



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

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

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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.

Physical activity and exposure to nature are important to good health

In this literature review, Pretty and colleagues examine the role of physical activity and nature contact on health and well-being, with a particular focus on children. The authors discuss the current state of physical inactivity, the positive health benefits of nature contact, and the potential role of green exercise (activity in the presence of nature) toward improving health and well-being. Pretty and colleagues review three stages of childhood and their differing needs, evidence regarding children's physical activity levels, and the benefits of children's exposure to nature. The authors discuss the impact of urban design and green space in terms of physical activity and various health outcomes, including cognitive health and learning, as well as the impact of nature-based interventions, such as care farms and wilderness therapy, for children with special needs. Based on their review, Pretty and colleagues propose two conceptual pathways—healthy and unhealthy—that shape our lives and life outcomes. On the healthy pathway, people are active, connected to people and society, engage with natural places, and eat healthy foods and as a result tend to live longer and have a better quality of life. On the unhealthy pathway, people are inactive, disconnected to people and society, do not engage with natural places, and eat unhealthy foods, and as a result die earlier and have a lower quality of life. In concluding their review, Pretty and colleagues make ten recommendations to improve people's well-being, including increasing children's outdoor free play and encouraging planners to incorporate access to green space.

Author Affiliation: Jules Pretty is with the University of Essex in the UK.

Pretty, J., Angus, C., Bain, M., Barton, J., Gladwell, V., Hine, R., et al. (2009). *Nature, childhood, health and life pathways*: University of Essex. This report is available online at: <http://www.essex.ac.uk/ces/occasionalpapers/Nature%20Childhood%20and%20Health%20iCES%20Occ%20Paper%202009-2%20FINAL.pdf> (Volume 5)

Being outdoors is important to our health

Godbey examines the health benefits of being outdoors, including the role these activities play in stress reduction. He also examines outdoor recreation as it relates to specific children's health issues, including obesity and attention-deficit hyperactivity disorder, and how spending time outdoors can benefit children with these health challenges. Godbey investigates children's connection with nature and the many variables that impact children's outdoor play. He discusses different approaches to measuring physical activity and participation in outdoor recreation, as well as recent trends in park visitation and outdoor activity participation. He also highlights numerous factors that impact participation in outdoor activities, including amount of leisure time, proximity to outdoor space, safety of parks, and park and playground design. Throughout the review, Godbey highlights specific research gaps that could help guide future efforts. He also discusses changing demographics as they relate to outdoor recreation and what these changes may mean in terms of successful policymaking.

Author Affiliation: Geoffrey Godbey is with Resources for the Future.

Godbey, G. (2009). *Outdoor Recreation, Health, and Wellness: Understanding and Enhancing the Relationship*. Washington DC: Resources for the Future. This report is available online at: <http://www.rff.org/documents/RFF-DP-09-21.pdf> (Volume 5)

Green environments are essential to human health

In this report, Kuo reviews evidence of the benefits that nature contact provides to our health. Kuo begins by discussing the development of nature-human health research and how in the last decade research has become incredibly diverse and rigorous. As a result of the research that has been conducted to date, she concludes that green environments are essential to human health. In the bulk of the report, Kuo reviews evidence of the benefits that nature contact provides to our social, psychological, and physical health. In each major section, she discusses evidence from a sampling of relevant studies that are diverse and of high quality. For example, she reviews evidence that nature contact promotes healthier social behavior and lessens social dysfunction, helps alleviate stress, improves resilience, promotes optimal psychological functioning, improves recovery from physical trauma, and reduces mortality. Kuo discusses current ideas on how nature might promote human health, including the role of physical activity, immune functioning, and stress reduction. She also discusses a set of larger themes that have emerged from the literature, such as that green environments must be experienced to have positive health impacts and that nature contact can take many forms and occur at many different dosage levels. Kuo concludes her report by providing specific recommendations on how to increase people's nature contact and its associated health benefits by: 1) providing as much nature, in as many forms as possible; 2) bringing nature to people; and 3) bringing people to nature.

Author Affiliation: Frances Kuo is with the University of Illinois at Urbana-Champaign.

Kuo, F. E. (2010). *Parks and other green environments: essential components of a healthy human habitat*. National Recreation and Park Association. This report is available online at: [http://www.nrpa.org/uploadedFiles/Explore_Parks_and_Recreation/Research/Ming%20\(Kuo\)%20Reserach%20Paper-Final-150dpi.pdf](http://www.nrpa.org/uploadedFiles/Explore_Parks_and_Recreation/Research/Ming%20(Kuo)%20Reserach%20Paper-Final-150dpi.pdf) (Volume 5)

Nature provides a variety of mental health and well-being benefits

Townsend and Weerasuriya review the literature on the relationship between nature and health and well-being, with a specific focus on mental health and well-being. To conduct their review, the authors examined peer-reviewed journal articles, grey literature, and books, with an emphasis on articles published in the last decade. Townsend and Weerasuriya provide a very thorough and detailed report covering a range of valuable topics. The authors begin by discussing major theories about why or how nature contact impacts human health and well-being, including the biophilia hypothesis and attention restoration theory. The authors then review physical, mental, and social health benefits associated with nature contact, including benefits for specific populations (e.g., children and the elderly). Townsend and Weerasuriya then move on to discuss the benefits of nature contact to mental health for the population in general, as well as specific populations (e.g., children, prisoners, and indigenous populations). The authors then review specific types of landscapes and their therapeutic mental health impacts, including local parks, forests and gardens, as well as different therapeutic approaches, including wilderness therapy and horticulture therapy. Townsend and Weerasuriya also discuss evidence concerning impacts to mental health from animal contact,

ranging from contact with pets to therapeutic programs with dolphins. The authors highlight various dimensions of mental health that can be positively impacted by nature contact, including cognitive functioning and stress reduction, depression, and attention-deficit hyperactivity disorder. In the last sections of the report, the authors discuss additional aspects of the relationship between nature and mental health, including physical activity and social connectedness, the relationship between climate change and mental health, and the linkages between urban environments and mental health.

Author Affiliation: Mardie Townsend is with Deakin University in Australia.

Townsend, M., & Weerasuriya, R. (2010). *Beyond blue to green: The benefits of contact with nature for mental health and well-being*. Melbourne, Australia. This report is available online at: http://www.beyondblue.org.au/index.aspx?link_id=59.1284 (Volume 5)

Natural environments may provide added health benefits above and beyond human-made environments

In recent years, a number of studies have examined the role of natural environments in human health. In this article, Bowler and colleagues conducted a systematic review of research to determine whether there is an “added benefit” from activities in natural environments that goes above and beyond those in more human-made environments. Bowler and colleagues specifically focused on studies where there was a comparison of the same activity in natural and human-made environments so that the effect of the environment could be determined. The authors examined 25 studies that included a variety of types of natural environments (e.g., public parks or university campuses) and outcome measures (e.g., emotions or attention/concentration). In analyzing the study results, Bowler and colleagues found that activities in a natural environment resulted in reduced negative emotions (e.g., anger, fatigue and sadness) as compared to similar activities in a human-made environment. The authors also found that activity in a natural environment may result in improved attention as compared to a human-made environment, however, the added benefit disappeared when pretest differences were taken into account. Bowler and colleagues did not find strong evidence of differences in terms of other physiological variables examined, such as blood pressure, however, there were not many studies in this area to examine. This article provides a valuable contribution toward our understanding of the benefits of nature to human health. In concluding their article, the authors discuss characteristics of the studies they examined and suggest areas of future research.

Author Affiliation: Andrew Pullin is with Bangor University in the UK.

Bowler, D. E., Buyung-Ali, L. M., Knight, T. M., & Pullin, A. S. (2010). A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health*, 10(1), 456. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.biomedcentral.com/bmcpublichealth/> (Volume 5)

Outdoor skills education supports our health, learning, and lifestyle

Cottrell and Raadik-Cottrell review the benefits that outdoor skills education and wildlife-related outdoor education provide to our health, learning, and lifestyle. In addition, the authors review information concerning the relationship between outdoor skills education and fishing and hunting

participation. In developing this report, Cottrell and Raadik-Cottrell reviewed over 100 relevant documents, including industry and non-governmental organization reports and academic peer-reviewed articles. In their review, the authors discuss evidence regarding the benefits of outdoor skills education, including improved interpersonal and intrapersonal skills; environmental awareness and stewardship ethics; physical, mental, and social health; and ability to learn and concentrate. With regard to hunting and fishing, Cottrell and Raadik-Cottrell discuss indicators of recruitment and retention in these outdoor activities, including early life experiences, mentorship, and structured programs that are culturally appropriate and more holistic/ecologically oriented. The authors highlight some successful outdoor skills programs and provide a series of recommendations to enhance different types of programs, such as understanding volunteer expectations and providing continuous and progressive outdoor education experiences. Cottrell and Raadik-Cottrell conclude their report with a list of recommendations for future research.

Author Affiliation: Stuart Cottrell is with Colorado State University and Cottrell and Associates Environmental Consulting.

Cottrell, S., & Raadik-Cottrell, J. (2010). *Benefits of outdoor skills to health, learning and lifestyle: A literature review*. Association of Fish & Wildlife Agencies' North American Conservation Education Strategy. This report is available online at: http://outdoornebraska.ne.gov/Education/pdf/BenefitsofOutdoorSkills_WhitePaper_11-2010_Final%20with%20cover.pdf (Volume 5)

Wilderness programs improve participants' health, behavior, and attitudes

The connection between natural landscapes and human health provides an important avenue to support land conservation and human health. In this review, Hine and colleagues examine 70 studies related to the benefits of wilderness and nature-based experiences. Hine and colleagues describe numerous characteristics of these studies, including their methodological type (e.g., qualitative or quantitative), outcomes measured, location of the programs they evaluated, types of experiences (e.g., therapeutic intervention or general experience), and age and gender of participants. In examining study results, the authors found that wilderness and nature-based experiences resulted in a range of benefits including: physical and mental health benefits (e.g., reduced body fat, reduced anxiety and stress, and improved self-esteem); positive changes in behavior; enhanced connectedness to nature; and improved knowledge and skills acquisition. Hine and colleagues discuss limitations to the reviewed studies, including the lack of quantitative and longitudinal studies, small sample sizes, and the lack of control groups. The authors highlight the need for additional research to address current limitations and provide specific research recommendations.

