



Children & Nature Worldwide: An Exploration of Children’s Experiences of the Outdoors and Nature with Associated Risks and Benefits

We are pleased to present this joint publication of the Children & Nature Network (www.childrenandnature.org) and the IUCN’s Commission on Education and Communication (www.iucn.org/about/union/commissions/cec/).

This document provides an evidence base for the importance of children’s and youth’s connections with nature, now and for the future. Evidence provided in this annotated bibliography of research relates to: 1) children’s experiences of the outdoors and nature, particularly the often limited nature of these experiences and 2) the benefits derived from children’s experiences of the outdoors and nature—both for their healthy development and the protection of the Earth.

The studies selected for this bibliography represent a small sample of the studies that have been conducted on these topics over the past several decades and were included to highlight: 1) the variety and quality of research in these areas and 2) the diversity of places where this research is taking place. Researchers have used a range of methods and techniques to creatively and effectively study these issues. In addition, research is increasingly taking place worldwide, which provides a critical opportunity to begin to understand children’s outdoor and nature experiences and the benefits derived from these experiences across cultures. While additional research is needed, these studies highlight some of the important progress that has been made in recent years as well as the profound risks to the health of the planet, its diversity, and its wild areas in a world in which children are increasingly disconnected from direct experiences in nature.

This document includes studies from five volumes of research summaries that have been compiled by the Children & Nature Network. These five volumes are available at <http://www.childrenandnature.org/>. This document includes an executive summary of each research report, information on lead/corresponding author affiliation, a full citation, information on each document’s availability, and information on which Children & Nature Network research volume the original report appears.

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Children's Experiences of the Outdoors & Nature

This section highlights research focused on children's experiences of the outdoors and nature, particularly the often limited nature of these experiences. While some studies document children's experience of the outdoors and nature directly, this section also highlights studies on related factors that provide insight into this topic. Research is grouped into several main focal areas.

Focus: Outdoor Behavior

How much time children spend outside and the activities that they engage in while outside affect their contact with nature. 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.

Country where research took place: United States.

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/research.youth.html>

In the UK, children's ability to play in their local community has declined

Playday is an annual celebration of children's right to play. In 2010, Playday's annual theme was *Our Place!*, which focused on children's play experiences in their communities. To support this theme, Play England conducted a literature review, a qualitative study, and an opinion poll related to community-based play. In the literature review, Gleave discusses evidence related to the benefits of community play, children's use of community spaces, and attitudes towards children's use of community spaces. With regard to the research components, ICM research surveyed a random sample of over 1,000 adults and 1,000 children, aged 7 to 14, from across the UK regarding children's community play. In addition, Play England conducted a series of seven focus groups across the UK with children, parents, and adults to gather additional information on children's community play. In their reports, the authors discuss many interesting findings, including the following:

- Compared to the previous generation, children today have fewer friends they can play with in their neighborhood. Adults reported having an average of 14 friends when they were children, compared to an average of just 6 friends for children today.
- 79% of adults reported that they believe community spirit has declined since they were children.
- Children's ability to play outside is limited due to safety concerns. For example, 49% of adults reported that they do not let their children play outside without an adult. The biggest concern for parents was road accidents.
- 55% of parents reported that they are concerned that their neighbors might get upset if their children make noise outside.
- Children are often negatively judged by adults. For example, 24% of children reported that they have been scolded for playing ball games in their neighborhood.
- People are hesitant to get involved with children in the community. For example, 44% of men reported that they would be concerned about approaching a child who needed help because others might think they were trying to abduct the child.
- People recognize the benefits of children playing outside for their community. For example, 88% of parents reported that they believe that children playing outside helps community members get to know each other.

While this research may be limited due to its reliance on self-reported information and adult memories of childhood, it provides valuable information about children's community play in the UK. As part of this research effort, report authors also present a range of solutions to help encourage more play in local neighborhoods.

Author Affiliation: ICM research conducted the opinion poll on behalf of Play England. Josie Gleave conducted the literature review and wrote the report on the focus group research. Josie Gleave is with Play England.

Country where research took place: United Kingdom.

Playday. Playday 2010 opinion poll survey.

Gleave, J. (2010). *Making it our place: Community views on children's play*. Play England.

Gleave, J. (2010). *Community play: A literature review*. Play England.

These reports are available online at: http://www.playday.org.uk/playday_campaigns/2010_theme.aspx

Norwegian children's play in natural spaces today is significantly different than the previous generation

Skår and Krogh investigated changes in children's outdoor play and use of natural areas in Brummunddal, a semi-urban community in Norway that has good access to a variety of natural areas. Researchers interviewed 20 residents between the ages of 18 and 72 about their experiences as children as well as their observations about children's experiences today. In analyzing the interview data, Skår and Krogh found that children's use of natural areas has changed from being self-initiated to being more planned and organized, as well being more time-limited and controlled by adult activities. The researchers found that children's geographical range used to be determined more by age and physical ability, but is now dependent on parental transport. In addition, Skår and Krogh found that social norms regarding children playing alone outside and the importance placed on participating in structured activities have changed. Participants highlighted the changing social dimension of children's play, from large groups of children that played outdoors in the past to small groups of children that play indoors today. Participants also noted changes in physical and social barriers, including increased train and road traffic and social fear. Skår and Krogh note that these findings are particularly significant given that they have occurred in a semi-urban area with good access to nature and in a country that is 40% wooded and that has a strong tradition of associations with nature. While this research may be limited due to its small sample size, reliance on self-reported information, and adult memories of childhood, it provides important information on shifting childhood experiences with nearby nature in Norway.

Author Affiliation: Margrete Skår is with the University of Life Sciences and Norwegian Institute for Nature Research in Norway.

Country where research took place: Norway.

Skår, M., & Krogh, E. (2009). Changes in children's nature-based experiences near home: from spontaneous play to adult-controlled, planned and organised activities. *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.tandfonline.com/doi/abs/10.1080/14733280903024506>

In one generation, there has been a huge decline in Australian children's outdoor play

In 2011, Planet Ark, a not-for-profit environmental organization, commissioned a study to examine childhood interaction with nature today as compared to a generation ago. Over 1,000 Australians between 14 and 65 years of age completed an online survey. In analyzing the data, researchers found many interesting results, including the following:

- *There has been a huge decline in children's outdoor play.* For example, 73% of respondents reported playing outdoors more often than indoors when they were young as compared to only 13% of their children. They also found that 1 in 10 children today play outside once a week or less.
- *The nature of children's outdoor play has changed.* For example, 64% of respondents reported climbing trees when they were children as compared to less than 20% of their children.
- *Respondents believe in the benefits of outdoor play.* For example, 93% of respondents agreed that outdoor play helps children develop physical and motor skills.
- *There are a number of barriers (perceived and real) that impact children's outdoor play.* For example, 33% of respondents reported that crime and safety concerns are a barrier to their child's outdoor play as compared to 9% who reported that crime and safety concerns were a barrier when they were young.
- *Routine opportunities for outdoor play have declined, such as walking or bicycling to school.* For example, 75% of respondents reported that they lived close enough to walk or bike to school when they were children, as compared to just 37% of children today.

