of the school grounds and local community as the foundational framework for the curricula. While the benefits are significant, this study also provides evidence for the challenges inherent in maintaining environment-based curricula in schools on a longitudinal basis, despite substantial evidence of benefits. (Original Research)

“California Student Assessment Project Phase Two: The Effects of Environment-Based Education on Student Achievement.” SEER: Poway, CA, 2005. (Original Research) Available on the Web site of the State Education and Environment Roundtable (SEER) at www.seer.org (Volume 1)

Green school grounds foster achievement and responsibility

There are numerous studies that document the benefits to students from school grounds that are ecologically diverse and include free-play areas, habitat for wildlife, walking trails, and gardens. One

major study is “Grounds for Action: Promoting Physical Activity through School Ground Greening in Canada” by Anne C. Bell and Janet E. Dymont. While this study has roots in concern about obesity in children, it documents results and benefits beyond weight loss. Children who experience school grounds with diverse natural settings are more physically active, more aware of nutrition, more civil to one another, and more creative. One of the major benefits of green school grounds is increased involvement by adults and members of the nearby community, from helping with gardens to enriching the lifescape of the school grounds. Concerned about policy implications, this report offers specific recommendations for actions communities can take, from local neighborhoods to cities, states, and provinces. (Original Research)

Bell, Anne C.; and Janet E. Dymont. “Grounds for Action: Promoting Physical Activity through School Ground Greening in Canada.” © 2006 Evergreen. <http://www.evergreen.ca/en/lg/pdf/PHACreport.pdf> (Volume 1)

Naturalized school grounds benefit children and communities

A precursor to the study above, this report, “Nature Nurtures: Investigating the Potential of School Grounds,” is an important compendium of documented benefits from “greening” school grounds. It includes citations of benefits to students, from improved academic performance to lower exposure to toxins; benefits to teachers, from increased enthusiasm for teaching to fewer classroom discipline problems; benefits to schools, from reduced absenteeism to fewer discipline problems; and benefits to communities, from better community health to “banked social capital.” The report provides recommendations and tangible examples of ways to transform traditional school grounds into “green” school grounds for enriched learning and other benefits. (Synthesis)

“Nature Nurtures: Investigating the Potential of School Grounds.” © 2000 Evergreen. <http://evergreen.ca/en/lg/naturenurtures.pdf> (Volume 1)

Focus: Physical Activity & Weight

These articles investigate linkages between the design of children’s school environments, children’s outdoor-related behavior, and their physical activity and weight.

Green school grounds improve quantity and quality of elementary school children’s physical activity

In recent years, there has been increasing interest in greening school grounds to diversify children’s play experiences, such as through the planting of trees, building of ponds, and development of vegetable gardens. Dymont and Bell investigated how green school grounds affect the physical activity of elementary school children by sending questionnaires to a diversity of Canadian schools that had greened their school grounds. Questionnaires were completed by 105 individuals from 59 schools who had been involved in their school’s greening project. In analyzing the study data, Dymont and Bell found that green areas were an important place for physical activity: respondents reported that 66% of students use green areas for active play. Interestingly, the researchers found that green areas tended to support more moderate and light activity as opposed to the more vigorous activity that generally takes place in traditional turf and asphalt areas. Dymont and Bell found that nearly 50% of the respondents reported that their school ground promotes more vigorous activity after greening, while about 70% reported more moderate and/or light physical activity taking place after greening. In addition, the researchers found that 90% of respondents

reported that their school ground appeals to a wider variety of student interests after greening; 85% reported that their school ground now supports a wider variety of play activities; and 84% reported that since greening, their school ground encourages more exploration of the natural world. While this study may be limited due to its reliance on retrospective self-report, it provides important insight into the benefits of green school grounds and their potentially significant role in complementing more traditional school ground areas and improving the quality and quality of elementary school children's physical activity.

Author Affiliation: Dymont is with the University of Tasmania in Australia. Bell is with Evergreen in Canada.

Dymont, J. E., & Bell, A. C. (2008). Grounds for movement: green school grounds as sites for promoting physical activity. *Health Education Research*, 23(6), 952-962. This study may be available in a library near you or can be purchased online through the publisher at: <http://her.oxfordjournals.org/> (Volume 4)

Schoolyard size and landscape quality influence children's satisfaction and weight

Outdoor school grounds are an important environment to consider when striving to promote children's physical activity and reduce childhood obesity. In this study, Ozdemir and Yilmaz investigate linkages between the physical characteristics of children's schoolyard environments and their attitudes, physical activity, and body mass index (BMI). The researchers interviewed nearly 300 3rd and 4th grade students, as well as teachers, and administrators in five public schools in Ankara, Turkey. Ozdemir and Yilmaz also measured students' weight and height, and had professionals assess the schoolyard environment based on factors such as size, material, vegetation cover, and maintenance. Although schoolyards differed, the researchers found that students generally had no direct contact with vegetation and that the amount of outdoor space was limited given the number of students using the space. While most students were satisfied with their schoolyard, which the researchers speculate may be due to acclimation, unsatisfied students highlighted the lack of trees and greenery as the primary reason for their dissatisfaction. Among their many findings, Ozdemir and Yilmaz report that the size of the schoolyard was significantly related to students' BMI, with students in larger yards having lower BMI values than students in smaller yards. The researchers also found that yard landscape characteristics were significantly associated with children's BMI values, but in the opposite direction than expected: students from schools with "advanced" landscape features had higher BMI values than students from schools with "low" landscape features, although BMI values were still in the normal range. While this study may be limited due to its relatively small sample size and reliance on self-report measures, it highlights the importance of participatory and well-thought-out school landscape design, as well as the need for adequate financing and maintenance of schoolyards.