Author Affiliation: Rachel Hine is with the University of Essex in the UK.

Hine, R., Pretty, J., & Barton, J. (2009). *Research project: Social, psychological and cultural benefits of large natural habitat & wilderness experience*. University of Essex. This report is available online at: <http://www.essex.ac.uk/ces/occasionalpapers/Kerry/Literature%20Review%20for%20WF.pdf> (Volume 5)

Place attachments are important to children's well-being

In this article, Jack reviews evidence about the relationship between place attachments and children's well-being. He discusses the meaning of place and place attachments and how place attachments develop in children. Jack also reviews evidence about how children use space, the various influences

(from individual to family and community) on children's use of space, and how use of space affects place attachments. He then discusses studies that have found significant declines in children's independent mobility or freedom to use their local environment and factors contributing to this decline. Jack highlights three social policy approaches (laissez-faire, service-oriented, and space-oriented) and related programs in the UK and their impacts on children's independent use of their local environments. In the last section of this review, the author discusses the importance of place attachments for children who are in the social-care system and the lack of current focus on children's attachments to place in favor of attachments to people. Importantly, Jack provides suggestions on how people working with children in the social system can better support their place attachments and well-being.

Author Affiliation: Gordon Jack is with Durham University in the UK.

Jack, G. (2010). Place Matters: The Significance of Place Attachments for Children's Well-Being. *British Journal of Social Work*, 40(3), 755-771. This study may be available in a library near you or can be purchased online through the publisher at: <http://bjsw.oxfordjournals.org/> (Volume 5)

Parks and playgrounds encourage physical activity

In this report, Mowen synthesizes research about the relationship between parks and healthy, active lifestyles. He reviews studies across a range of populations, including children, adults, seniors, lower-income families, and various racial and ethnic groups. Mowen reports a number of key findings. A few findings that pertain to children include the following:

- Children who live in close proximity to parks, use parks more and engage in more physical activity.
- Not everyone has equal access to parks. Lower-income populations and some racial and ethnic populations have poor access to parks.
- Certain park features seem to encourage more physical activity. For example, one study found that girls living close to parks with good lighting were more physically active.
- Perception of neighborhood safety influences whether parents encourage their children to use local playgrounds.
- Organized park programs and supervision may increase children's use of parks and their physical activity.
- Park renovations can increase children's use of playgrounds and their level of physical activity.

In concluding his literature review, Mowen highlights areas where future research is needed to continue to build the evidence base related to parks and active living.

Author Affiliation: Andrew Mowen is with The Pennsylvania State University.

Mowen, A. J. (2010). *Parks, playgrounds and active living*. Robert Wood Johnson Foundation. This report is available online at: <http://www.activelivingresearch.org/resourcesearch/summaries> (Volume 5)

Adventure playgrounds foster healthy child development

In this article, Staempfi provides an overview of what adventure playgrounds are and the role that they can play in enhancing child development. She discusses the changing nature of children's play, and the history of adventure playgrounds and their recent prominence in many European countries,

as well as variations in adventure playground philosophy, structure, and setting. Staempfi highlights the unique role of trained professionals or playworkers at adventure playgrounds that serve as unobtrusive guides to facilitate children's development through play. She also discusses the developmental benefits of adventure playgrounds as well as positive community development outcomes. Staempfi examines the issue of safety and risk on playgrounds and the influence of society's values, beliefs, and legal system in shaping the development of adventure playgrounds. In concluding her article, Staempfi makes a number of recommendations for future research and highlights the importance of educational efforts to build awareness about the developmental benefits of adventure play.

Author Affiliation: Marianne Staempfi is with the University of Waterloo in Canada.

Staempfi, M. B. (2009). Reintroducing Adventure Into Children's Outdoor Play Environments. *Environment and Behavior*, 41(2), 268-280. This study may be available in a library near you or can be purchased online through the publisher at: <http://eab.sagepub.com/> (Volume 5)

Being physically active outdoors and in nature can improve children's health

Many children in the U.S. today have chronic health conditions such as obesity, asthma, and attention deficit/hyperactivity disorder. In this article, McCurdy and colleagues review the current status of children's health, including children's physical inactivity; increasing obesity; the prevalence of obesity-related diseases such as type 2 diabetes and hypertension; vitamin D deficiency; and mental health challenges such as depression and anxiety. The authors then review evidence regarding the benefits of physical activity, and in particular physical activity outdoors and in natural environments. In addition, the authors discuss the benefits natural environments can have on children's mental health, as well as additional potential health benefits, including improving asthma and nearsightedness. In concluding their article, McCurdy and colleagues examine the important role that pediatric health care providers play in the management of childhood obesity and other chronic health challenges. The authors review current guidance available to pediatricians and discuss a new initiative—The Children and Nature Initiative—which works with pediatric health care providers to increase the amount of time that children spend outside being physically active and in nature as a way to address chronic conditions and improve children's health.

Author Affiliation: Leyla McCurdy is with the National Environmental Education Foundation in Washington D.C.

McCurdy, L. E., Winterbottom, K. E., Mehta, S. S., & Roberts, J. R. (2010). Using nature and outdoor activity to improve children's health. *Current Problems in Pediatric and Adolescent Health Care*, 40(5), 102-117. This study may be available in a library near you or can be purchased online through the publisher at: [http://www.cppah.com/article/S1538-5442\(10\)00044-1/abstract](http://www.cppah.com/article/S1538-5442(10)00044-1/abstract) (Volume 5)

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 his newest book, *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 and/or nature-related behavior and their school performance and learning.

Plants in classrooms benefit students' emotions, behavior, and health

The classroom environment can play an important role in students' learning and academic performance. Han examined the effect of living plants in a classroom on students' psychology, behavior, and health. To investigate this relationship, he conducted a study with two similar classrooms, located next to each other, of sophomore students at a high school in Taiwan. Han used surveys every 2 weeks to assess students' emotions and collected objective information on students' academic performance, health, and behavior. After an initial assessment period, he brought six small trees into the back of one of the classrooms. In comparing data from the two classrooms, Han found that shortly after the plants were introduced, students had significantly higher scores than the regular classroom in terms of preference, comfort, and friendliness. In addition, he found that students in the classroom with plants had significantly fewer sick leave hours and punishment

records than students in the regular classroom. While this study may be limited due to its small sample size and there is the potential that other variables may have influenced the results, Han's research provides valuable insight into the benefits that even small amounts of nature can provide to students and suggests promising avenues for future research.

Author Affiliation: Ke-Tsung Han is with National Chin-Yi University of Technology in Taiwan.

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. [Article]. *Environment and Behavior*, 41(5), 658-692. This study may be available in a library near you or can be purchased online through the publisher at: <http://eab.sagepub.com/> (Volume 5)

Preschool children experiencing a weekly outdoor lesson have improved self-efficacy and early literacy skills

The Outdoor Discovery Center Macatawa Greenway--a non-profit entity that delivers outdoor, nature-based education and programming in Holland, MI--developed a nature-based program intervention to improve the health and well-being of preschool children and their families. As part of the intervention, naturalist educators visited six preschools on a weekly basis to deliver an hour-long lesson focused on a science concept that was taught through outdoor activities. To understand the impact of the intervention on students, Trent-Brown and colleagues examined a number of health and well-being measures for over 100 preschool students, between the ages of 3 and 5, prior to and 6 months after the intervention began in both an experimental group that received the intervention, as well as a control group that did not receive the intervention. Researchers measured children's blood pressure, body mass index (BMI), activity preferences, self-efficacy, and early literacy skills. In analyzing the data for experimental and control groups, Trent-Brown and colleagues found that preschool students in the nature intervention program had significantly improved with regard to their self-efficacy and early literacy skills when compared to the control group. In examining relationships between outcomes for the control and experimental groups, researchers found that there was a more significant and positive relationship between activity preferences and self-efficacy and early literacy skills for the experimental group as compared to the control group, indicating that children with more active preferences tended to improve more with regard to self-efficacy and early literacy skills. While there were notable positive outcomes, researchers also found that preschool students in the nature intervention program had significantly elevated mean arterial blood pressure scores, as well as significant increases in the number of students classified as prehypertensive as compared to the control group, which did not experience these increases. With regard to BMI and activity preferences, researchers found no significant changes among the experimental or control groups. While this study may be limited due to student and teacher turnover in the classrooms, as well as a number of other factors that were not controlled as part of the study and therefore might influence study outcomes, such as nutrition and family health history, it provides an important contribution to the literature about the impact of nature programs on children's health and well-being. Importantly, this study will continue in future years, providing important information about the long-term impact of nature programs on students.

Author Affiliation: Trent-Brown is with Hope College in Holland, MI.

Trent-Brown, S. A., Vanderveen, J. D., Cotter, R., Hawkins, K., Schab, A., Dykstra, S., et al. (2011). *Effects of a nature-based science enrichment program on preschool children's health, activity*

preferences, self-efficacy, and cognition: Outdoor Discovery Center Macatawa Greenway. This report may be available via the Outdoor Discovery Center Macatawa Greenway at <http://odcofwu.schoolwires.com/odcofwu/site/default.asp> (Volume 5)

Elementary school principals overwhelmingly believe recess has a positive impact on students' achievement, learning, and development

Children spend more time in school than almost anywhere else. At school, recess provides one of the few opportunities for children to play and to potentially be outdoors. Gallup conducted a nationwide survey of 1,951 elementary school principals from urban, suburban, and rural schools to understand principals' attitudes and experiences with recess. A few of the key findings include: 1) more than 80% of principals reported that recess has a positive impact on academic achievement; 2) 75% of principals stated that students are more focused in class after recess and listen better; and 3) more than 95% of principals believe that recess positively impacts students' social development and general well-being. Despite these benefits, researchers found that many principals reported offering very limited recess times. For example, 50% of principals reported that students receive 30 minutes or less of recess per day. In addition, over 75% of principals reported taking recess away from students as a punishment. According to principals, one of the biggest challenges with recess is discipline-related problems. Principals identified additional staff, better equipment, and playground management training as ways to improve recess at schools.