In addition to detailing the findings of the survey, the authors discuss similarities between this study and a similar study that was conducted in the U.S. in 2004. The authors also discuss the benefits for children of spending time outside and provide a list of resources for individuals interested in increasing the amount of time children spend outside. While this study may be limited due to its reliance on self-reported information and adult memories of childhood, this survey provides valuable information about children's outdoor behavior in Australia.

Author Affiliation: The authors are with Planet Ark in Australia.

Country where research took place: Australia.

C&NN Research Volume 5

Planet Ark. (2011). Climbing trees: Getting Aussie kids back outdoors. This report is available online at:

<http://treeday.planetark.org/about/health-benefits.cfm>

A variety of factors influence American children's connection with nature

In 2011, The Nature Conservancy commissioned a nationwide poll of American children to understand children's connection with nature. The polling team conducted on-line interviews with a diverse and representative sample of 602 children between the ages of 13 to 17. Survey questions explored children's current connection with nature, environmental attitudes, and obstacles and opportunities to connect with nature. The survey report highlights many interesting findings, a few of which include:

- Children spend a lot of time engaged in electronic media. For example, 88% of children reported using a computer almost every day, while only 11% of children reported visiting a local park or natural area almost every day.
- Obese children prefer indoor activities more than children who are not obese and are less likely to have had a meaningful experience in nature.
- 66% of children reported having a meaningful experience in nature.
- Children who have had a meaningful experience in nature are more likely to prefer spending time outdoors, express concern about environmental issues, consider themselves a strong environmentalist, and express interest in studying the environment or pursuing an environmental career.
- Children most often experience nature with friends (79%), followed by parents (46%) and brothers and sisters (44%).
- Children reported that feelings of discomfort (bugs, heat, etc.), lack of transportation to natural areas, and lack of natural areas near home were the top 3 reasons why they did not spend more time in nature.
- Children living in the West are most likely to prefer spending time outdoors, while children living in the Northeast are most likely to prefer spending time indoors.
- 86% of children said that it is “cool” to do things that protect the environment.

Based on the survey results, researchers highlight a number of strategies to enhance children’s connection to nature, including providing opportunities at school that engage children with nature, getting friends and parents to encourage children to spend more time outside, and ensuring that activities are fun and easy.

Author Affiliation: This report was produced by The Nature Conservancy, a nonprofit conservation organization based in Arlington, VA.

Country where research took place: United States.

C&NN Research Volume 5

The Nature Conservancy. (2011). *Connecting America's youth to nature*. This report is available online at: <http://www.nature.org/newsfeatures/kids-in-nature/kids-in-nature-poll.xml>

The neighborhood environment influences children’s active free-play outdoors

Active free-play outdoors may serve as an important way to increase children’s physical activity levels. In this study, Veitch and colleagues investigated the relationship between various individual, social, and environmental factors and children’s active free-play in three locations outside of school hours: the yard at home, in their street/court/footpath, and the park/playground. Researchers also examined relationships between how often children played in these three locations and their physical activity levels. As part of this study, 187 parents of 8- to 9-year-old children from primary schools in Melbourne, Australia completed a survey about individual factors (e.g., marital and employment status), social environmental factors (e.g., crime rate in neighborhood), and physical environmental factors (e.g., size of yard and quality of parks). In addition, participating children wore an accelerometer for 8 days to measure their physical activity levels. In analyzing the data, Veitch and colleagues found the following results for each of the three locations examined:

- *Yard at Home:* Parents reported that their child played most often in this location. Children were more likely to play in their yard if their parents reported a high crime rate in their neighborhood. Children who preferred activities not involving physical activity were less likely to play in their yard.
- *Street/Court/Footpath:* Children were more likely to play in their street/court/footpath if their parents reported that the neighborhood was safe, they lived in a cul-de-sac, and that their child had many friends in their neighborhood.
- *Park/Playground:* Children were more likely to play in the park/playground if their parents reported that the family went to the park together on a regular basis.

As part of their analysis, Veitch and colleagues found no relationship between how frequently children played in these locations and their physical activity levels. While this study may be limited due to its use of parent reports and its cross-sectional design, it suggests important avenues for future research as well as opportunities to increase children's active free-play, such as by enhancing social neighborhood networks and improving knowledge about neighborhood safety.

Author Affiliation: Jenny Veitch is with Deakin University in Australia.

Country where research took place: Australia.

C&NN Research Volume 5

Veitch, J., Salmon, J., & Ball, K. (2010). Individual, social and physical environmental correlates of children's active free-play: a cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity*, 7. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.ijbnpa.org/content/7/1/11>

Children's activities outside of school are similar across nations

Singer and colleagues surveyed 2400 mothers of 1- to 12-year-old children in sixteen nations about their attitudes and beliefs regarding their children's play and well-being, as well their children's activities outside of school. Participating mothers were from a diversity of socioeconomic backgrounds, urban to rural areas, and developed to developing countries. Despite this diversity, Singer and colleagues found many similarities in mothers' responses. In their article, the researchers present many findings. A few of their key overall findings include: 1) the most common activity that children were reported to engage in outside of school was watching television, with 72% of mothers reporting that their child participated in this activity; 2) 58% of mothers reported that their child played outdoors; 3) 54% of mothers reported that playing outside was the activity their children enjoyed most; 4) 73% of mothers reported that their child would rather play outside than inside; 5) 47% of mothers were concerned that their children do not spend enough time playing outside; and 6) 72% of mothers agreed that children are growing up too quickly today. The researchers also analyzed survey data in terms of country development status, child gender, child age, and family characteristics, among other factors. For example, Singer and colleagues found that significantly more boys than girls played outside and participated in organized sports, and children with more siblings were reported to play outside more than children with fewer siblings. In addition, researchers found that mothers from rural areas were significantly more likely to report that their children participated in rough and tumble play or explored nature as compared to mothers from city and suburban areas. While this survey

may be limited due to its reliance on proxy and self-report, it provides an important contribution to the literature because of its relatively large sample size and unique focus on mothers from a diversity of nations.

Author Affiliation: Singer and Singer are with Yale University.

Country where research took place: Argentina, Brazil, China, France, India, Indonesia, Ireland, Morocco, Pakistan, Portugal, South Africa, Thailand, Turkey, the United Kingdom, the United States, and Vietnam.