Author Affiliation: The authors are with Ankara University in Turkey.

Ozdemir, A., & Yilmaz, O. (2008). Assessment of outdoor school environments and physical activity in Ankara's primary schools. *Journal of Environmental Psychology*, 28(3), 287-300. This study may be available in a library near you or can be purchased online through the publisher at: http://www.elsevier.com/wps/find/journaldescription.cws_home/622872/description#description (Volume 4)

Focus: Other Benefits

These articles highlight other various benefits to children from contact with nature. While many of these articles are not directly related to an educational environment, they are relevant to the benefits nature might provide to children in an educational context.

Green School Gyms improve children's health

BTCV is a charitable organization in the United Kingdom that created Green Gyms to improve people's health and the environment. As part of Green Gyms, individuals participate in a range of conservation and gardening projects outdoors, such as planting trees and constructing footpaths. From 2007 to 2009, BTCV implemented Green Gyms in 9 primary schools. As part of these School Green Gyms, a weekly 1 to 1.5 hour session was provided for 10 weeks for groups of about 10 children at each school. During these sessions, children participated in environmental activities on their school grounds or nearby open spaces. BTCV commissioned a university to evaluate the School Green Gyms. As part of this evaluation, children completed a questionnaire before and after participation in the program. In analyzing the data, researchers found that children's psychosocial health and overall health significantly improved after the Green Gyms program. In addition, they found that children's weekend physical activity levels significantly increased after the program and that children felt very positive about the program. While the study data is based on self-reported information and it is difficult to separate the impact of the program activities from the outdoor context, this evaluation provides valuable information about the impact of an innovative program on children's health.

BTCV. (2009). Evaluation findings: health and social outcomes 2009. BTCV. This report is available online at: http://www2.btcv.org.uk/display/greengym_research (Volume 4)

Children benefit from appropriate risk-taking during outdoor play

Play is critical to children's healthy development. Little and Wyver examine outdoor play with a focus on early childhood education and urban Western culture. The authors review a number of social and environmental factors that have influenced children's outdoor play experiences in recent years (e.g., traffic, lack of space, other time demands, and parental fears). Little and Wyver discuss the importance of children's experience with risk to healthy development, including children's ability to develop and refine their motor skills and enjoy and gain confidence in being physically active. The authors also review literature related to the impacts of not providing children with opportunities to engage in challenging and risk-related experiences, including children's engagement in inappropriate risk-taking and underdevelopment of decision-making skills related to making sound risk judgments. Little and Wyver discuss the inability of many early childhood educators to provide challenging and stimulating outdoor experiences to children due to restrictive regulations and a cultural emphasis on eliminating or minimizing physical risk. The authors review the difference between "hazard" and "risk" and emphasize the importance of considering risk within the larger context of children's development, as well as the need to focus on identifying and fostering a risk balance that is appropriate for each individual child. In concluding their article, Little and Wyver articulate a model they developed that illustrates possible pathways from specific factors (e.g., poor outdoor environments or fear of litigation) to minimization of risk-taking and developmental outcomes, and emphasize the need to examine early childhood education policy and practice.

Author Affiliation: The authors are with Macquarie University in Australia.

Little, H., & Wyver, S. (2008). Outdoor play - does avoiding the risks reduce the benefits? *Australian Journal of Early Childhood*, 33(2), 33-40. This study may be available in a library near you or can be purchased online through the publisher at: http://www.earlychildhoodaustralia.org.au/australian_journal_of_early_childhood/about_ajec.html (Volume 4)

Children with ADHD concentrate better after walking in a park

Building off of their recent work related to children with Attention-deficit hyperactivity disorder (ADHD) and different types of activity settings, in this study, Andrea Faber Taylor and Frances Kuo investigate the impacts of three different outdoor environments on the attention of seventeen 7- to 12-year-old children diagnosed with ADHD. After completing a series of puzzles that required focused attention, each child, over the course of three different weeks, participated in a 20 minute guided walk in three different outdoor settings (an urban park, a downtown area, and a residential area). After each guided walk, children completed a concentration test and answered several questions about their walking experience. Importantly, the authors controlled for a number of potential confounding factors, including the order of environments experienced, the time of day and day of week, terrain, and season. In analyzing the data, Faber Taylor and Kuo found that children concentrated better after walking in a park setting as compared to either a downtown or residential setting and that the effect of walking in a park on concentration helped close the gap between children with ADHD and those without ADHD with regard to the concentration measure used and that the effect was similar to that of two common types of ADHD medication. In addition, the authors found that children rated their experiences more positively in the park setting than in the other two settings. Faber Taylor and Kuo discuss these findings in light of Attention Restoration Theory and their previous studies related to different environments and children with ADHD and suggest additional avenues for research and the potential of using nature in the treatment of ADHD.