Author Affiliation: The poll was conducted by Gallup with sponsorship from the Robert Wood Johnson Foundation and assistance from the National Association of Elementary School Principals and Playworks.

Robert Wood Johnson Foundation. (2010). The state of play: Gallup survey of principals on school recess. This study is available online at: <http://www.rwjf.org/files/research/stateofplayrecessreportgallup.pdf> (Volume 5)

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 Shephard 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 Shephard 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 Pittsburg 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

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/Fitness & Weight

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

An outdoor program enhances children’s well-being, physical activity, and feelings of health, safety, and satisfaction

Many children in their teenage years face mental health challenges. Several studies have found that contact with nature and physical activity in a natural environment, what some call “green exercise,” improves psychological well-being. In this study, Wood and colleagues evaluated the impact of the Youth Outdoor Experience (YOE) project on participating children’s well-being and physical activity. The YOE project provides 11- to 18-year-old children from disadvantaged urban areas in England with opportunities to participate in a 12-week program where children engage in weekly

structured outdoor activities. As part of this study, researchers had 14 participants complete a questionnaire to assess their well-being, connectedness to nature, and physical activity. Researchers also had 114 participants complete a questionnaire to assess the impact of the project on a range of well-being areas (e.g., being healthy, staying safe, and enjoying and achieving). Most participants completed both questionnaires at the start, middle, and end of the project. In analyzing the data, Wood and colleagues found a number of interesting results, including:

- Participants' well-being increased from the start to the end of the program.
- Participants' contact with nature varied a lot over the course of the project.
- Participants increased the number of days that they performed 30 minutes of moderate physical activity.
- Project leaders reported positive changes in participants' attitudes, self-esteem, and behavior.
- Participants reported feeling healthier, safer, and more positive with regard to their school, home, and social lives, as well as their achievements.

While this study may be limited due to its small sample size and reliance on self-report measures, it highlights the need for additional research in this area and the potential role that nature-based activities can have on participants' well-being, physical activity, and feelings of health, safety, and satisfaction.

Author Affiliation: Carly Wood is with the University of Essex in the UK.

Wood, C., Hine, R., & Barton, J. (2011). *The health benefits of the Youth Outdoor Experience (YOE) project*: University of Essex. This report may be available through the University of Essex, Suffolk Wildlife Trust, or Natural England. (Volume 5)

Children with better access to public parks and recreation programs are less likely to have significant increases in BMI over time

Wolch and colleagues investigated whether proximity to parks and recreational programs impacts the development of childhood obesity. Researchers gathered information on over 3,000 children, aged 9-10, from 12 communities in Southern California over an 8-year period. As part of this study, participants completed surveys and researchers measured children's height and weight on an annual basis. In addition, researchers evaluated public parks and recreation programs around children's homes. Wolch and colleagues found that 20% of children did not have access to recreation programs within 10km of their home and that over 50% of children did not have a park within 500m of their home. In examining the relationship between access to parks and recreation programs and children's body mass index (BMI), researchers found that children with better access to parks within 500m of their homes and recreation programs within 10km of their homes had a reduced risk of being overweight or obese at age 18. Wolch and colleagues found that the impact of recreation programs and parks was stronger for boys than girls and that the impact of recreation programs on BMI was stronger than that of parks. While this study did not consider private recreation space and programs or the influence of children's dietary intake, it provides a valuable contribution to the literature and demonstrates the important role that public parks and recreation programs can play in reducing the risk of childhood obesity.

Author Affiliation: Jennifer Wolch is with the University of California, Berkeley.

Wolch, J., Jerrett, M., Reynolds, K., McConnell, R., Chang, R., Dahmann, N., et al. (2010). *Childhood obesity and proximity to urban parks and recreational resources: A longitudinal cohort*

study. *Health & Place*. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.elsevier.com/> (Volume 5)

9-year-old children who play outdoors after school and 15-year-old children who participate in sport clubs are more physically active

Many efforts aimed at preventing childhood obesity have targeted increasing physical activity. To successfully increase physical activity levels it is important to understand factors that influence children's physical activity. In this study, Nilsson and colleagues investigated four leisure time behaviors and their relationship to physical activity: 1) mode of transportation to school; 2) outdoor play after school; 3) participation in sport and exercise clubs; and 4) TV viewing. Researchers analyzed data for over 1,300 9- and 15-year-old children from three European countries (Norway, Estonia, and Portugal). Nilsson and colleagues measured children's moderate to vigorous physical activity with accelerometers and their leisure activities via a self-report questionnaire. In analyzing the data, researchers found significant differences between age and gender groups. For example, 9-year-olds more frequently reported active commuting, outdoor play, and exercise in clubs as compared to 15-year-olds; while boys reported playing more outdoors after school than girls. With regard to physical activity levels, researchers found that 9-year-olds were significantly more active than 15-year-olds and that boys were significantly more active than girls. In examining relationships between leisure activities and physical activity, Nilsson and colleagues discovered that playing outdoors after school was associated with higher physical activity levels for 9-year-olds, while participating in sport clubs was associated with higher physical activity levels for 15-year-olds. These results indicate that children's physical activity behavior changes as they age. Nilsson and colleagues did not find a relationship between active commuting or TV viewing and physical activity levels. Researchers also did not find relationships between leisure time behaviors and the amount of time children spent being sedentary, suggesting that there may be different factors that influence sedentary behavior and physical activity. Although this study could not examine causation and may be limited due to its use of self-reported information, it provides useful information about leisure time behaviors that influence children's moderate-to-vigorous physical activity levels, which can help inform interventions designed to enhance children's health.

Author Affiliation: Andreas Nilsson is with Örebro University in Sweden.

Nilsson, A., Andersen, L. B., Ommundsen, Y., Froberg, K., Sardinha, L. B., Piehl-Aulin, K., et al. (2009). Correlates of objectively assessed physical activity and sedentary time in children: a cross-sectional study (The European Youth Heart Study). *BMC Public Health*, 9. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.biomedcentral.com/bmcpublichealth/> (Volume 5)

Green areas on elementary school grounds support the highest level of children's moderate physical activity

Dyment and colleagues examined the relationship between school ground design and children's physical activity levels. Researchers collected information from two elementary schools, one in Australia and the other in Canada. The Australian school was selected because of its diversity of play areas, while the Canadian school was selected because of its long-term school ground greening efforts. At each school, Dyment and colleagues observed the location and intensity of children's play behaviors (sedentary, moderately active, or vigorously active) during lunch and recess periods. In

analyzing the data, researchers found that in Australia the greatest number of students spent time in the green area and paved sporting courts, while in Canada the greatest number of students spent time in the open asphalt area and open playing field. In terms of physical activity levels, children at both schools engaged in vigorous physical activity the most in areas with manufactured equipment (e.g., slides, swings, monkey bars, etc.), while children engaged in moderate physical activity the most in green areas (e.g., large grassy areas, gardens, etc.). With regard to children's sedentary behavior, researchers found that sedentary behavior was highest in the paved sporting courts and paved courtyard at the Australian school and the treed grassy berm, treed concrete steps, and open asphalt areas at the Canadian school. Dymont and colleagues highlight gender differences in area use, discuss their results in terms of other studies, and highlight potential design and cultural factors that might suggest why certain school ground areas are related to vigorous, moderate, and sedentary activity. While this study may be limited due to its focus on only two schools and its reliance on observational data, it demonstrates the important role that green areas on school grounds can play in enhancing children's moderate physical activity levels, especially for children who are not interested or able to play vigorous games in more traditional areas.

Author Affiliation: Janet Dymont is with the University of Tasmania in Australia.

Dymont, J. E., Bell, A. C., & Lucas, A. J. (2009). The relationship between school ground design and intensity of physical activity. *Children's Geographies*, 7(3). This study may be available in a library near you or can be purchased online through the publisher at: <http://www.tandf.co.uk/journals/titles/14733285.asp> (Volume 5)

Children living in neighborhoods where parents believe that there are good parks and sidewalks spend less time engaged in screen-based behaviors, are more physically active, and are more likely to walk or bike to and from school

Parents play a large role in determining what children can and cannot do. In this study, Carson and colleagues investigated whether parents' perceptions of their neighborhood environments are associated with children's screen time, physical activity, and active transport to and from school. Researchers gathered data from over 3,000 fifth grade students from 148 schools in Alberta, Canada. Children and parents completed several surveys on physical activity, screen time, active transport, and neighborhood perceptions. Carson and colleagues found that 59% of fifth grade students in Alberta engaged in less than 2 hours of screen time a day, 27% of students were physically active, and 39% walked or biked to and from school. In examining associations between parents' perceptions and children's screen time, physical activity, and active transport, researchers grouped parental perceptions into three areas: 1) satisfaction/services (satisfaction with where you live and access to sports, recreation, and stores); 2) safety (traffic and crime); and 3) sidewalks/parks (access to good sidewalks and parks). In analyzing the data, Carson and colleagues found that good satisfaction/services and sidewalks/parks were associated with less screen time and more physical activity in children and neighborhoods with good sidewalks/parks were also associated with more children using active transport to and from school. Researchers found no significant associations between neighborhood safety and children's physical activity, screen time, or active transport. This study may be limited due to its reliance on child and parental reports and is correlational (not causal) in nature, however, it suggests that interventions that increase access to parks, sidewalks, and sports and recreation programs could help increase children's physical activity and active transport, while reducing their sedentary behaviors.

Author Affiliation: Valerie Carson is with the University of Alberta in Canada.