C&NN Research Volume 4

Singer, D. G., Singer, J. L., D'Agostino, H., & DeLong, R. (2009). Children's pastimes and play in sixteen nations. *American Journal of Play* (Winter). This study may be available in a library near you or can be purchased online through the publisher at: <http://www.journalofplay.org/issues/27/59-childrens-pastimes-and-play-sixteen-nations>

Outdoor play behavior has changed between today's generation of children and their parent's generation

While it is often suggested that children today have less contact with nature than in previous generations, little quantitative information is available. In 2009, Natural England commissioned England Marketing to conduct an online survey of adults and children in England to better understand nature contact between today's generation of children and their parent's generation. A total of 1150 adults and 502 seven- to eleven-year-old children participated in the online survey. In their report, England Marketing discusses a number of findings. A few of their key findings include: 1) 62% of children reported playing at home or a friend's home more than any other place, whereas adults reported playing outdoors in local streets the most when they were children; 2) less than 10% of children today reported playing in natural places, whereas 40% of adults reported playing in such places when they were young; and 3) 41% of children reported that playing indoors is their favorite place to play, whereas only 16% of adults reported that playing indoors was their favorite place to play as children. In addition, with regard to "freedoms" to play, England Marketing found that 29% of adults reported that they do not allow their children to play unsupervised outdoors, 81% of children reported wanting more freedom to play outside, and 85% of adults reported that they would like their children to be able to play in natural spaces without supervision. While this survey relied on self-reported information and it is challenging to compare children's current activities with adults' memories of their childhood activities, this survey provides valuable information on a topic that has received limited attention.

Author Affiliation: Natural England advises England's government on natural environment issues and is based in Sheffield.

Country where research took place: United Kingdom.

C&NN Research Volume 4

England Marketing. (2009). Childhood and nature: a survey on changing relationships with nature access across generations. This report is available online at: http://www.naturalengland.org.uk/Images/Childhood%20and%20Nature%20Survey_tcm6-10515.pdf

There is an on-going national movement away from nature-based recreation

As a follow-up to their recent work demonstrating about a 25% decline in per capita visits to U.S. National Parks between 1987 and 2003, in this study, Oliver R.W. Pergams and Patricia A. Zaradic test whether this decline in U.S. National Park visits is an isolated incident or a good indicator with regard to how much people are visiting natural areas more generally. The authors examined 16 large national and international nature-related visitor and activity data sets, including visitation to Japanese national parks, recreational visits to all U.S. state parks, and total number of U.S. hunting and fishing licenses. In analyzing these data sets, Pergams and Zaradic found that nature-based recreation peaked between 1981 and 1991, and has been declining at a rate of between 1 and 1.3% per year since this peak, for a total decline of 18-25% to date. The similarities among these multiple and different measures suggest a general decline in visits to natural areas in the U.S. and potentially in other countries, such as Japan. It is important to note that the impact of this decline varies for each variable. For example, many more people visit National Parks per year than finish the Appalachian Trail. The authors found that the most popular nature-based recreation activity in the U.S. is camping, followed by fishing and hunting, all of which show a declining trend. Pergams and Zaradic found only one countertrend to nature use decline: a slight increase in hiking and backpacking. While the cause(s) for this over-arching decline requires further investigation, this study demonstrates a fundamental shift away from visits to natural areas, with potentially important implications for health, well-being, and conservation.

Author Affiliation: Oliver Pergams is with Olive-Harvey College and the University of Illinois at Chicago in Chicago.

Country where research took place: United States.

C&NN Research Volume 3

Pergams, O. R. W., & Zaradic, P. A. (2008). Evidence for a fundamental and pervasive shift away from nature-based recreation. *Proceedings of the National Academy of Sciences of the United States of America*, 105(7), 2295-2300. This study is available online at: <http://www.videophilia.org/uploads/PNAScomplete.pdf>

Many children and adolescents are vitamin D deficient

Worldwide, there is a high prevalence of vitamin D deficiency among infants, children, and adolescents. Vitamin D deficiency is a risk factor for rickets and may be a risk factor for development of a number of chronic diseases, such as cardiovascular diseases and cancer. In this paper, S.Y. Huh and C.M. Gordon review the sources of vitamin D, which includes endogenous synthesis (the first step of which is the absorption of ultraviolet B radiation), how vitamin D deficiency is defined and measured, and the prevalence of and risk factors for vitamin D deficiency, which includes reduced sun exposure. In addition, the authors review the health effects of vitamin D deficiency and its prevention and treatment. Huh and Gordon stress the importance of additional research to determine the optimum concentration of vitamin D for children of different ages and to compare different regimens designed to prevent and treat

vitamin D deficiency as well as to better understand short and long-term impacts on critical health outcomes.

Author Affiliation: Susanna Huh is with the Children's Hospital in Boston, MA.

Country where synthesis was created: United States.

C&NN Research Volume 3

Huh, S. Y., & Gordon, C. M. (2008). Vitamin D deficiency in children and adolescents: Epidemiology, impact and treatment. *Reviews in Endocrine & Metabolic Disorders*, 9(2), 161-170. This study is available online at: <http://www.vitamedelft.org/files/art/huh2008.pdf>

Children spend less time playing outdoors than their mothers did when they were young

In this study, Dr. Rhonda Clements surveyed over 800 mothers in the United States to explore the extent to which children in the early 2000s play outdoors as compared to a generation ago when the mothers interviewed were children. In analyzing the survey results, Dr. Clements found that children in the early 2000s, as compared to a generation ago: 1) spend less time playing outdoors; 2) participate in different activities outdoors (e.g., fewer street games and more organized youth sports); and 3) participate in more indoor than outdoor play activities. In her survey, Dr. Clements also asked mothers about obstacles to outdoor play and their thoughts regarding the benefits of outdoor play. She found that while almost all mothers recognized some of the diverse benefits of outdoor play, obstacles, such as television, computers, and concerns about crime, safety, and injury, prevented their children from participating in more outdoor play. This study provides important insights into the changing nature of children's outdoor play and is one of the few studies that explore this topic in the United States.

Author Affiliation: Rhonda Clements is with Manhattanville College in New York.

Country where research was conducted: United States.