Faber Taylor, A., & Kuo, F. E. (2008). Children with attention deficits concentrate better after walk in the park. *Journal of Attention Disorders OnlineFirst*. This article will be published in print in 2009 and may be available in a library near you or can be purchased online at: <http://jad.sagepub.com>. (Volume 3)

Childhood nature experiences may be an important pathway to adult environmental attitudes and behaviors

In this study, Nancy M. Wells and Kristi S. Lekies examine linkages between childhood nature experiences and adult environmental attitudes and behaviors. Data for this study were collected as part of a large telephone survey, which interviewed about 2,000 individuals, 18-90 years of age, in over 100 urban areas in the United States. In this survey, participants answered a number of questions about their nature-related experiences during childhood and their current environmental attitudes and behaviors. To analyze the survey data, Wells and Lekies used structural equation modeling, which enabled them to test complex relationships between childhood nature experiences and adult environmental attitudes and behaviors. In their analysis, the authors controlled for a number of socio-demographic variables (e.g., gender and race). Wells and Lekies found that childhood participation with “wild” nature (e.g., hiking, camping, or playing in the woods), had a significant, positive effect on both adult environmental attitudes and behaviors. That is, people who participated in “wild” nature activities as children were more likely to have pro-environmental attitudes and behaviors as adults. Additionally, Wells and Lekies found that childhood participation with “domesticated” nature (e.g., picking flowers or planting seeds), while having a significant, positive effect, did not have as great an influence as that of “wild” nature on environmental attitudes

and had only a marginal effect on environmental behaviors. While additional research is needed to demonstrate causality between childhood experiences and adult environmental attitudes and behaviors, this study is one of the first to investigate the long-term impacts of childhood contact with nature and provides an important contribution to the field by demonstrating that early experiences with the natural environment, and specifically “wild” nature, may be an important pathway toward adult environmentalism.

Wells, N. M., & Lekies, K. S. (2006). “Nature and the life course: Pathways from childhood nature experiences to adult environmentalism.” *Children, Youth and Environments*, 16(1). This study is available online at: http://www.colorado.edu/journals/cye/16_1/16_1_01_NatureAndLifeCourse.pdf (Volume 3)

Natural settings provide psychological benefits

“Coping with ADD: The Surprising Connection to Green Play Settings,” by Andrea Faber Taylor; Frances E. Kuo; and William C. Sullivan (2001) is one of the earliest studies to explore the potential for contact with nature to have a positive effect in reducing the impact of attention deficit disorder in children. The study was designed to test two hypotheses: 1) Attention deficit symptoms will be more manageable after activities in green settings than after activities in other settings; and 2) The greener a child’s everyday environment, the more manageable their attention deficit symptoms will be in general. The results were positive. (Original Research)

Taylor, Andrea Faber; Frances E. Kuo; and William C. Sullivan. In *Environment and Behavior*, Vol. 33, No. 1, January 2001. © 2001 Sage Publications, Inc. Available on the web site of the University of Illinois Urbana-Champaign. <http://www.lhhl.uiuc.edu/> (Volume 1)

Nature activities soothe ADD symptoms

Contact with the natural world can significantly reduce symptoms of attention deficit disorder in children as young as five. Here is another important study that supports this finding. In addition to access to reports of the primary research, the scholars provide a Power Point presentation that may be used in communities to disseminate this positive information based on sound research. (Original Research)

Kuo, Frances E.; and Andrea Faber Taylor. “A Potential Natural Treatment for Attention-Deficit/Hyperactivity Disorder: Evidence from a National Study.” In *American Journal of Public Health*, Vol 94, No. 9, September 2004. © American Public Health Association. The study and the educational Power Point are available on the web site of the University of Illinois Urbana-Champaign. <http://www.lhhl.uiuc.edu/> (Volume 1)

Access to nature nurtures self-discipline

This study focuses on the positive benefits to inner city youth, particularly girls, from access to green spaces for play. Even a view of green settings enhances peace, self-control, and self-discipline. While the results are most notable for girls, the evidence is not limited to the positive impact on girls. (Original Research)

Taylor, Andrea Faber; Frances E. Kuo; and William C. Sullivan. “Views of Nature and Self- Discipline: Evidence from Inner City Children.” In the *Journal of Environmental Psychology*, 21, 2001. © 2001 Academic Press. Available on the Web site of the University of Illinois Urbana-Champaign. <http://www.lhhl.uiuc.edu/> (Volume 1)

Nearby nature reduces stress in children

This study, reported in 2003, by Cornell assistant professor Nancy Wells, focuses on rural children and finds that even a view of nature — green plants and vistas — helps reduce stress among highly stressed children. Further, the more plants, green views and access to natural play areas, the more positive the results. (Original Research)