Carson, V., Kuhle, S., Spence, J. C., & Veugelers, P. J. (2010). Parents' perception of neighbourhood environment as a determinant of screen time, physical activity and active transport. *Canadian Journal of Public Health, 101(2)*, 124-127. This study may be available in a library near you or can be purchased online through the publisher at: <http://jpubhealth.oxfordjournals.org/> (Volume 5)

Forest School sessions increase children's and families' play in natural environments and provide numerous benefits

Forest Schools were developed in many European countries, starting in the 1960s, to encourage children to access natural places. In this study, Ridgers and colleagues investigated the impact of Forest School sessions on children's natural play and their families' participation in nature-based activities. To conduct this study, researchers observed, interviewed, and surveyed 17 children, 6 to 7 years of age, before and after they participated in 12 Forest School outdoor sessions that were each 2 hours long at a school in the UK's Mersey Forest. Researchers also interviewed and surveyed 15 parents before and after they participated in a related engagement project, designed to reconnect families to natural play opportunities in the Mersey Forest through organized activities and targeted information. In examining the data, Ridgers and colleagues found that, overall, children increased their natural play and experienced a variety of benefits as a result of the Forest School sessions. Researchers also found that, overall, families participated in more natural play as a result of the Forest School activities. In their reports, researchers discuss many findings, including the following:

- Children's social skills and confidence increased as a result of the Forest School sessions. For example, there was a 7.8% increase in pro-social interactions between children.
- Children engaged in more moderate intensity physical activity following the Forest School sessions.
- Children reported being able to play more on playgrounds and football fields after the Forest School sessions.
- Children increased their knowledge and understanding of the natural environment as a result of their experiences.
- Some parents changed the restrictions they placed on their child's outdoor behavior as a result of their experiences.
- Parents made more of an effort to play in natural environments with their children as a result of their experiences.
- Parents reported seeing positive changes in their children as a result of the Forest School sessions.

While this study may be limited due to the small number of participants and focus on a single Forest School program, very few evaluations of this sort have been completed. This study provides valuable information that can support future research and intervention efforts.

Author Affiliation: Nicola Ridgers is with John Moores University in the UK.

Ridgers, N. D., & Sayers, J. (2010). *Natural play in the forest: Forest school evaluation (Children): Natural England.* This report may be available from Natural England or The Mersey Forest. (Volume 5)

Ridgers, N. D., & Sayers, J. (2010). *Natural play in the forest: Forest school evaluation (Families): Natural England.* This report may be available from Natural England or The Mersey Forest. (Volume 5)

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 quantity 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 and/or the outdoors. 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.

An outdoor program enhances children’s well-being, physical activity, and feelings of health, safety, and satisfaction

Many children in their teenage years face mental health challenges. Several studies have found that contact with nature and physical activity in a natural environment, what some call “green exercise,” improves psychological well-being. In this study, Wood and colleagues evaluated the impact of the Youth Outdoor Experience (YOE) project on participating children’s well-being and physical activity. The YOE project provides 11- to 18-year-old children from disadvantaged urban areas in England with opportunities to participate in a 12-week program where children engage in weekly structured outdoor activities. As part of this study, researchers had 14 participants complete a questionnaire to assess their well-being, connectedness to nature, and physical activity. Researchers also had 114 participants complete a questionnaire to assess the impact of the project on a range of well-being areas (e.g., being healthy, staying safe, and enjoying and achieving). Most participants completed both questionnaires at the start, middle, and end of the project. In analyzing the data, Wood and colleagues found a number of interesting results, including:

- Participants’ well-being increased from the start to the end of the program.
- Participants’ contact with nature varied a lot over the course of the project.
- Participants increased the number of days that they performed 30 minutes of moderate physical activity.
- Project leaders reported positive changes in participants’ attitudes, self-esteem, and behavior.
- Participants reported feeling healthier, safer, and more positive with regard to their school, home, and social lives, as well as their achievements.

While this study may be limited due to its small sample size and reliance on self-report measures, it highlights the need for additional research in this area and the potential role that nature-based activities can have on participants’ well-being, physical activity, and feelings of health, safety, and satisfaction.

Author Affiliation: Carly Wood is with the University of Essex in the UK.

Wood, C., Hine, R., & Barton, J. (2011). *The health benefits of the Youth Outdoor Experience (YOE) project*. University of Essex. This report may be available through the University of Essex, Suffolk Wildlife Trust, or Natural England. (Volume 5)

The Berkeley School Lunch Initiative enhances students' preference for and consumption of healthy foods, nutrition knowledge, and food-related attitudes

In 2005, the Berkeley Unified School District started the School Lunch Initiative and phased the Initiative into schools from 2006 to 2009. The School Lunch Initiative is a collaborative partnership that was developed to improve student health and understanding of sustainable food systems. The Initiative is a comprehensive program that features hands-on cooking classes, food and dining services changes, and curriculum changes. Rauzon and colleagues evaluated the School Lunch Initiative to examine its effects on students' eating behaviors, attitudes about healthy eating and environmental responsibility, and knowledge about nutrition and food and the environment. To evaluate program impacts, researchers compared over 200 4th and 5th grade students over a period of 3 years from 4 different schools—2 with highly developed School Lunch Initiative programs and 2 with lesser-developed School Lunch Initiative programs. Participants completed food diaries and answered questionnaires about their knowledge, attitudes, and behaviors as they related to nutrition, food, and the environment. In addition, researchers conducted interviews with school staff, observed food service environments, collected information on students' academic test scores and body mass index, and had parents of participating students complete a survey related to family and neighborhood characteristics. In analyzing the data, Rauzon and colleagues found that the School Lunch Initiative had positive impacts on students' nutrition knowledge, preference for and consumption of healthy foods, and food-related attitudes. A few of their findings include:

- *Parents reported that the program positively impacted their child's eating habits.* For example, 35% of parents with children in schools with advanced programs reported that school had improved their child's eating habits, as compared to 16% of parents with children in schools with lesser-developed programs.
- *Students' nutrition knowledge was higher.* Students attending schools with advanced programs had higher nutrition knowledge scores, compared to students attending schools with lesser-developed programs.
- *Younger students preferred more fruits and vegetables.* Younger students attending schools with advanced programs preferred more fruits and vegetables as compared to students attending schools with lesser-developed programs. These differences, however, with the exception of green leafy vegetables, disappeared as students moved into higher grades.
- *Middle school students had more positive food-related behaviors.* Middle school students attending schools with advanced programs had more positive attitudes toward eating school food and agreed more often that produce tasted better in-season and that eating choices can impact the environment, as compared to students attending schools with lesser-developed programs.
- *Younger students ate more fruits and vegetables.* Younger students attending schools with advanced programs ate nearly 1.5 more servings of fruits and vegetables daily as compared to students in schools with lesser-developed programs where consumption actually decreased by 0.4 servings.

Researchers also examined the impact of school programs on students' academic test scores and body mass index, but found no significant differences between students in advanced versus lesser-developed programs, which may have been due to the small sample size or length of time examined. This report provides a valuable contribution regarding the impact that innovative school programs can have on students' food-related behavior and attitudes. Researchers conclude their report with a series of recommendations to help enhance the current program and/or apply the program in other school districts.

Author Affiliation: Suzanne Rauzon is with the University of California at Berkeley.

Rauzon, S., Wang, M., Studer, N., & Crawford, P. (2010). *An evaluation of the school lunch initiative*. Berkeley, CA: University of California at Berkeley. This report is available online at: http://cwh.berkeley.edu/sites/default/files/primary_pdfs/An_Evaluation_of_the_School_Lunch_Initiative_Final%20Report_9.22.10.pdf (Volume 5)

Children with ADHD functioned better in the woods than in a built setting

Several studies have found that contact with nature may reduce symptoms of attention-deficit hyperactivity disorder (ADHD) in children. To build upon this work, van den Berg and van den Berg examined the behavior and cognitive and emotional functioning of 12 children, between the ages of 9 and 17, enrolled in a care program for children with ADHD at two farms in the Netherlands. As part of this study, researchers observed and tested the two groups of children during visits to a wooded area and a nearby town on consecutive days. At both of these locations, researchers observed children participating in a group activity (e.g., building a cabin or exploring a neighborhood), and had children evaluate their experience, describe their mood, and take a concentration test. In analyzing the data, van den Berg and van den Berg found that both groups performed better on a concentration task in the woods than in the town, however, they found that children's behavior and emotional functioning in the two settings differed. Researchers found that children in one group liked the woods better than the town and had more positive behaviors and feelings in the woods, whereas children from the other group liked the town and woods equally and displayed positive behaviors in both settings, although they showed somewhat less positive behaviors overall in the town than in the woods. While this study may be limited due to its small sample size and inability to control for a number of potentially influencing factors, its findings, in conjunction with previous research, suggest that the natural environment may help children better cope with ADHD.

Author Affiliation: A.E. van den Berg is with Wageningen University and Research Center in The Netherlands.

Van Den Berg, A., & Van Den Berg, C. A comparison of children with ADHD in a natural and built setting. *Child: Care, Health and Development*. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.wiley.com/bw/journal.asp?ref=0305-1862> (Volume 5)

Children with ADHD who regularly play in green settings have milder symptoms than children who play in built outdoor and indoor settings

In the United States, an estimated 4.4 million children have been diagnosed with Attention Deficit/Hyperactivity Disorder (ADHD). In this study, Faber Taylor and Kuo examined whether routinely experienced greenspaces—those that children visit on a daily or near daily basis—impact children’s ADHD symptoms. Researchers collected data via an internet survey from 421 parents of 5- to 18-year-old children with ADHD. Parents provided information about where their child played most of the time during the past week and the severity of their child’s ADHD symptoms. In analyzing the data, Faber Taylor and Kuo found that most children played in one of five settings: 1) Places where there are big trees and grass (Big Trees & Grass); 2) Places indoors where it feels very much indoors (Indoors); 3) Places where there is a lot of open grass (Open Grass); 4) Places that are paved or built (Built Outdoors); and 5) Other. Researchers examined the relationship between these five settings and the severity of children’s ADHD symptoms and found that children who regularly play in green play settings (Big Trees & Grass and Open Grass) have milder ADHD symptoms than children who play in built outdoor and indoor settings. Importantly, Faber Taylor and colleagues found that the impact of green play settings on children’s ADHD symptoms did not vary based on family income or the child’s gender. Interestingly, in examining differences between children with hyperactivity (ADHD) and without hyperactivity (ADD), researchers found that for children with hyperactivity only one of the green play settings--Open Grass--is associated with less severe symptoms, while for children without hyperactivity both green play settings--Open Grass and Big Trees & Grass--are associated with less severe symptoms. This study may be limited due to its reliance on parental reports and is correlational (not causal) in nature, however, it provides a valuable contribution to the growing research in this area as it is the first large study to examine linkages between greenspace exposure and ADHD symptoms. Faber Taylor and colleagues conclude their article by discussing the potential role of greenspace exposure to ADHD management and the need for randomized control trials to strengthen our understanding of the relationship between nature and ADHD symptoms.