C&NN Research Volume 2

Clements, R. An Investigation of the State of Outdoor Play. *Contemporary Issues in Early Childhood*, Vol. 5(1):68-80, 2004. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.wvwords.co.uk/pdf/freetoview.asp?j=ciec&vol=5&issue=1&year=2004&article=7> Clements CIEC 5 1 web

Children's use of space has changed from being primarily outdoors to indoors and has become increasingly adult supervised

In this study, Dr. Lia Karsten takes a detailed look at three different streets in Amsterdam to investigate children's use of space in 2003 as compared with children's use of space during the 1950s and early 1960s. She made numerous observations of the three streets and conducted over 90 extensive interviews with children and parents and with adults who lived on these streets in the 1950s and early 1960s. To validate information from her interviews, Dr. Karsten also

conducted archival and statistical analyses of historical data. Dr. Karsten found a great deal of similarity in children's daily lives in the 1950s and early 1960s. Specifically, she found that in this generation "playing meant playing outside." This was often a matter of both necessity, primarily due to small living spaces, and pleasure. She also found that children had considerable freedom to move around on their own, had a relatively large territory to roam, played with children from diverse backgrounds, and used urban public space for many of their activities. In contrast, Dr. Karsten found that children in 2003 did not play outside as much or for as long a period of time, had a more restricted range in which they could move freely, had fewer playmates from less diverse backgrounds, were more home-centered, and experienced many more parent-induced constraints. Importantly, Dr. Karsten documents how these changes from the 1950s and 1960s to 2003 have occurred within a spatial, social, and cultural context. She discusses contributing factors to many of these changes, such as the introduction of the car, which changed safety in the streets, and the trend toward bigger homes and fewer children, which made indoor space more readily available. She also documents how these changes are not universal and that neighborhoods differ in their support of children's activities. To capture this diversity, Dr. Karsten describes three primary types of children in the current generation — "outdoor" children, "indoor" children, and those she calls the "backseat generation" (i.e., children who are escorted many places and whose activities are largely driven by adults). Each type has benefits and drawbacks with regard to children's daily activities.

Author Affiliation: Lia Karsten is with the University of Amsterdam in the Netherlands.

Country where research was conducted: Netherlands.

C&NN Research Volume 2

Karsten, L. It All Used to be Better? Different Generations on Continuity and Change in Urban Children's Daily Use of Space. *Children's Geographies*, Vol.3 (3), pp275-290, 2005. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.ingentaconnect.com/content/routledg/cchg/2005/00000003/00000003/art00002>

Individual and social factors impact the amount of time children spend outdoors

Physical activity is important for good health, however, little is known about the specific settings where physical activity takes place. In this study, Cleland and colleagues investigated individual, social, and physical environmental influences on children's outdoor time over a period of 5 years. Over 400 children aged 5 to 6 and 10 to 12, from elementary schools in Melbourne, Australia, participated in the study. Parents completed surveys about the amount of time their child spent outside, as well as surveys on a range of individual (e.g., outdoor and indoor tendencies), social (e.g., rules and restrictions and parental encouragement), and environmental factors (e.g., yard size and number of destinations within walking distance). In analyzing the data, Cleland and colleagues found that children's time spent outdoors significantly declined over time among younger and older boys and older girls. When examining predictors of children's time spent outdoors over the 5 years, researchers found the following:

- Younger boys who had higher "indoor tendencies" spent less time outdoors, while younger boys with a lot of social opportunities spent more time outdoors.

- Older boys who had higher “indoor tendencies” spent less time outdoors, while older boys with higher “outdoor tendencies” spent more time outdoors. In addition, they found that older boys who did not have adult supervision spent less time outdoors.
- Younger girls who had higher “indoor tendencies” spent less time outdoors, while younger girls who received a lot of parental encouragement spent more time outdoors.
- Older girls who did not have adult supervision spent less time outdoors, while older girls who received a lot of parental encouragement spent more time outdoors.

Cleland and colleagues found a number of individual and social factors that were related to changes in children’s time spent outdoors over the 5 year period. The researchers, however, did not find any evidence of linkages between physical environmental factors and children’s time spent outdoors. While this study relied on self-report measures, its longitudinal design and emphasis on a range of factors help advance our understanding about children’s time outdoors. This study demonstrates the importance of individual and social factors in the amount of time children spend outside, which can help inform future research and intervention efforts.

Author Affiliation: Verity Cleland is with Deakin University in Australia.

Country where research was conducted: Australia.

C&NN Research Volume 5

Cleland, V., Timperio, A., Salmon, J., Hume, C., Baur, L. A., & Crawford, D. (2010). Predictors of time spent outdoors among children: 5-year longitudinal findings. *Journal of Epidemiology and Community Health*, 64(5), 400-406. This study may be available in a library near you or can be purchased online through the publisher at: <http://jech.bmj.com/content/64/5/400.abstract>

Road characteristics impact the amount of time children spend outside

Bringolf-Isler and colleagues investigated the effects of socio-cultural and environmental factors, both from parents’ perceptions and from objectively assessed characteristics, on children’s vigorous outdoor play. The study was conducted with 6- to 7-, 9- to 10-, and 13- to 14-year-old children from three urban or rural communities in Switzerland that were French and/or German speaking. Parents completed surveys about the amount of time their child spent playing outdoors, various demographic characteristics, and environmental characteristics of their neighborhood. In addition, researchers used a geographic information system (GIS) to examine various environmental characteristics around each child’s home, such as street density and amount of green space. In analyzing the data, Bringolf-Isler and colleagues found that younger children spent an average of about 82 minutes a day playing outside, while older children spent an average of 42 minutes a day playing outside. The researchers also found that girls, older children, and children with a French speaking background spent less time vigorously playing outdoors, while children who were non-Swiss and had younger siblings spent more time playing outside. With regard to environmental factors, Bringolf-Isler and colleagues found that children spent less time playing outdoors if they lived in an area with higher street density. In addition, the researchers found that younger children in urbanized areas spent less time playing outdoors if their parents were concerned about traffic safety. This study may be limited due to its cross-sectional design and thus cannot examine causation, however, the researchers’ examination of a broad range of factors, use of both objective (GIS) and subjective (parent surveys) assessment measures, and focus on Europe provides a valuable contribution to the literature in this area.

Overall, this study highlights the importance of road characteristics in terms of children's physical activity.

Author Affiliation: Bettina Bringolf-Isler, is with the Swiss Tropical and Public Health Institute in Switzerland.

Country where research was conducted: Switzerland.