Wells, N.M., and Evans, G.W. “Nearby Nature: A Buffer of Life Stress Among Rural Children.” *Environment and Behavior*. Vol. 35:3, 311-330. This study is not available online without purchase; <http://www.sagepub.co.uk/journals/details/j0163.html> (Volume 1)

Nearby nature boosts children’s cognitive functioning

A precursor to Nancy Wells’ study reported above, this research, reported in 2000, shows that proximity to, views of, and daily exposure to natural settings increases children’s ability to focus and therefore enhances cognitive abilities. (Original Research)

Wells, N.M. “At Home with Nature: Effects of ‘Greenness’ on Children’s Cognitive Functioning.” *Environment and Behavior*. Vol. 32, No. 6, 775-795. This study is not available online without purchase; <http://eab.sagepub.com/cgi/content/abstract/32/6/775> (Volume 1)

Outdoor experience for teens has self-reported life-changing results

A classic 1998 study by Dr. Stephen R. Kellert of Yale University, with assistance from Victoria Derr, remains the most comprehensive research to date to examine the effects on teenage youth of participation in outdoor education, specifically wilderness-based programs. Subjects were participants in programs offered through three old and well-respected organizations: the Student Conservation Association (SCA), the National Outdoor Leadership School (NOLS), and Outward Bound. The researchers used quantitative and qualitative research techniques, and parallel use of both retrospective and longitudinal study techniques. Results indicate that the majority of respondents found this outdoor experience to be “one of the best in their life.” Participants report positive effects on their personal, intellectual and, in some cases, spiritual development. Pronounced results were found in enhanced self-esteem, self-confidence, independence, autonomy and initiative. These impacts occurred among both the retrospective and longitudinal respondents in this study, which means, in part, that these results persisted through many years.

Kellert, Stephen R.; with the assistance of Victoria Derr. “A National Study of Outdoor Wilderness Experience.” New Haven: Yale University, 1998.
<http://www.nols.edu/resources/research/pdfs/kellert.complete.text.pdf> (Volume 1)

Children’s experience of the outdoors and nature

This section reviews research focused on the type and amount of contact that children have with the outdoors and nature. Research is grouped into several main focal areas.

Focus: Outdoor Behavior

These articles examine children's outdoor behavior, including time spent outside, outdoor activities, and influencing factors.

Very few children walk to school and distance is the primary barrier

Beck and Greenspan documented children's usual mode of travel to school and reasons why children do not walk to school. To investigate this topic, researchers used data from a nationally representative telephone survey where over 2,000 parents answered questions about the school travel behavior of their 5- to 15-year-old child. In analyzing the data, Beck and Greenspan found that about 46% of children traveled to school via car, 40% via school bus, and 14% via walking. Children's usual travel mode varied by age group, income and region of the country. For example, 5- to 11-year-old children were more likely to travel to school via car than 12- to 14-year-old children and children in the Northeast and West were more likely to walk to school than children in the South. In addition, researchers found that about 70% of parents identified distance as the primary barrier to their child walking to school, while about 9% identified traffic danger. While the study may be limited due to its emphasis on self-report, it provides important information concerning barriers to children walking to school, which could help inform policies and targeted interventions.

Author Affiliation: The authors are with the National Center for Injury Prevention and Control in Georgia.

Beck, L. F., & Greenspan, A. I. (2008). Why don't more children walk to school? *Journal of Safety Research*, 39(5), 449-452. This study may be available in a library near you or can be purchased online through the publisher at: http://www.elsevier.com/wps/find/journaldescription.cws_home/679/description#description (Volume 4)

Children are walking and bicycling to school less than they used to

The Centers for Disease Control and Prevention (CDC) has compiled statistical information from a number of sources that document changes in children's active transportation to and from school over the past thirty years. The data indicate that the percent of children who live within a mile of school and who walk or bike to school as their primary means of transportation has declined almost 25% over the past thirty years (from 87% to 63%) and that children who walk or bike from any distance has declined 26% (from 42% to 16%). The CDC also provides statistical information regarding four common barriers to children's active transportation and how they have changed over time: distance to school, adverse weather conditions, traffic dangers, and crimes against children. The data indicate that distance to school and traffic volume have increased over the past thirty years (for example, 34% of children in 1969 lived within 1 mile of their school, whereas just 21% of children live within 1 mile of their school today), whereas adverse weather conditions, crimes against children, and traffic-related accidents have not increased and in the case of crimes against children (12 to 19 years of age) and traffic accidents (from 1995 to 2002) rates have actually decreased. In looking at this data, it is important to recognize that these are broad, general statistics and while providing important information, they do not explain why some of these changes may be occurring (for example, the reduction in traffic-related accidents may be due to the fact that there are less people on the street). In addition, they do not capture local and regional variations that may exist. In closing, the CDC offers strategies for moving forward and overcoming each of these barriers, such as changing school siting policies, increasing education related to the risk of neighborhood crime, and reducing traffic dangers.