Author Affiliation: Faber Taylor is with the University of Illinois at Urbana-Champaign.

Faber Taylor, A., & Kuo, F. E. M. (2011). Could exposure to everyday green spaces help treat ADHD? Evidence from children's play settings. *Applied Psychology: Health and Well-Being*. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.wiley.com/bw/journal.asp?ref=1758-0846> (Volume 5)

Plants in classrooms benefit students’ emotions, behavior, and health

The classroom environment can play an important role in students’ learning and academic performance. Han examined the effect of living plants in a classroom on students’ psychology, behavior, and health. To investigate this relationship, he conducted a study with two similar classrooms, located next to each other, of sophomore students at a high school in Taiwan. Han used surveys every 2 weeks to assess students’ emotions and collected objective information on students’ academic performance, health, and behavior. After an initial assessment period, he brought six small trees into the back of one of the classrooms. In comparing data from the two classrooms, Han found that shortly after the plants were introduced, students had significantly higher scores than the regular classroom in terms of preference, comfort, and friendliness. In addition, he found that students in the classroom with plants had significantly fewer sick leave hours and punishment records than students in the regular classroom. While this study may be limited due to its small

sample size and there is the potential that other variables may have influenced the results, Han's research provides valuable insight into the benefits that even small amounts of nature can provide to students and suggests promising avenues for future research.

Author Affiliation: Ke-Tsung Han is with National Chin-Yi University of Technology in Taiwan.

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. [Article]. *Environment and Behavior*, 41(5), 658-692. This study may be available in a library near you or can be purchased online through the publisher at: <http://eab.sagepub.com/> (Volume 5)

Preschool children experiencing a weekly outdoor lesson have improved self-efficacy and early literacy skills

The Outdoor Discovery Center Macatawa Greenway--a non-profit entity that delivers outdoor, nature-based education and programming in Holland, MI--developed a nature-based program intervention to improve the health and well-being of preschool children and their families. As part of the intervention, naturalist educators visited six preschools on a weekly basis to deliver an hour-long lesson focused on a science concept that was taught through outdoor activities. To understand the impact of the intervention on students, Trent-Brown and colleagues examined a number of health and well-being measures for over 100 preschool students, between the ages of 3 and 5, prior to and 6 months after the intervention began in both an experimental group that received the intervention, as well as a control group that did not receive the intervention. Researchers measured children's blood pressure, body mass index (BMI), activity preferences, self-efficacy, and early literacy skills. In analyzing the data for experimental and control groups, Trent-Brown and colleagues found that preschool students in the nature intervention program had significantly improved with regard to their self-efficacy and early literacy skills when compared to the control group. In examining relationships between outcomes for the control and experimental groups, researchers found that there was a more significant and positive relationship between activity preferences and self-efficacy and early literacy skills for the experimental group as compared to the control group, indicating that children with more active preferences tended to improve more with regard to self-efficacy and early literacy skills. While there were notable positive outcomes, researchers also found that preschool students in the nature intervention program had significantly elevated mean arterial blood pressure scores, as well as significant increases in the number of students classified as prehypertensive as compared to the control group, which did not experience these increases. With regard to BMI and activity preferences, researchers found no significant changes among the experimental or control groups. While this study may be limited due to student and teacher turnover in the classrooms, as well as a number of other factors that were not controlled as part of the study and therefore might influence study outcomes, such as nutrition and family health history, it provides an important contribution to the literature about the impact of nature programs on children's health and well-being. Importantly, this study will continue in future years, providing important information about the long-term impact of nature programs on students.

Author Affiliation: Trent-Brown is with Hope College in Holland, MI.

Trent-Brown, S. A., Vanderveen, J. D., Cotter, R., Hawkins, K., Schab, A., Dykstra, S., et al. (2011). *Effects of a nature-based science enrichment program on preschool children's health, activity preferences, self-efficacy, and cognition: Outdoor Discovery Center Macatawa Greenway*. This report may be available via the Outdoor Discovery Center Macatawa Greenway at <http://odcofwu.schoolwires.com/odcofwu/site/default.asp> (Volume 5)

Forest School sessions increase children's and families' play in natural environments and provide numerous benefits

Forest Schools were developed in many European countries, starting in the 1960s, to encourage children to access natural places. In this study, Ridgers and colleagues investigated the impact of Forest School sessions on children's natural play and their families' participation in nature-based activities. To conduct this study, researchers observed, interviewed, and surveyed 17 children, 6 to 7 years of age, before and after they participated in 12 Forest School outdoor sessions that were each 2 hours long at a school in the UK's Mersey Forest. Researchers also interviewed and surveyed 15 parents before and after they participated in a related engagement project, designed to reconnect families to natural play opportunities in the Mersey Forest through organized activities and targeted information. In examining the data, Ridgers and colleagues found that, overall, children increased their natural play and experienced a variety of benefits as a result of the Forest School sessions. Researchers also found that, overall, families participated in more natural play as a result of the Forest School activities. In their reports, researchers discuss many findings, including the following:

- Children's social skills and confidence increased as a result of the Forest School sessions. For example, there was a 7.8% increase in pro-social interactions between children.
- Children engaged in more moderate intensity physical activity following the Forest School sessions.
- Children reported being able to play more on playgrounds and football fields after the Forest School sessions.
- Children increased their knowledge and understanding of the natural environment as a result of their experiences.
- Some parents changed the restrictions they placed on their child's outdoor behavior as a result of their experiences.
- Parents made more of an effort to play in natural environments with their children as a result of their experiences.
- Parents reported seeing positive changes in their children as a result of the Forest School sessions.

While this study may be limited due to the small number of participants and focus on a single Forest School program, very few evaluations of this sort have been completed. This study provides valuable information that can support future research and intervention efforts.

Author Affiliation: Nicola Ridgers is with John Moores University in the UK.

Ridgers, N. D., & Sayers, J. (2010). *Natural play in the forest: Forest school evaluation (Children): Natural England*. This report may be available from Natural England or The Mersey Forest. (Volume 5)

Ridgers, N. D., & Sayers, J. (2010). *Natural play in the forest: Forest school evaluation (Families): Natural England*. This report may be available from Natural England or The Mersey Forest. (Volume 5)

Children's connection to nature influences their interest in participating in nature-based activities and performing environmentally friendly behaviors

Cheng and Monroe developed a new children's connection to nature index and used this index to examine children's connection to nature and factors influencing children's nature-related interests and pro-environmental choices. In developing this new instrument, researchers identified key factors presented in the literature to date regarding people's attitudes towards nature, experiences with nature, and interest in environmentally friendly practices, including sympathy, empathy, interest in nature, experience with nature, and self-efficacy. In addition, Cheng and Monroe conducted interviews with fourth grade students to understand their attitudes toward nature and nature experiences and pilot test index questions. Once the final index was developed, researchers had almost 1,500 fourth-grade students in Brevard County, Florida complete the survey after participating in an environmental education program. In analyzing the data, Cheng and Monroe found that there were 4 main dimensions to children's connection to nature: 1) enjoyment of nature; 2) empathy for creatures; 3) sense of oneness; and 4) sense of responsibility. Cheng and Monroe also developed several models to explore factors that best predict children's interest in participating in nature-based activities and performing environmentally friendly behaviors. In analyzing the data, researchers found that children's connection to nature was the strongest factor in predicting students' interest in participating in nature-based activities, while children's connection to nature, previous experience with nature, perceived family value toward nature, and their perceived control most strongly influenced their interest in performing environmentally friendly behaviors. Cheng and Monroe discuss the implications of their research in terms of future research needs, as well as the development of environmental education programs. This study may be limited due to its cross-sectional design and focus on a specific age group, however, it provides an encouraging new instrument to predict children's interest in participating in nature-based activities and performing environmentally friendly behaviors.

Author Affiliation: Judith Cheng is with Tamkang University in Taiwan.

Cheng, J. C. H., & Monroe, M. C. (2010). Connection to Nature: Children's Affective Attitude Toward Nature. *Environment and Behavior*. This article may be available in a library near you or can be purchased online through the publisher at: <http://eab.sagepub.com/> (Volume 5)

Non-formal outdoor environmental education programs can improve children's environmental orientations

Although there are many environmental education programs, few studies have examined the impact of non-formal (i.e., out-of-school) outdoor environmental education programs on children's environmental orientations. Larson and colleagues conducted an exploratory study to investigate differences in children's environmental orientations in terms of gender, age, and ethnicity, as well as to evaluate the impacts of a one-week, non-formal outdoor environmental education program on children's environmental orientations. As part of this study, 133 6- to 13-year-old children in Athens-Clarke County, Georgia participated in a five-day Eco-Explorer Camp, while another group of 69 students participated in traditional after-school programs. Researchers measured children's environmental orientations, including eco-affinity (personal interest in nature and intention to engage in pro-environmental behavior) and eco-awareness (cognitive understanding of environmental issues), as well as environmental knowledge prior to and after the camp/after school program. In addition, researchers gathered more qualitative data on children's camp experiences through interviews and evaluations. In analyzing the data in terms of gender, age, and ethnicity,

Larson and colleagues found no gender differences in terms of children's environmental orientations, however, researchers found that older children had lower eco-affinity levels than younger children and African-American children had lower eco-awareness and environmental knowledge scores than White children. In analyzing the data in terms of the impact of the environmental education program, Larson and colleagues found that after the program children scored significantly higher in terms of eco-affinity and environmental knowledge across all gender, age, and ethnicity groups, however, the program did not impact children's eco-awareness. In talking with children about their camp experiences, researchers discovered that children preferred activities that involved physical activity and "having fun" was a critical component. Researchers also found interesting ethnicity differences, such as that White children were more than twice as likely to report engaging in solitary nature-based activities than African American children. While this study may be limited due to its small sample size and inability to control for numerous differences between camp and after school groups, this study provides valuable insight into the potential positive impacts of a non-formal outdoor environmental education program on children's environmental orientations.