C&NN Research Volume 5

Bringolf-Isler, B., Grize, L., Mader, U., Ruch, N., Sennhauser, F. H., & Braun-Fahrlander, C. (2010). Built environment, parents' perception, and children's vigorous outdoor play. *Preventive Medicine, 50*(5-6), 251-256. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.sciencedirect.com/science/article/pii/S0091743510001040>

In three generations, there has been a significant decline in the amount of time Danish children spend in nature

The Danish Society for Nature Conservation had TNS Gallup conduct a poll to investigate how three different generations of Danes experienced nature. As part of this poll, a representative sample of 1,000 parents of 5- to 12- year-old children and 1,000 adults between 55 and 70 years of age (the grandparent generation) answered a series of questions about their or their children/grandchildren's use of natural space and attitudes toward nature. In this report, Paltved-Kaznelson presents many interesting findings, including the following:

- In three generations, there has been a significant decline in the amount of time that children spend in nature. For example, 59% of grandparents reported visiting a natural setting every day during the summer when they were children, as compared to 42% of parents and just 26% of children today.
- The level of engagement in organized sports has increased significantly. For example, 22% of grandparents reported participating in organized sports several times a week when they were children, compared to 38% of parents and 44% of children today.
- 73% of grandparents and 54% of parents reported that children do not spend enough time in nature.
- 81% of grandparents and 67% of parents reported that electronic media (TV, computers, electronic games) is the most important reason why children spend less time outside than in previous generations. In addition, 44% of parents believe that "parents not taking time to let their children experience nature" is an important reason why children do not spend as much time outdoors.
- In general, parents agreed that childhood experiences in nature had a positive influence on their lives and that a childhood with nature experiences is better than one with few or no nature experiences.
- The majority of parents agreed that it is important for their children to learn about nature and that it is healthy for children to spend time in nature.

While this study may be limited due to its reliance on self-reported information and adult memories of childhood, it provides valuable information about children's outdoor behavior over three generations in Denmark.

Author Affiliation: Celia Paltved-Kaznelson is with The Danish Society for Nature Conservation.

Country where research was conducted: Denmark.

C&NN Research Volume 5

Paltved-Kaznelson. (2009). *Nature through the generations*. The Danish Society for Nature Conservation. This report may be available through The Danish Society for Nature Conservation: <http://www.dn.dk/Default.aspx?ID=4592>

In the past 5 years, children's media use has increased substantially

In this report, Rideout and colleagues discuss the results of one of the largest and most comprehensive studies on American children's media use. The Kaiser Family Foundation has conducted this study 3 times: in 1999, 2004, and 2009. For their 2009 study, more than 2,000 children between 8 and 18 years of age completed a survey regarding their media-related activities, including watching television and movies, playing video games, listening to music, using computers, and reading newspapers, magazines, and books. In addition, about 700 of these children completed seven-day media use diaries. In their report, Rideout and colleagues present many interesting findings, including the following:

- From 2004 to 2009, children's media use increased substantially. In 2004, children spent an average of almost 6.21 hours with media daily, whereas children in 2009 spent an average of 7.38 hours daily with media.
- When multitasking is taken into account (time spent using more than one form of media at a time), children in 2009 packed nearly 11 hours of media exposure each day into 7.38 hours, an increase of almost 2.25 hours over 2004 levels.
- Children in 2009 spent more time with every type of media, except for reading, as compared to 2004. For example, children spent an average of 38 minutes more watching TV a day and 47 minutes more a day with music and other audio than they did in 2004.
- Mobile and online media has facilitated children's increasing media use. For example, 66% of children in 2009 had their own cell phone, as compared to 39% in 2004, and 76% had an iPod or other MP3 player, as compared to 18% in 2004.
- How children use media has also changed. For example, cell phones are no longer used just for talking, they are used for listening to music, playing games, and watching TV.
- Children who spend more time with media report that they receive lower grades and are more likely to report that they are often sad or unhappy as compared to children who spend less time with media.
- Media use does not seem to impact children's physical activity. Children who spend more time with media reported spending similar amounts of time being physically active as children who spend less time with media.
- Children who have parents that limit their media use (e.g., do not put a TV in their bedroom) spend less time with media.
- 11- to 14-year-old children experience a huge increase in media use as compared to 8- to 10-year-olds. For example, 8- to 10-year-olds spend an average of 5 hours and 29 minutes with media, while 11- to 14-year-olds spend an average of 8 hours and 40 minutes with media.
- Hispanic and Black children spend more time than White children with media (about 13 hours a day as compared to 8.5 hours a day).

This report provides valuable information for parents, researchers, and policymakers interested in children's media use and health and well-being.

Author Affiliation: Victoria Rideout is with the Kaiser Family Foundation.

Country where research was conducted: United States.

C&NN Research Volume 5

Rideout, V. J., Foehr, U. G., & Roberts, D. F. (2010). *Generation M2: Media in the lives of 8- to 18-year-olds*. Kaiser Family Foundation. This report is available online at: <http://www.kff.org/entmedia/entmedia030905pkg.cfm>

Children's independent mobility influences their outdoor activity

Wen and colleagues examined the amount of time children play outside after school and the relationship between outdoor play and children's independent mobility. As part of this study, nearly 1400 ten- to twelve-year-old children from schools in Sydney, Australia completed a five-day diary about their time spent playing outdoors and engaged in screen time (watching television/video or playing computer games). In addition, children answered a question about their independent mobility and parents provided family and demographic information. In analyzing the survey data, Wen and colleagues found that 37% of children reported spending less than 30 minutes a day playing outdoors after school, 43% reported spending more than 2 hours a day engaged in screen time, and 48% reported being allowed to mostly walk on their own where they live. With regard to these measures, researchers found some gender differences. For example, significantly more boys than girls spent 2 or more hours a day playing outdoors and engaged in screen time. In addition, boys were significantly more likely to have greater independent mobility as compared to girls. In examining the relationship between outdoor play and children's independent mobility, Wen and colleagues found a significant association between the two factors after adjusting for a number of other factors. Specifically, researchers found that children who reported being allowed to walk on their own sometimes or mostly were 1.74 and 2.56 times more likely to spend more than 30 minutes a day outdoors after school as compared to children who were never allowed to walk on their own near home. The researchers also found that children of parents who reported their neighborhood as being safe, reported being employed, and reported having an English-speaking home were more likely to have children that reported spending more time outdoors. While this study is cross-sectional in nature and relies on self-reported data, it provides important information from a relatively large sample concerning the role of independent mobility in children's time spent outdoors.

Author Affiliation: Li Ming Wen is with the Sydney West Area Health Service in Australia.

Country where research was conducted: Australia.