Kids Walk-to-school: Then and Now—Barriers and Solutions. Center for Disease Control and Prevention, 2006. This information is available online at: http://www.cdc.gov/nccdphp/dnpa/kidswalk/then_and_now.htm (Volume 2)

Schools are too far away for children to walk or bike to

In 2003, Beldon Russonello and Stewart Research and Communications conducted a survey to investigate American's attitudes toward walking. In this national, random sample telephone survey of 800 adults, they found that while 71% of adults indicated that they walked or rode a bike to school when they were young, only 22% of children do so today. The primary reason reported for more children not walking or biking was because schools were too far away.

Beldon Russonello and Stewart Research and Communications. "Americans' Attitudes toward Walking and Creating Better Walking Communities." *Surface Transportation Policy Project Report*. Washington: Beldon Russonello & Stewart Research and Communications, 2003. This report is available online at: www.transact.org/report.asp?id=205 (Volume 2)

Sociodemographic and physical environment factors influence children's active travel between home and school

Larsen and colleagues investigated relationships between children's mode of travel to and from school and various social and physical environment factors among 11- to 13-year-old students from a diversity of schools in London, Ontario, Canada. As part of this study, over 600 students, living within 1 mile of their school, completed a survey about their travel behavior and neighborhood. In addition, researchers used a Geographic Information System to identify participants' home and school neighborhoods and used various databases to calculate specific sociodemographic and physical environment characteristics (e.g., presence of street trees, intersection density, and dwelling density). In analyzing the study data, Larsen and colleagues found that 62% of students actively traveled from home to school, while 72% of students actively traveled from school to home. Researchers found that students were more likely to actively travel to or from school if they lived closer to school, were male, their neighborhood had a higher land use mix, and there were more street trees. For example, boys were about 1.5 times more likely to actively travel to/from school than girls. Additional research is needed to understand why some of these factors influence children's travel behavior. While this study may be limited due to its reliance on self-report and use of neighborhood-level information, it improves our understanding of the social and physical factors influencing children's travel to and from school and highlights the importance of school location.

Author Affiliation: Larsten and Irwin are with the University of Western Ontario in Canada. Gilliland is with the Children's Health Research Institute and University of Western Ontario in Canada. Hess is with the University of Toronto in Canada. He is with the University of Texas.

Larsen, K., Gilliland, J., Hess, P., Tucker, P., Irwin, J., & He, M. Z. (2009). The influence of the physical environment and sociodemographic characteristics on children's mode of travel to and from school. *American Journal of Public Health, 99*(3), 520-526. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.ajph.org/> (Volume 4)

Technology may help engage children in outdoor activities

Chavez conducted an exploratory study to investigate the role of technology in supporting or enhancing children's outdoor experiences. As part of Youth Day in Los Angeles, CA 38 six- to seventeen-year-old children participated in four activities—two were technology-based (a camera safari and geocaching for treasure) and two were not technology-based (nature rubbings and a nature scavenger hunt). All children participated in each of the four activities and voted on how much they liked each activity. In addition, adult observers and trained facilitators provided feedback on children's participation in each activity. In analyzing the data, Chavez found that all activities received a majority of positive votes, but that technology dependent activities received a higher percentage of positive votes as compared to non-technology dependent activities. While there are a number of factors that could have influenced these findings, such as participant age and the specific activities selected, this study suggests that technology may help engage children in outdoor activities.

Author Affiliation: Chavez is with the USDA Forest Service.

Chavez, D. J. (2009). Youth day in Los Angeles: evaluating the role in technology in children's nature activities. *Children, Youth and Environments*, 19(1), 102-124. This article is available online at: http://www.colorado.edu/journals/cye/index_issues.htm. (Volume 4)

Parents and preschool staff weigh in on factors influencing children's physical activity

Dwyer and colleagues investigated parent and preschool staff attitudes and knowledge about factors that influence physical activity and television viewing behavior among preschool-age children. To examine these issues, researchers conducted 9 focus groups with 39 participants in Sydney, Australia from specific sociocultural groups that are at an increased risk for the development of overweight and obesity (i.e., children from lower socioeconomic and Middle-Eastern and Chinese communities). In analyzing the themes from the focus group data, Dwyer and colleagues reported many interesting findings. For example, researchers found that parents and preschool staff recognized the difference in physical activity behavior between young children, older children, and adults and suggested that the term "intensity" was not applicable to young children's physical activity behavior. Parents and staff identified physical, mental, and social benefits of physical activity, however, were not familiar with physical activity guidelines. Parents and preschool staff also reported a number of facilitators and barriers to children's physical activity. Key facilitators of physical activity included a child's preference for being active, positive family or peer modeling, access to safe play areas and play opportunities (e.g., organized programs), and a sense of social connectedness (e.g., neighborhood friends). Key barriers to physical activity included concerns about safety at both a personal and community level, time and financial constraints, competing values (e.g., for educational achievement), and safety regulations with regard to preschool environment design. In addition, Dwyer and colleagues found that many parents were concerned with the effects of excessive TV viewing and thus consciously moderated their children's viewing behavior. Many parents believed that young children were naturally active and societal influences, such as television, negatively influenced this natural tendency. Preschool staff were also concerned about television viewing and over-scheduling and believed that they negatively influenced children's ability to engage in creative play. While this study may be limited due to its reliance on volunteers, it provides a valuable contribution to the literature because it examines the influences of physical activity in young children using a qualitative approach.