Author Affiliation: Lincoln Larson is with the University of Georgia.

Larson, L. R., Castleberry, S. B., & Green, G. T. (2010). Effects of an Environmental Education Program on the Environmental Orientations of Children from Different Gender, Age, and Ethnic Groups. *Journal of Park and Recreation Administration, 28(3)*, 95-113. This article may be available in a library near you or can be purchased online through the publisher at: <http://journals.sagamorepub.com/ebooks/> (Volume 5)

Direct nature experiences are important for changing environmental attitudes & behavior

Many environmental education programs strive to positively influence children's environmental behavior, however, we currently know very little about program elements and experiences that lead to changes in environmental behavior. In this study, Duerden and colleagues investigated the relationship between indirect and direct nature experiences and children's environmental knowledge, attitudes, and behavior. Researchers used surveys, focus groups, and observations to evaluate the experiences of 108 middle and high school students that participated in an international immersion environmental education program, which included a preparatory program (indirect nature experience), a 7-14 day international field workshop (direct nature experience), and a post-trip service project. Duerden and colleagues surveyed participants at multiple stages in the program, as well as a comparison group of 49 middle and high school students who did not participate in the program. In analyzing the data, researchers found that program participants had a significant increase in environmental knowledge as compared to the comparison group. In examining the impact of different program components, Duerden and colleagues found that during the indirect nature experience (i.e., the preparatory program) children's environmental knowledge increased more than their environmental attitudes and environmental attitudes had a stronger impact on children's environmental behavior, while during the direct nature experience (i.e., the international workshop) both children's environmental knowledge and attitudes developed rather equally and both environmental knowledge and attitudes were related to environmental behavior. In addition, researchers discovered that while children's indirect experiences led to enhanced environmental knowledge, it was their direct experiences that led to attitude and behavior development. Interestingly, Duerden and colleagues found that the nature of children's direct experience was vital to the impact it had on children. For example, researchers discovered that children perceived experiences to be more direct if they were afforded freedom and autonomy during the experience.

While this study may be limited due to its small sample size, reliance on self-report data, and environmental program variability, the researchers' study design and mix of methods provides an important contribution to the literature. In concluding their article, Duerden and colleagues highlight program implications from their research, as well as future research needs.

Author Affiliation: Mat Duerden is with Texas A&M University.

Duerden, M. D., & Witt, P. A. (2010). The impact of direct and indirect experiences on the development of environmental knowledge, attitudes, and behavior. *Journal of Environmental Psychology*(April 3). This article may be available in a library near you or can be purchased online through the publisher at: <http://www.elsevier.com/> (Volume 5)

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.

Youth participation in outdoor activities has declined since 2006

For the past three years, The Outdoor Foundation has conducted a nationwide survey to examine youth participation in outdoor recreation. In 2009, The Outdoor Foundation conducted a nationwide survey of over 41,000 individuals between the ages of 6 and 25. Respondents under the age of 13 completed the survey with a parent, while respondents over the age of 13 completed the survey themselves. In their report, The Outdoor Foundation outlines a number of key findings, including the following:

- 59% of 6- to 24 year-olds participated in outdoor recreation (defined as having taken part in one or more of 40 activities at least once during 2008).
- Youth participants made up 34% of all outdoor recreation participants. Participation in outdoor recreation was highest among 6- to 12-year-olds at 64%, declined to 61% for 13- to 17-year-olds, and declined further to 54% for 18- to 24-year-olds.
- Youth participation in outdoor recreation declined since 2006 in all age groups and among both boys and girls. The rate of decline was greatest among 6- to 12-year-old girls (77% in 2006 versus 58% in 2008).
- More males participated in outdoor recreation than females (56% versus 44%).
- More Caucasians participated in outdoor recreation than other ethnic populations (79% versus 7.4% for African Americans).
- Running, bicycling, and freshwater fishing were the most popular outdoor activities among youth.
- Parents, friends, and family were the strongest influences in getting younger children to participate in outdoor recreation.
- 46% of youth reported that lack of time and interest kept them from participating in outdoor activities more often.
- Youth with nearby walking and biking routes participated in more outdoor recreation (21% more for walking routes and 25% more for biking routes).

This nationwide survey provides important information about trends in and characteristics of youth outdoor recreation, which can help inform research, policy, and programs focused on enhancing children's outdoor experiences.

Author Affiliation: The Outdoor Foundation is located in Boulder, Colorado.

The Outdoor Foundation. (2010). *Special report on youth: The next generation of outdoor champions*. Boulder. This report is available online at:
<http://www.outdoorfoundation.org/pdf/ResearchYouth.pdf> (Volume 5)

Hunting, shooting, and fishing programs play an important role in maintaining and increasing interest in these outdoor activities

It is estimated that there are more than 400 national and statewide hunting, shooting, and fishing recruitment and retention programs for youth and adults, however, there have been no comprehensive evaluation efforts undertaken to understand program effectiveness. In this study, researchers investigated the impact of 37 diverse hunting, shooting, and fishing programs on participation in and participant attitudes toward hunting, sport shooting, and fishing. Thousands of youth and adult participants from a representative sample of 37 state and national hunting, shooting, and fishing programs completed pre- and post-program surveys and participated in telephone interviews. In their report, researchers discuss program impacts in great detail, including pre- and post-program results for each program, as well as top-rated programs for achieving certain end results, such as increasing self-identification as a hunter, shooter, or angler. In addition, the researchers provide a summary of their major findings, including the following:

- Programs are generally more effective at retaining people already initiated into hunting, shooting, and fishing than they are at recruiting new people to these activities.
- Programs generally have a positive impact on participants thinking of themselves as hunters, shooters, and anglers.
- Most participants' interest in hunting, shooting, or fishing remained the same or increased after program participation. Youth participants in particular seemed to have increased interest after program participation.
- Most participants' hunting, shooting, or fishing activity increased or remained the same after program participation.
- Most youth participants said that they learned a lot from program participation.
- Participants were generally highly satisfied with the overall program they participated in, as well as individual program elements.
- Most participants were interested in enrolling in other hunting, shooting, or fishing programs in the future.

In addition to discussing major findings, researchers provide a number of recommendations to help organizations improve existing programs and develop new programs to increase participation in hunting, sport shooting, and fishing.

Author Affiliation: Responsive Management is based in Virginia and is a public opinion and attitude survey research firm. The National Wild Turkey Federation is based in South Carolina and is a nonprofit organization dedicated to conserving the wild turkey and preserving our hunting heritage.

Responsive Management & National Wild Turkey Federation. (2011). *Effectiveness of hunting, shooting, and fishing recruitment and retention programs: Final report.* This report is available online at: http://www.responsivemanagement.com/download/reports/R&R_Evaluation_Report.pdf (Volume 5)

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 of 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.

Different schoolyard areas support different types of physical activity and gender use

Children spend a considerable amount of time in school, making it particularly important to understand the impact of the school environment on children's physical activity. In this study, Fjørtoft and colleagues investigated how 70 6-year-old children at two different schoolyards in Southern Norway use their schoolyard at recess and the environmental characteristics that facilitate

children's physical activity. The two schools differed in their location and schoolyard design: one schoolyard was located in a city and had an asphalt area and soccer field, while the other schoolyard was located in a rural area and had an asphalt area and small forest. Researchers used global positioning system technology to track children's movement in each schoolyard, heart rate monitors to measure children's physical activity, and geographic information systems to examine linkages between environmental characteristics and children's movement and physical activity. In analyzing the data, Fjørtoft and colleagues found that children's physical activity levels were similar in both schoolyards, however, different areas of the schoolyards supported different types of physical activity and different gender use. For example, asphalt areas facilitated running and soccer play and were used more by boys than girls, while girls favored the forest area for physical activity. In addition, Fjørtoft and colleagues found that children at both schoolyards were physically active at moderate and vigorous levels for about 20 minutes of their 40 minute recess. While this study examined children in only two schoolyards, it highlights the opportunity that exists to increase children's physical activity levels during school and the importance of investigating environmental factors that support boys' and girls' physical activity.

Author Affiliation: Ingunn Fjørtoft is with Telemark University College in Norway.

Fjørtoft, I., Kristoffersen, B., & Sageie, J. (2010). Children in schoolyards: Tracking movement patterns and physical activity in schoolyards using global positioning system and heart rate monitoring. *Landscape and Urban Planning, 93*. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.elsevier.com> (Volume 5)

Students with more outdoor school facilities are more likely to participate in daily physical activity at recess

Haug and colleagues investigated the relationship between physical environmental characteristics of school grounds and children's physical activity during school breaks. Researchers had over 16,000 students in 4th through 10th grades from 130 schools in Norway complete questionnaires about their physical activity during school classes and recess. Researchers also had principals at each school complete a questionnaire about the school environment and recess opportunities. In analyzing the data, Haug and colleagues found that boys were more active than girls at recess. For example, with regard to primary school children (grades 4-7), 73% of boys and 57% of girls reported that they were physically active during recess. In addition, researchers found that girls' and boys' physical activity peaked in Grade 6 and then declined. With regard to the relationship between physical environmental characteristics and children's physical activity, Haug and colleagues discovered that secondary level students (grades 8-10) were almost three times as likely to participate in daily physical activity during recess if they had a larger number of outdoor facilities at their school. In particular, researchers found that soccer fields, areas for hopscotch/skipping rope, playground equipment and sledding hills supported more physical activity among secondary school boys, while sledding hills supported more physical activity among secondary school girls. Haug and colleagues did not find any relationship between physical environmental characteristics and primary school children's physical activity and discuss several possible reasons for this finding, including less variability in terms of physical activity participation and facility availability. This study may be limited due to its reliance on self-reported information, however, it highlights the important role that outdoor facilities might play in encouraging physical activity in secondary school children, a time when physical activity levels appear to decline.

Author Affiliation: Ellen Haug is with the University of Bergen in Norway.