C&NN Research Volume 4

Wen, L. M., Kite, J., Merom, D., & Rissel, C. (2009). Time spent playing outdoors after school and its relationship with independent mobility: a cross-sectional survey of children aged 10-12 years in Sydney, Australia. *International Journal of Behavioral Nutrition and Physical Activity*, 6,

8. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.ijbnpa.org/content/6/1/15>

New survey tracks children's outdoor behavior

Despite growing interest in children's outdoor behavior, we know very little about how much time children spend outdoors. In 2007, Cordell and colleagues started the National Kids Survey to improve our understanding of how much time children spend outdoors and the activities that they engage in while outside. Data is collected via a random-digit-dialed telephone survey of the general population. As part of this survey, researchers interview a parent/guardian of children under 16-years-old or 16- to 19-year-old teenagers to gather information on outdoor behavior. To date, the survey has been implemented two times—fall-summer 2007/08 and summer-spring 2008/09. In analyzing data from these surveys, Cordell and colleagues present a number of findings in a series of three reports. A few of the researchers' key findings include: 1) over the two survey periods, about 61% of children were reported to spend two or more hours outdoors on a typical weekday and about 77% were reported to spend two or more hours outdoors on a typical weekend day; 2) more younger children (6- to 15-years-old) were reported to spend 2 or more hours outdoors as compared to older children (16- to 19-years-old) and more Hispanic children were reported to spend 4 or more hours per day outdoors on weekends as compared to white or black children; 3) the most popular outdoor activity reported was "just playing or hanging out outdoors" at 83% followed by "biking, jogging, walking, skate boarding, etc." at 79%; 4) almost 40% of respondents reported that children spent more time outside now as compared to the same time last year; and 5) in examining changes between survey periods, there was a slight, but statistically significant decline in the percentage of children that spent no time outdoors on weekend days. While this study may be limited due to its reliance on self or proxy report, it provides an important contribution to the literature as it is collecting and examining data on a large number of children over multiple years. Additional data are needed to make robust conclusions about changes in children's time spent outside and to understand factors causing any observed trends.

Author Affiliation: H. Ken Cordell is with the USDA Forest Service in Athens, GA.

Country where research was conducted: United States.

C&NN Research Volume 4

Cordell, K. H., Betz, C. J., & Green, G. T. (2009). National kids survey. Internet Research Information Series. These reports are available online at: <http://warnell.forestry.uga.edu/nrrt/nsre/IrisReports.html>

Children have less free time and spend more of the little free time they have in structured activities

In two studies, one released in 2001 and the other in 2006, Dr. Sandra Hofferth and colleagues look at changes in how American children spent their time between 1981 and 1997 and between 1997 and 2002/3. By collecting 24-hour time diaries (one for a school day and one for a non-school day) from thousands of parent/child participants, they investigated time spent in 18

different activities during the school year* and analyzed the impact of various demographic variables on children's time (e.g., number of parents, employment status of parents, the number of children in the family, and the level of parental education). In their studies, Dr. Hofferth and colleagues present many interesting findings. A few of their overarching findings include: 1) children's discretionary time (i.e., time not spent in school, child care, etc.) declined 12% (7.4 hours a week) from 1981 to 1997 and an additional 4% (2 hours) from 1997 to 2002/3; and 2) the way children spend their discretionary time has changed—less time is spent in unstructured activities (e.g., free play) and more time is spent in structured activities (e.g., sports and youth programs). Other changes of interest include a doubling of computer use and substantial increase in time spent studying and reading, as well as an increase in participation and time spent in church activities and youth groups. In their analyses, they found that a number of these and other findings are associated with demographic changes in U.S. families, such as the increase in households headed by single parents and the increase in maternal employment.

*Please note that the activity categories used in this study are inclusive of many subsets of activities. For example, two categories of particular interest to this audience—play and the outdoors—are represented in a mix of activities. “Play” includes indoor and outdoor play, such as playing cards and board games, playing social games, and playing with toys, whereas “outdoors” includes gardening, boating, hiking, walking, and pleasure drives, among other activities. Descriptions of these two categories can be found in Hofferth, S. L., & Sandberg, J. F. (2001), “How American children spend their time.” *Journal of Marriage and the Family*, 63(2), 295-308. It is also important to note that these studies focus on activities at home; they do not describe activities that take place at school or other non-home settings.

Author Affiliation: Sandra Hofferth is with the University of Maryland in College Park, MD.

Country where research was conducted: United States.

C&NN Research Volume 2

Hofferth, S.L. & J.F. Sandberg. Changes in American Children's Time, 1981-1997. In S.L. Hofferth & T.J. Owens (Eds.), *Children at the Millennium: Where Have We Come From, Where Are We Going?* (pp. 1-7). New York: JAI, 2001. This study may be available in a library or bookstore near you.

Hofferth, S.L. & S.C. Curtin. Changes in Children's Time, 1997-2002/3: An Update, 2006. This study can be accessed online at: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2939468/>

Children do not play outside as much as they would like to

Playday is a national campaign, based out of the United Kingdom (UK), to celebrate children's right to play. As part of an annual celebration, the Children's Play Council, often in partnership with other organizations, commissions a survey related to children's play. For their 2005 survey, the British Market Research Bureau interviewed 671 children age 7 to 14 in Great Britain to investigate children's opportunities for outdoor play and the barriers they encounter. In addition, for their 2006 survey, the British Market Research Bureau interviewed 543 7 to 14 year olds across the four UK nations to investigate where children play. Some of the key findings from these two surveys include: 1) a number of children do not play outside very often (20% of children play outside for an hour or less a week), 2) 39% of children do not play outside as much

as they would like to, 3) children generally prefer to play in natural spaces over non-natural spaces, 4) safety and the quality of their environment (e.g., the places to play outside) are the biggest factors that impact how much children play outside, and 5) outdoor and indoor activities (e.g., computer games, TV, and homework) seem to compete against one another for children's time.

Author Affiliation: Sandra Hofferth is with the University of Maryland in College Park, MD.

Country where research was conducted: United Kingdom.

C&NN Research Volume 2

Playday 2005 and 2006 Survey Reports. British Market Research Bureau for the Children's Play Council, 2005, 2006. Playday's research and reports can be accessed online at: <http://www.playday.org.uk/>

Focus: Physical Activity/Fitness and Weight

The outdoors/nature may encourage and support children's physical activity and help them maintain a healthy weight. While not directly related to children's experience of the outdoors/nature, 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.

Cardiorespiratory fitness has significantly declined in English 10-year-olds from an affluent area

While childhood obesity has been increasing in many countries, cardiorespiratory fitness has been decreasing. Between 1998 and 2008, Sandercock and colleagues investigated changes in the body mass index (BMI) and cardiorespiratory fitness of 10-year-old children from an affluent area of the UK. Researchers recruited about 300 children from similar schools in 1998 and 2008 to participate in the study. Researchers measured children's weight and stature to calculate BMI and used a 20 meter shuttle-run test to assess children's cardiorespiratory fitness. Over the 10-year period, Sandercock and colleagues found that girls' BMI did not change, however, there was a significant increase in boys' BMI. They also found a significant decline in performance for both boys and girls in the 20 meter shuttle-run test. Importantly, Sandercock and colleagues discovered that the rate of decline in cardiorespiratory fitness between 1998 and 2008 was between 7-9% for this group of children, almost twice the predicted global average rate of decline. Based on the study results, researchers suggest that schools may need to assess cardiorespiratory fitness, in addition to BMI, particularly since BMI and cardiorespiratory fitness are not necessarily linked, to better monitor and promote children's health.