Author Affiliation: Dwyer, Hardy, and Baur are with the University of Sydney in Australia. Higgs is with Charles Sturt University in Australia.

Dwyer, G. M., Higgs, J., Hardy, L. L., & Baur, L. A. (2008). What do parents and preschool staff tell us about young children's physical activity: a qualitative study. *International Journal of Behavioral Nutrition and Physical Activity*, 5, 11. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.ijbnpa.org/> (Volume 4)

Not all children have recess and those that do have recess do not have it for very long periods of time

Recess is an important opportunity for children to be outdoors, to play and to be physically active. In this report, the National Center for Education Statistics (U.S. Department of Education) investigated food and physical activity in public elementary schools. This report is based on a survey of 1,198 public elementary schools in all 50 states and the District of Columbia. The survey covered a variety of topics, including whether schools provided recess, the number of days per week recess was provided, and the length of time for recess. A few of the report's findings include:

- Most public elementary schools have scheduled recess (87% to 93%), depending on the specific grade discussed, however, 7% to 13% of elementary schools do not have scheduled recess.
- Most schools have recess every day (83% to 88%), depending on the specific grade discussed.
- The majority of schools have recess once a day (55% to 66%), depending on the specific grade discussed.
- The average number of minutes per day or recess ranged from 23.8 to 27.8 (depending on the specific grade discussed).

There were differences with regard to whether a school provided recess, the frequency of recess, and the amount of recess, based on specific school characteristics (e.g., school size, location, region, percent minority enrollment, or percent poverty concentration). For example, schools with the highest poverty concentrations were more likely not to have scheduled recess than those with lower concentrations of poverty.

Parsad, B. and Lewis, L. *Calories In, Calories Out: Food and Exercise in Public Elementary Schools, 2005* (NCES 2006-057). U.S. Department of Education. Washington, DC: National Center for Education Statistics, 2006. This study is available online at: <http://nces.ed.gov/Pubs2006/nutrition> (Volume 2)

Focus: Outdoor Spaces

The quality and quantity of children's outdoor spaces may influence their experiences and contact with the outdoors and nature. These articles examine topics related to children's outdoor spaces.

Early childhood educators prefer vegetated outdoor play spaces

The quality of children's outdoor environments can influence their health and development. In this study, Herrington investigated early childhood educators' opinions on their center's outdoor play spaces. She conducted focus group interviews with 78 educators at a diversity of childcare centers for 3- to 5-year-olds in Vancouver, Canada and evaluated the design of each outdoor play space. In analyzing the data in terms of educators' positive and negative comments about center location,

layout, and plant material, Herrington found that outdoor play spaces with plants had significantly more positive responses from educators than spaces without plants. She also found that educators at centers with plants commented more positively on seasonal changes than educators at centers without plants. In considering the socioeconomic status of the centers, Herrington found that the greatest need for vegetation was in mixed-income and economically stressed neighborhoods. Overall, she found that play spaces in economically stressed neighborhoods received some of the most negative comments from educators. With regard to desired changes at their centers, Herrington found that 79% of educators wanted more sensory stimuli for children, such as plants or water; 64% wanted more space; 57% wanted more challenging equipment; and 50% wanted less concrete. In addition, all the educators at centers with bark mulch indicated that they wanted it removed as it caused splinters. While this study may be limited due to its reliance on volunteers, it provides valuable insight into the opinions of early childhood educators and the importance of vegetation in their positive evaluation of outdoor play spaces.

Author Affiliation: Herrington is with the University of British Columbia.

Herrington, S. (2008). Perspectives from the ground: early childhood educators' perceptions of outdoor play spaces at child care centers. *Children, Youth and Environments*, 18(2), 65-87. This article is available online at: http://www.colorado.edu/journals/cye/index_issues.htm. (Volume 4)

Schoolyards are dominated by turf grass and impervious surface

Increasingly, research is demonstrating the benefits that green space can provide to children's health and well-being and to environmental quality (e.g., reduced urban runoff and moderation of climate). Children spend about one third of their day at school; however, little is known about the actual physical structure of school property. In this study, Alexis Schulman and Catherine A. Peters classified and compared land cover on 258 U.S. public elementary and middle schoolyards in three major U.S. cities (Baltimore, Boston, and Detroit). The authors used aerial photographs from the mid- to late 1990s and Geographic Information System software to classify and analyze schoolyard landcover. Schulman and Peters found that, on average, schoolyards covered more than 68% of the school property and that they were dominated by turf grass and impervious surface, with very little tree cover (on average, less than 10%). The authors also found that schoolyard size had an important influence on cover type in that larger schoolyards tended to have lower levels of impervious surface. Schulman and Peters contend that the amount of tree cover found in most schoolyards is inadequate given health and environmental quality research findings to date. In concluding their article, the authors discuss important opportunities and obstacles to greening schoolyards and provide a number of recommendations.