Haug, E., Torsheim, T., Sallis, J. F., & Samdal, O. (2010). The characteristics of the outdoor school environment associated with physical activity. *Health Education Research, 25(2)*, 248. This article may be available in a library near you or can be purchased online through the publisher at: <http://her.oxfordjournals.org/> (Volume 5)

Green schoolyards provide rich play environments

In the last 20 years, there have been many school ground naturalization projects in Canada. In this study, Samborski investigated the impact of two different school grounds, one highly vegetated and diverse and the other more barren, on children's use, preferences, and perceptions. Samborski conducted her research with children from two neighboring schools in Victoria, British Columbia that were similar in many respects (e.g., population size, socio-demographics, and size of outdoor space available), but differed in terms of their school ground design and composition, in particular the degree of botanical diversity. To understand the impact of the school grounds on children, Samborski worked with almost 350 students between the ages of 6 and 13. Participating children completed drawings of their school ground, a survey regarding their preferences, participated in a focus group with other children, and completed a "walking" interview. Samborski found many interesting results, a few of which include the following:

- Children from the "green" school had more intricate drawings and mentioned over three times more plants and animals in their drawings than children from the "barren" school.
- Children from the "green" school mentioned more constructions and surface elements (e.g., forts) in their drawings than children from the "barren" school.
- Children's preferences for different school ground elements varied by school as well as by age. For example, children from the "green" school preferred more natural elements (e.g., wildflowers, trees and shrubs, and ponds and streams), as compared to children from the "barren" school who preferred swings and fixed play equipment.
- Children at both schools valued dens—vegetative rooms consisting of shrubs that provide some privacy—as places to spend time.

Overall, Samborski found that the "green" school provided more possibilities for play and discovery than the "barren" school. Although this study may be limited due to its focus on only two schools, it provides an important perspective—children's perspective—on their schoolyard environments. In concluding her article, Samborski discusses implications for school ground management and directions for future research.

Author Affiliation: Sylvia Samborski is with the University of Victoria in Canada.

Samborski, S. (2010). Biodiverse or barren school grounds: their effects on children. *Children, Youth and Environments, 20(2)*. This article is available online at: <http://www.colorado.edu/journals/cye/> (Volume 5)

Outdoor affordances at child care settings vary based on physical and social factors

Kernan examined children's outdoor play experiences at four early childhood education and care settings in Dublin, Ireland that represent a diversity of care settings and outdoor environments. She examined children's experiences in terms of the availability and level of outdoor affordances—what possibilities the environment offers children—in three different parts of each care setting: the

indoor-outdoor interface, the enclosed outdoor space, and the wider outdoors in the surrounding neighborhood. To examine children's experiences, Kernan observed children and conducted interviews and informal discussions with children and practitioners and managers at the care settings. Importantly, she also considered the interactions between children and between children and adults. For each of the care settings, Kernan detailed the outdoor affordances available to children in the three different locations. For example, in one of the child care centers Kernan found that many of the affordances in the wider outdoors were not experienced by children because of the limited view of the outdoors from the inside of the facility, the limited time children had outdoors, and the fact that children largely remained in strollers when outside. While this study may be limited due to its small sample size, it provides a potentially new framework for examining children's experiences at early childhood education and care settings.

Author Affiliation: Margaret Kernan is with the International Child Development Initiatives in The Netherlands.

Kernan, M. (2010). Outdoor affordances in early childhood education and care settings: adults' and children's perspectives. *Children, Youth and Environments, 20*(1). This article is available online at: <http://www.colorado.edu/journals/cye/> (Volume 5)

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 greenspace 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 landcover 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: Physical Activity/Fitness & Weight

Spending time in nature/outdoors may encourage and support children's physical activity and help them maintain a healthy weight. While not directly related to children's experience of nature/the outdoors, these studies highlight the current status of children's physical activity/fitness and weight, as well as key factors influencing children's physical activity/fitness and weight.

Many U.S public elementary and secondary schools are not doing enough to support students' healthy eating and physical activity behaviors

In 2004, the Child Nutrition and WIC Reauthorization Act required school districts participating in federal child nutrition programs to develop a wellness policy with regard to nutrition and physical activity by the start of the 2006-07 school year. Following the wellness mandate, in 2007 and 2008, University of Illinois researchers collected data on nutrition and physical activity policies and practices from a nationally representative sample of public elementary and secondary schools. Researchers collected data from school administrators via a mail-back survey and weighted the data to reflect the percentage of students nationwide who attended a school with the policy or practice examined in the surveys. A few of the key findings from 2007-08 include:

- More than 80% of secondary school students and 62% of public elementary school students had access to at least one competitive food or beverage venue (e.g., vending machines, school stores and/or snack bars). These venues generally offer less-healthy items, such as soda, candy, and cookies.

- While most secondary schools offered vegetables and fresh fruits some or most days of the week as part of the lunch program, only 20% of elementary school students had salad bars and whole grains available most or all days of the week.
- 32% of third-grade students did not receive at least 20 minutes of recess a day.
- 21% of elementary school students, 25% of middle school students, and 14% of high school students walked or biked to school.
- 34% of elementary school students, 54% of middle school students, and 16% of middle school students attended a school that annually tested students' physical fitness.

While many schools have made positive changes to help create a healthier environment for their students, researchers found that more changes are needed. Researchers highlight a number of opportunities for changing policies and/or practices to continue to improve student health.

Author Affiliation: Lindsey Turner and Lloyd Johnston are with the Institute for Health Research and Policy at the University of Illinois at Chicago.

Turner, L., & Chaloupka, F. J. (2010). *School policies and practices to improve health and prevent obesity: National elementary school survey results: School years 2006-07 and 2007-08*. University of Illinois.

Johnston, L. D., O'Malley, P. M., Terry-McElrath, Y., Freedman-Doan, P., & Brenner, J. S. (2011). *School policies and practices to improve health and prevent obesity: national secondary school survey results, school years 2006-07 and 2007-08*. University of Illinois.

These reports are available online at: <http://www.bridgingthegapresearch.org/> (Volume 5)

Children are largely indoors and sedentary at preschool

Many children in the U.S. attend center-based preschools. Given recent trends in childhood obesity, preschools could be an important setting for interventions. In this study, Brown and colleagues investigated children's physical activity in preschools to determine which conditions supported different physical activity levels during outdoor play. Researchers observed over 450 3- to 5-year-old children from 24 different preschools (commercial child-care centers, church-affiliated preschools, or Head Start programs) in a metropolitan area of South Carolina. Brown and colleagues recorded children's physical activity behaviors and the social and nonsocial environmental factors related to those behaviors (e.g., group composition and indoor and outdoor activity contexts). In analyzing the data, researchers found many interesting results, including the following:

- Children are largely indoors and sedentary at preschool: 87% of researchers' observations of children occurred inside and during this inside time, 94% of children's total physical activity intervals were sedentary.
- Children were largely sedentary outdoors, but displayed higher levels of physical activity outside than inside: 17% of children's total physical activity intervals were moderate to vigorous and 56% were sedentary.
- When outside, children were observed most often in open spaces, using fixed equipment, using balls or other objects, using socio-dramatic props, or using wheeled toys. Children were most often observed in high-level physical activity in open spaces or when playing with balls and other objects.
- Adults initiated the majority of children's activities and most activities took part in groups.

- Children engaged in more high-level physical activity when activities were child-initiated instead of adult-initiated.
- Many teachers did not encourage or participate in children's physical activities during outdoor play.

While this study may be limited due to its reliance on observational data, its relatively large sample of diverse participants provides an important contribution to the literature. In concluding their article, Brown and colleagues make a series of recommendations for researchers, as well as for early childhood policy makers and practitioners, including the need for intentional and active adult involvement in children's outdoor activities.

Author Affiliation: William Brown is with the University of South Carolina.

Brown, W. H., Pfeiffer, K. A., McIver, K. L., Dowda, M., Addy, C. L., & Pate, R. R. (2009). Social and Environmental Factors Associated With Preschoolers' Nonsedentary Physical Activity. *Child Development, 80*(1), 45-58. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.wiley.com/> (Volume 5)

Child-care centers' social and physical environments influence children's physical activity levels

With over half of European children attending some form of child-care, it is important to understand how these environments impact children's physical activity. In this study, Gubbels and colleagues examined the relationship between child-care center environments and children's physical activity by observing 175 2-to3-year-old children at 9 Dutch child-care centers. Researchers assessed children's physical activity intensity, the social environment (e.g., group size and physical activity prompts), and the physical environment (e.g., portable and fixed equipment). In analyzing the data, Gubbels and colleagues found that the majority of children's activity was sedentary (59.4% of indoor activity and 31.2% of outdoor activity), however, children's physical activity levels were more intense outdoors, with 21.3% of activity being classified as moderate to vigorous as compared to 5.5% of activity indoors. With regard to the relationship between children's physical activity and social and physical environment factors, Gubbels and colleagues found that more activity opportunities in the physical environment (both indoors and outdoors) and physical activity prompts by staff (outdoors) and peers (indoors) were related to higher activity intensities, while larger group size was related to lower activity intensities. In addition, researchers discovered that the social environment interacts with the physical environment to influence children's physical activity intensity. For example, Gubbels and colleagues found that the outdoor physical environment influenced children's physical activity only when children engaged in an activity with multiple other peers and that positive physical activity prompts from peers more positively impacted boys' outdoor physical activity. This study, while potentially limited due to its small sample size and reliance on observational data, demonstrates the value of examining physical and social environmental factors and highlights the importance of including child-care environments in efforts to improve children's physical activity levels and prevent childhood obesity.

Author Affiliation: Jessica Gubbels is with Maastricht University Medical Center in the Netherlands.