Author Affiliation: Gavin Sandercock is with the University of Essex in the UK.

Country where research was conducted: United Kingdom.

C&NN Research Volume 5

Sandercock, G., Voss, C., McConnell, D., & Rayner, P. (2010). Ten year secular declines in the cardiorespiratory fitness of affluent English children are largely independent of changes in body mass index. *Archives of Disease in Childhood*, 95(1), 46-47. This study may be available in a library near you or can be purchased online through the publisher at: <http://adc.bmj.com/content/95/1/46>

In 1999-2002, less than 0.5% of U.S. adolescents met current nutrition, exercise, and screen time recommendations

In 2007, health care experts released a series of 4 recommendations concerning daily nutrition and physical activity to help prevent obesity: 1) children and adolescents consume 5 or more servings of fruits/vegetables a day; 2) engage in less than 2 hours of screen time; 3) engage in more than 1 hour of physical activity; and 4) consume no (0) sugar-sweetened beverages (often referred to as the “5-2-1-0” criteria). With these recommendations being used by health providers to help combat obesity, it is important to understand the extent to which U.S. children met or failed to meet these guidelines prior to their release so that the success of prevention efforts can be evaluated. In this study, Foltz and colleagues analyzed 1999-2002 National Health and Nutrition Examination Survey (NHANES) data for over 4,000 adolescents (ages 12-19) to determine how many U.S. adolescents would have met the 5-2-1-0 guidelines before they were released in 2007. Specifically, researchers analyzed NHANES interview and health examination data, which included a food diary and questions about screen time and physical activity. Foltz and colleagues found that only 0.4% of U.S. adolescents would have met all four 5-2-1-0 guidelines, while 41% of adolescents would not have met any of the guidelines. Importantly, researchers found that very few adolescents would have met each individual guideline. For example, they discovered that only 9% of adolescents ate 5 or more servings of fruits/vegetables, 27% engaged in less than 2 hours of screen time, 32% engaged in more than 1 hour of physical activity, and 14% drank no sugar-sweetened beverages each day. While Foltz and colleagues found some differences among different demographic subgroups, they found that all subgroups were far from meeting the current guidelines and thus could benefit from prevention efforts. This study may be limited due to its reliance on self-reported measures and the accuracy of participant memories, however, its use of a nationally representative sample, composed of many adolescents, provides a valuable contribution to our understanding of this topic. Foltz and colleagues hope that their research can help guide health intervention activities and serve as a baseline from which to evaluate prevention efforts and future adolescent health behaviors.

Author Affiliation: Jennifer Foltz is with the University of Rochester School of Medicine and Dentistry.

Country where research was conducted: United States.

C&NN Research Volume 5

Foltz, J. L., Cook, S. R., Szilagyi, P. G., Auinger, P., Stewart, P. A., Bucher, S., et al. (2011). US adolescent nutrition, exercise, and screen time baseline levels prior to national recommendations. *Clinical Pediatrics*, 50(5), 424. This study may be available in a library near you or can be purchased online through the publisher at: <http://cpj.sagepub.com/content/50/5/424.abstract>

Childhood & adolescent obesity rates remain high

In the eighth edition of *F as in Fat*, Levi and colleagues review current trends in obesity rates, as well as state and federal policies designed to address the obesity epidemic. To investigate childhood obesity rates, researchers reviewed evidence from the 2007 National Survey of Children's Health. Levi and colleagues report that 16.4% of children ages 10-17 were obese (defined as having a BMI at or above the 95th percentile), while 18.2% of children ages 10-17 were overweight (defined as having a BMI at or above the 85th percentile, but lower than the 95th percentile). In examining state-specific rates, Levi and colleagues found that childhood obesity rates ranged from 9.6% in Oregon to 21.9% in Mississippi. In 2007, nine states (Arkansas, Georgia, Illinois, Kentucky, Louisiana, Mississippi, Tennessee, Texas, and West Virginia) and Washington D.C. had childhood obesity rates greater than 20%, whereas in 2003, only 3 states and Washington D.C. had childhood obesity rates higher than 20%. In addition, researchers reported that 9 of the 10 states with the highest rates of obese children were located in the South. Levi and colleagues also examined obesity rates among high school students as part of the 2009 National Youth Risk Behavior Survey and children ages 2-5 from lower-income families as part of the Pediatric Nutrition Surveillance Survey. Researchers report that 12% of high school students were obese and 15.8% were overweight, while 14.8% of 2-5 year-old children from lower-income families were obese as compared to the national rate of 12.4% for children of a similar age. In addition to discussing current obesity rates and trends, Levi and colleagues highlight state and federal policies and programs, as well as community efforts, to reduce obesity, and provide recommendations for enhancing obesity prevention efforts.

Author Affiliation: Jeffrey Levi is with the Trust for America's Health.

Country where research was conducted: United States.

C&NN Research Volume 5

Levi, J., Segal, L., Laurent, R., & Kohn, D. (2011). *F as in fat: How obesity threatens America's future*. Trust for America's Health, Robert Wood Johnson Foundation. This report is available online at: <http://healthyamericans.org/report/88/>

Canadian children today are taller, heavier, larger, and weaker than in 1981

Tremblay and colleagues analyzed data from the 2007-2009 Canadian Health Measures Survey: the first comprehensive, national survey in more than two decades designed to assess the fitness of Canadians. The survey involved a detailed health interview, as well as body composition measurements and fitness tests. In this article, researchers provide an assessment of over 2,000 6- to 19-year-old Canadian children's fitness levels, and when possible compare current information with findings from a similar 1981 fitness survey. In analyzing the data, Tremblay and colleagues found that there are many significant differences between boys' and girls' fitness levels. For example, boys' mean grip strength was higher than girls', regardless of age. Researchers also found that children's fitness levels change significantly between the ages of 6 and 19. For example, body mass index and waist circumference increased with age. When comparing 2007-2009 survey data to 1981 data, Tremblay and colleagues discovered that children's fitness levels have significantly declined. They found that children are taller, heavier, larger and weaker now than they were in 1981. For example, compared to a 12-year-old boy in 1981, a 12-year-old boy in 2007-2009 was, on average, about 2 inches taller, 14 pounds heavier,

had a larger waist and hip circumference, a higher BMI, and reduced grip strength and flexibility. While this study may be limited due its use of certain screening criteria, it provides valuable information on the fitness levels of Canadian children, which can help inform interventions to improve fitness, as well as future assessments.

Author Affiliation: Mark Tremblay is with the Children's Hospital of Eastern Ontario Research Institute and University of Ottawa in Canada.

Country where research was conducted: Canada.