Schulman, A., & Peters, C. A. (2008). "GIS analysis of urban schoolyard landcover in three U.S. cities." *Urban ecosystems*, 11(1), 65-80. This article is available online at: <http://www.princeton.edu/~cap/papers/Schulman%20Peters%20urban%20ecosystems.pdf> (Volume 3)

Focus: Environmental Knowledge & Behavior

Children's exposure to nature may influence their environmental knowledge and behavior as children, as well as throughout their lives. These articles examine youth's environmental knowledge and behavior.

Adolescents' environmental concerns have generally declined since the early 1990s

Wray-Lake and colleagues describe and analyze trends in environmental attitudes, beliefs, and behaviors of nearly 10,000 adolescents from 1976 to 2005. Researchers examined data from the Monitoring the Future study, a survey that has been conducted annually among a nationally representative sample of U.S. high school seniors. As part of this survey, a wide range of information is gathered from adolescents, including information about their conservation behaviors; attitudes toward consumer, government, and personal responsibility for the environment; and resource scarcity. In examining trends in adolescents' environmental concerns over the past three decades, overall, the researchers found increases during the early 1990s and declines over the remainder of the last three decades. For example, researchers found steep declines in adolescents' willingness to engage in conservation behaviors, such as reducing their electricity or heat usage or driving less. In addition, Wray-Lake and colleagues found that adolescents were more likely to support consumer and government responsibility to protect the environment than to take personal action. The researchers also conducted some preliminary explorations of associations between different trends, as well as materialistic values and technological beliefs. Among their findings, Wray-Lake and colleagues reported parallel trends for resource scarcity and conservation behavior and negative associations between materialism and personal environmental responsibility and conservation. The researchers discuss observed trends as they relate to adult opinions and specific historic events and time periods, such as the 1970s energy crisis and different presidential administrations. Wray-Lake and colleagues highlight the importance of examining and understanding young people's environmental concerns and suggest areas for future research. While this study may be limited due to the specific conservation behaviors investigated, it is unique and provides a valuable contribution to the literature in that it examines adolescents' environmental concerns among a nationally representative sample of youth over time.

Author Affiliation: The authors are with The Pennsylvania State University.

Wray-Lake, L., Flanagan, C. A., & Osgood, D. W. (2009). Examining trends in adolescent environmental attitudes, beliefs, and behaviors across three decades. *Environment and Behavior*(May 5). This study may be available in a library near you or can be purchased online through the publisher at: <http://eab.sagepub.com/> (Volume 4)

Childhood experiences in natural spaces are strong predictors of adult use and attitudes toward natural spaces

C.W. Thompson and colleagues investigate factors contributing to adult outdoor access and activity in two survey-based projects that explored people's use and attitudes toward natural spaces near their homes in Central Scotland and the East Midlands of England. As part of these projects, the authors questioned a large and diverse sample of individuals (339 adults in Scotland and 459 in England) in public venues and green spaces to obtain information about their background, use and attitudes toward natural spaces, demographic status, and frequency of childhood visits to green spaces. In analyzing the survey data, Thompson and colleagues found that most people used natural spaces for walking and that over 35% of respondents visited woodlands at least once a week. Using a variety of statistical techniques, the authors examined which factors best explained the frequency with which adults visited natural spaces and found that frequency of childhood visits to natural spaces and distance from home to natural spaces were the most important factors. These results indicate that people who have had frequent childhood experiences in natural spaces are more likely to visit such places as adults. Thompson and colleagues also found that people who have had

frequent childhood experiences in natural places tend to feel more comfortable visiting these places alone and have a more positive attitude towards these spaces as adults (e.g., they feel more energetic and restored in these spaces). The authors discuss several limitations to their study, including the possibility that adult memories of childhood may be distorted, and the implications their study findings might have given the increasing restrictions children face today with regard to outdoor access and play.

Thompson, C. W., Aspinall, P., & Montarzino, A. (2008). “The childhood factor - Adult visits to green places and the significance of childhood experience.” *Environment and behavior*, 40(1), 111-143. This study may be available in a library near you or can be purchased online through the publisher at: <http://eab.sagepub.com/> (Volume 3)

Direct experience and mentoring are key elements

The focus of this recent research from Dr. Louise Chawla is on those factors that contribute to individuals choosing to take action to benefit the environment when they are adults. This is a reprise of earlier research by Dr. Chawla in the 1990s (Journal of Environmental Education, 1998, 1999). Positive, direct experience in the out-of-doors and being taken outdoors by someone close to the child — a parent, grandparent, or other trusted guardian — are the two most significant contributing factors. While lifelong activism is the primary focus of Dr. Chawla’s inquiry, as reported in this article, her well-documented study includes citations and explanations of many additional benefits to children from early experiences in the out-of-doors. Creativity, physical competence, social skills, environmental knowledge, confidence, and problem-solving ability are among those benefits to children’s development. Given the important role of adults in taking children into the out-of-doors, Dr. Chawla is specific about the attributes of the experiences those adult mentors provide. She states, the “adults gave attention to their surroundings in four ways — care for the land as a limited resource essential for family identity and well-being; a disapproval of destructive practices; simple pleasure at being out in nature; and a fascination with the details of other living things and elements of the earth and sky.” Modeling those attributes while in the presence of the child does even more. As Dr. Chawla states, “The very fact that a parent or grandparent chose to take the child with them to a place where they themselves found fascination and pleasure, to share what engaged them there, suggests not only care for the natural world, but, equally, care for the child.” (Original Research and Synthesis)