Gubbels, J. S., Kremers, S. P. J., van Kann, D. H. H., Stafleu, A., Candel, M. J. J. M., Dagnelie, P. C., et al. (2011). Interaction between physical environment, social environment, and child characteristics in determining physical activity at child care. *Health Psychology, 30*(1), 84. This article may be available in a library near you or can be purchased online through the publisher at: <http://hpq.sagepub.com/> (Volume 5)

Children who actively commute to school have higher physical activity levels

Faulkner and colleagues systematically review research to determine whether children who actively commute to school are more physically active and have a healthier body weight than children who travel by motorized transport. The authors examined thirteen studies focused on these issues. In reviewing the evidence, Faulkner and colleagues reported that eleven of the thirteen studies found that children who actively commuted to school were more physically active than children who took motorized transport. The authors also found some evidence for age and gender differences in terms of the relationship between active commuting and physical activity, but no clear pattern emerged as the results were often conflicting. With regard to the relationship between active commuting and body weight, Faulkner and colleagues found that only one of ten studies found that active commuters had a lower body weight than passive commuters. In concluding their article, the authors discuss limitations of research conducted to date and recommend areas for future research.

Author Affiliation: Guy Faulkner is with the University of Toronto in Canada.

Faulkner, G. E. J., Buliung, R. N., Flora, P. K., & Fusco, C. (2009). Active school transport, physical activity levels and body weight of children and youth: A systematic review. *Preventive Medicine, 48*(1), 3-8. This review may be available in a library near you or can be purchased online through the publisher at: <http://www.elsevier.com/> (Volume 5)

Children who actively commute to school are more active and engage in more moderate to vigorous physical activity

While active commuting to school has been linked to higher physical activity levels, little is known about the actual journey to school. Cooper and colleagues investigated children's level and location of physical activity during the school commute. As part of this study, 137 11-year-old children in west London wore an accelerometer for one week and a global positioning system receiver for two days. Participating children also completed a diary and survey. In analyzing the data, Cooper and colleagues found that 51% of the children walked to school, 34% traveled by car, 13% traveled by bus, and 1.5% traveled by bicycle. In terms of physical activity, researchers found that children who walked to school were more active in the hour before school and engaged in more moderate to vigorous physical activity than children who traveled by car. Cooper and colleagues also discovered that children took very direct routes to school and spent time on the playground before school started. In terms of physical activity, researchers found that children were more physically active during the journey to school as compared to on the playground before school. While this study may be limited due to its small sample size, it demonstrates the important role that active commuting to school can play in supporting children's physical activity.

Author Affiliation: Ashley Cooper is with the University of Bristol in the UK.

Cooper, A. R., Page, A. S., Wheeler, B. W., Griew, P., Davis, L., & Hillsdon, M. (2010). Mapping the walk to school using accelerometry combined with a Global Positioning System. *American Journal of Preventive Medicine*, 38(2). This review may be available in a library near you or can be purchased online through the publisher at: <http://www.elsevier.com/> (Volume 5)

Social support and environmental perceptions impact children's active commuting to school

Panter and colleagues investigated whether children's active commuting to school is associated with attitudes, social support, and environmental perceptions and whether distance to school impacts these associations. As part of this study, over 2,000 9- to 10-year-old children from urban and rural schools in Norfolk, UK and their parents completed questionnaires about travel behavior, socio-demographic information, attitudes towards active commuting, social support, and neighborhood environments. In addition, researchers measured the distance from home to school for each child using a geographic information system. In analyzing the data, Panter and colleagues found that 40% of children usually walked to school, 9% cycled, and 51% used motorized travel. In addition, researchers found that children were more likely to walk to school if their journey to school was less than 1km and their mothers actively commuted to work. With regard to the relationship between attitudes, social support, and environmental perceptions and active commuting, Panter and colleagues discovered that parental attitudes and safety concerns, social support from parents and friends, and neighborhood walkability were related to higher rates of active commuting among children. In addition, researchers found that journey distance moderated the impact of attitudes on cycling behaviors, but that social support and environmental perceptions were important whether the journey to school was long or short. This study may be limited due to its reliance on self-reported data and is cross-sectional in nature and thus causation cannot be examined, however, it is based on data from a large-scale, population-based study and improves our understanding of factors influencing children's active commuting. Based on their findings, as well as findings from other studies, Panter and colleagues recommend that interventions focused on increasing children's active commuting focus on road safety as well as parental and peer support.

Author Affiliation: Jenna Panter is with the University of East Anglia in the UK.

Panter, J. R., Jones, A. P., van Sluijs, E. M. F., & Griffin, S. J. (2010). Attitudes, social support and environmental perceptions as predictors of active commuting behaviour in school children. *Journal of Epidemiology and Community Health*, 64(01), 41. This article may be available in a library near you or can be purchased online through the publisher at: <http://jech.bmj.com/> (Volume 5)

Focus: Environmental Knowledge & Behavior

Children's exposure to the outdoors/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.

Understanding how children come to care about the natural world

In this review, Chawla examines developmental pathways related to children's active care for the natural world. Specifically, Chawla focuses on three key factors that have been associated with active care for the environment: motivation to care for nature, a sense of efficacy, and knowledge of action skills and strategies. In examining these factors, she draws on three developmental models or

frameworks and discusses research in light of these models. A few of the findings Chawla highlights in her review are: 1) the important role of socializers (e.g., influential family members, teachers, or other adult mentors) within the context of the surrounding culture; 2) that children come to value environmental actions through a variety of mechanisms (interest/enjoyment value, attainment value, utility value, and relative cost); 3) empathy and sympathy are a foundation for the development of care for the natural world; and 4) the importance of providing opportunities for children to develop a sense of efficacy to achieve environmental goals, such as through mastery experiences. This review provides an important new perspective on how children develop care for the natural world. In concluding her review, Chawla discusses future research needs.

Author Affiliation: Louise Chawla is with the University of Colorado Denver.

Chawla, L. (2009). Growing up green: Becoming an agent of care for the natural world. *Journal of Developmental Processes*, 4(1). This article may be available in a library near you or can be purchased online through the publisher at: <http://www.icdl.com/staging/bookstore/journal/index.shtml> (Volume 5)

Children have little biodiversity knowledge

In 2009, Airbus surveyed 1,500 children in the UK between the ages of 5 and 10 and their parents to investigate children's biodiversity knowledge. Researchers had children complete a picture survey that tested their knowledge of nature, while parents answered questions related to their child's nature experiences and knowledge. In analyzing the data, Airbus reports some interesting findings, including the following:

- 40% of children could not tell the difference between a bee and a wasp.
- 30% of children did not know what a moose looked like.
- 25% of children did not know what a beaver looked like.
- 83% of children said they enjoyed learning about nature.
- 70% of parents said they were concerned that their child does not know enough about nature.
- 69% of parents said they were concerned that their child spends too much time indoors.

While this survey relied on self-reported information and it is difficult to know how these results compare to knowledge and experiences in the past, this survey highlights children's current knowledge of certain biodiversity topics and could serve as an important baseline from which to compare future measurements.

Author Affiliation: This survey was conducted by Airbus, an aircraft manufacturer in the UK.

Airbus. (2009). *The Greenwave program: Research results.* This document is available online at: <http://www.cbd.int/doc/groups/youth/greenwave/greenwave-research-results-summary-2009-en.pdf> (Volume 5)

Key experiences lead to involvement in natural history based professions

James and colleagues investigated natural history professionals' development of nature interests in their childhood, teen, and early adult years in order to better understand what leads children to continue participating in natural history-oriented professions/education/hobbies as a young adult. Researchers interviewed 51 individuals between the ages of 18 and 35 who were identified as being

high achievers in natural history (recreationally, educationally, or professionally) about how their interests developed from childhood to the present. In addition, James and colleagues interviewed 10 individuals who were not outdoor enthusiasts to serve as a comparison group. In analyzing the interviews, researchers coded the data and identified specific domains that were relevant to the development of nature interests. With this information, James and colleagues developed a model of how individuals become involved in natural history professions. The model consists of four stages, each of which has 3 main facets or domains: social mediation and facilitation, play, and exploration. Each of the 4 stages of the model are described briefly below:

- 1) *Direct experiences*—This stage occurs in early childhood and is driven by direct, informal and unstructured experiences with nature (from wildlands to vacant lots). There is a lack of adult supervision or structure and much fantasy play.
- 2) *Emerging formal skills*—This stage occurs in middle childhood and is driven by learning formal outdoor recreation skills and enhancing environmental competencies. Family members provide children with opportunities to learn a range of nature-based recreation activities. In addition, children push their geographic boundaries through exploration.
- 3) *Role awareness*—This stage emerges in middle childhood and the teenage years and is driven by involvement in adult-like nature roles through volunteering or working at camps, nature centers, etc. The emphasis is on further development of social relationships around nature-based activities and a strengthened awareness of environmental vocational roles.
- 4) *Natural history identity formation*—This stage occurs in the teenage years and early adulthood and is focused on the creation of social and professional affiliations based on a view of oneself as an environmental person. By this stage, nature has become a part of the individual's identity.

In contrast to the group of natural history professionals, James and colleagues found that the comparison group had little interaction with natural resources during their life events. In reviewing their findings, researchers highlight the importance of self-directed childhood play, a variety of nature-based recreation and formal nature study opportunities, and interaction with different types of mentors at different times during development. While this study may be limited due to its emphasis on retrospective data and a small sample size, it provides an important perspective on how young adult natural history professionals develop their nature interests. James and colleagues highlight implications of their work for practice, as well as areas for future research.

Author Affiliation: J. Joy James is with Appalachian State University.

James, J. J., Bixler, R. D., & Vadala, C. E. (2010). From play in nature, to recreation then vocation: a developmental model for natural history-oriented environmental professionals. *Children, Youth and Environments, 20*(1). This article is available online at: <http://www.colorado.edu/journals/cye/> (Volume 5)

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/...Journals/.../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.

Bebbington, A. “The Ability of A-level Students to Name Plants.” *Journal of Biological Education*, 39(2), 62-67, 2005. This study is available online at: <http://www.iob.org/downloads/234.pdf> (Volume 2)

This annotated bibliography has been developed by the Children & Nature Network (C&NN), www.childrenandnature.org and is available worldwide at no charge as a means by which to make relevant research easily available, and to encourage additional research. The vision of the Children & Nature Network is a world in which all children play, learn and grow with nature in their everyday lives. C&NN is leading a movement to connect all children, their families and communities to nature through innovative ideas, evidence-based resources and tools, broad-based collaboration and support of grassroots leadership. For additional information, contact info@childrenandnature.org.

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