Chawla, Louise. “Learning to Love the Natural World Enough to Protect It,” in Barn nr. 2 2006:57-58. © 2006 Norsk senter for barneforskning. Barn is a quarterly published by the Norwegian Centre for Child Research at the Norwegian University of Science and Technology, Trondheim, Norway. This article was written for a special issue in honor of the Norwegian child psychologist, Per Olav Tiller. http://www.cnaturenet.org/02_rsrch_studies/PDFs/Chawla_LearningtoLove.pdf (Volume 1)

Children and adults in Switzerland know little about biodiversity

Lindemann-Matthies and Bose interviewed and surveyed over 350 potentially more “biodiversity-knowledgeable” youth and adults in Switzerland to better understand people’s knowledge of biodiversity. In analyzing the study data, researchers found that 60% of study participants had never heard the term biodiversity. With regard to grammar school students, however, the percentage was higher with 77% of students reporting to have never heard about biodiversity. Lindemann-Matthies and Bose found that for those participants who had heard the term biodiversity, the media, rather than school education, was identified as a provider of biodiversity information. In addition,

researchers found that participants highly overestimated plant species richness in Switzerland and worldwide. Importantly, Lindemann-Matthies and Bose found that most participants were interested in biodiversity issues and thought that it was important. While this study had a relatively small sample size, it demonstrates that despite the increased attention biodiversity has received from the environmental research and policy communities, many people in Switzerland are still unfamiliar with biodiversity. To enhance biodiversity education and conservation, Lindemann-Matthies and Bose suggest the need to reconnect people to nature, promote more in-depth knowledge of biodiversity, and encourage people to take environmentally-friendly actions.

Author Affiliation: The authors are with the University of Zurich in Switzerland.

Lindemann-Matthies, P., & Bose, E. (2008). How many species are there? public understanding and awareness of biodiversity in Switzerland. *Human Ecology*, 36(5), 731-742. This study may be available in a library near you or can be purchased online through the publisher at: www.krepublishers.com/.../JHE-00-0-000-000-1990-1-Cover.htm (Volume 4)

Children can identify few local species

Knowing about one's environment is an important foundation to being able to understand various issues and act in an informed and responsible manner. In a recent study, BBC Wildlife Magazine asked 700 children between the ages of 9 and 11 from 17 schools in Bristol (United Kingdom) to identify a number of local wild species. The magazine also asked participants a number of questions related to wildlife and their activities more generally. While 70% of children could correctly identify blackberry and magpie, only 8% could identify goldfinch and 12% a primrose. Additional research is needed to better understand this study's findings and whether or not these numbers might represent a significant lack of or decline in environmental knowledge.

Information on this study can be found online at: <http://www.bbcwildlifemagazine.com/newsread.asp?id=45018> (Volume 3)

Children know more about Pokémon than common wildlife

In a small, innovative study, Dr. Andrew Balmford and colleagues surveyed 109 United Kingdom (UK) primary schoolchildren (ages 4 to 11) to investigate their knowledge of natural and non-natural objects. Each child was shown a set of 20 flashcards—10 of common British wildlife species (including plants, invertebrates, and mammals) and 10 of Pokémon characters. The authors found that while individual children's scores varied, children's overall identification success for common wildlife species rose from 32% at age 4 to 53% at age 8 and then fell slightly, whereas children's identification success for Pokémon characters rose from 7% at age 4 to 78% at age 8. Dr. Balmford and colleagues discuss the possible implications of children's lack of knowledge of common wildlife types and the importance of reconnecting children with local nature.

Balmford, A., Clegg, L., Coulson, T., & Taylor, J. "Why Conservationists Should Heed Pokémon." *Science*, 295(5564), 2367-2367, 2002. This study is available online at: http://www.sciencemag.org/cgi/content/full/295/5564/2367b?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&fulltext=pokemon&searchid=1141908863643_6399&FIRSTINDEX=0&journalcode=sci (Volume 2)

Biology students know very few common plants

In this study, Anne Bebbington tested nearly 800 advanced-level biology students (secondary school students in the United Kingdom (UK) who are generally 16-17 years of age) on their ability to identify 10 common wildflowers that were illustrated in color on a sheet of paper. Interestingly, she found that none of these students could name all 10 wildflowers and the vast majority of students (86%) could not name more than three common wildflowers. Ms. Bebbington also tested Post Graduate Certificate of Education students and teachers, but the sample sizes for both of these groups were too small to conduct comparative analyses. In closing, Ms. Bebbington discusses how science is taught in primary and secondary schools in the UK and what implications this study may have for education. Importantly, she highlights the role of identification and how it is not an end in itself—in fact it is just the beginning. Knowing the name of organisms (in this case wildflowers) can prompt students to ask questions and learn about organisms and their environments.