C&NN Research Volume 5

Tremblay, M. S., Shields, M., Laviolette, M., Craig, C. L., Janssen, I., & Gorber, S. C. (2009). Fitness of Canadian children and youth: Results from the 2007-2009 Canadian health measures survey. *Health Reports, 21*(1). This study may be available in a library near you or can be purchased online through the publisher at: <http://www.statcan.gc.ca/pub/82-003-x/2010001/article/11065-eng.htm>

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.

Country where research was conducted: United States.

C&NN Research Volume 5

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://onlinelibrary.wiley.com/doi/10.1111/j.1467-8624.2008.01245.x/abstract>

An update on children's physical activity and sedentary behavior

Keeton and Kennedy review recent research related to physical activity and sedentary behavior among children. The authors review current information about childhood overweight and obesity; the relationship between active transportation to school, access to recreational opportunities, and physical activity; the relationship between screen time, physical activity, and obesity; and physical activity among children with disabilities. Among the findings they discuss, Keeton and Kennedy highlight several recent studies that have found that children who actively commute to school tend to be more physically active. In addition, while more research is needed to understand some conflicting results, the authors discuss research that has found a relationship between children's proximity to recreation sites and site use, and proximity to playgrounds and children's weight. Keeton and Kennedy discuss the importance of safety and how it is a common barrier identified in studies to date. The authors also highlight inconsistent findings with regard to the relationship between physical activity, screen time, and obesity and emerging studies in the area of active gaming. Finally, Keeton and Kennedy discuss the special needs of children with disabilities and the importance of removing environmental barriers to support their ability to engage in physical activity. The researchers conclude their review by offering a set of tips for pediatric providers to help them address the topic of physical activity with families.

Author Affiliation: Victoria Keeton is with the University of California San Francisco.

Country where research was conducted: United States.

C&NN Research Volume 4

Keeton, V. F., & Kennedy, C. (2009). Update on physical activity including special needs populations. *Current Opinion in Pediatrics, 21*(2), 262-268. This study is available online at: http://journals.lww.com/co-pediatrics/Fulltext/2009/04000/Update_on_physical_activity_including_special.16.aspx

Many preschoolers do not achieve recommended physical activity levels

Tucker reviews 39 studies published between 1986 and 2007 on the physical activity levels of preschool-aged children. She reviews the literature in terms of guidelines put forth by the National Association for Sport and Physical Education, which recommends that preschool children engage in at least 60 minutes of physical activity and up to several hours of unstructured play each day. In examining the literature, Tucker found that almost half of preschool-aged children do not engage in 60 minutes of physical activity a day. Importantly, she notes that this is a conservative estimate as it does not include information on unstructured play. In addition, Tucker found that male children were more active than female children. In concluding her review, she identifies the need for interventions that support physical activity, especially in females, and more uniform assessment and reporting methods to facilitate understanding and comparison across studies. Tucker also highlights the important role of early childhood educators, parents, and teachers in promoting children's healthy physical activity levels.

Author Affiliation: Patricia Tucker is with the University of Western Ontario in Canada.

Country where synthesis was created: Canada.

C&NN Research Volume 4

Tucker, P. (2008). The physical activity levels of preschool-aged children: a systematic review. *Early Childhood Research Quarterly, 23(4), 547-558.* This study may be available in a library near you or can be purchased online through the publisher at:
<http://www.sciencedirect.com/science/article/pii/S0885200608000719>

Over the past several decades, there has been a dramatic increase in the number of overweight children in the United States

Over the past 40 to 50 years, the Centers for Disease Control and Prevention has conducted large national surveys to measure and better understand nutrition and health in the United States. By looking at some of these measurements over time, we can track changes with regards to various health measures, such as the prevalence of children and adolescents who are overweight. Dr. Richard Troiano and colleagues investigated overweight prevalence and trends for children and adolescents from the 1960s to the early 1990s, and Dr. Cynthia Ogden and colleagues investigated prevalence and trends from the late 1990s to 2004. Together, these two studies show that the prevalence of overweight children and adolescents has increased dramatically. The prevalence of children (ages 6 to 11) who are overweight has increased from about 4% in the 1960s to almost 19% in 2003/4. Similarly, the prevalence of adolescents (ages 12 to 19) who are overweight has increased from about 4.5% in the 1960s to about 17.5% in 2003/4. This increase in overweight children and adolescents appears to have started in the 1980s. It is important to note, and the authors discuss, that there are variations within these trends. For example, the prevalence of children and adolescents who are overweight at any given time period is not the same for males and females or for different racial and ethnic groups.

Author Affiliation: Richard Trojano is with the U.S. National Institutes of Health. Cynthia Ogden is with the Centers for Disease Control and Prevention in Hyattsville, MD.

Country where research was conducted: United States.

Troiano, R. P., Flegal, K. M., Kuczmarski, R. J., Campbell, S. M., & Johnson, C. L. **Overweight Prevalence and Trends for Children and Adolescents: The National-Health and Nutrition Examination Surveys, 1963 to 1991.** *Archives of Pediatrics & Adolescent Medicine*, 149(10), 1085-1091, 1995. This study may be available in a library near you or can be purchased online through the publisher at: <http://archpedi.ama-assn.org/cgi/content/abstract/149/10/1085>

Ogden, C. L., Carroll, M. D., Curtin, L. R., McDowell, M. A., Tabak, C. J., & Flegal, K. M. **Prevalence of Overweight and Obesity in the United States, 1999-2004.** *Jama-Journal of the American Medical Association*, 295(13), 1549-1555, 2006. This study may be available in a library near you or can be purchased online through the publisher at: <http://jama.ama-assn.org/content/295/13/1549.abstract>

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.

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Country where research was conducted: United States.

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/>

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.

Author Affiliation: The Centers for Disease Control & Prevention.

Country where research was conducted: United States.

C&NN Research Volume 2

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

Focus: Independent Mobility

Independent mobility is an important part of healthy child development. Understanding children's opportunities to play freely outside/in nature is an important aspect of their outdoor/nature experiences.

In two decades children's independent mobility has dramatically declined

This article summarizes some of the results of a study conducted by Dr. Mayer Hillman and colleagues in 1990 of almost 4,500 children and parents to explore junior (7 to 11 years of age) and senior (11 to 15 years of age) schoolchildren's travel patterns and levels of independence in England and Germany. This particular article focuses on the results of the survey in England of junior schoolchildren and their parents, as compared to a 1971 survey that was implemented in the same schools. Some of the key findings highlighted in this article include:

- In 1971, 80% of 7 to 8 year olds could go to school on their own, whereas just 9% could do so in 1990.
- In 1990, only half as many 7 to 11 year olds as in 1971 could go to places other than school by themselves.
- In 1971, 66% of children who owned bicycles could use them on roads, whereas just 25% of children could do so in 1990.
- There were large increases in the proportion of children being driven to school by car (from about 9% in 1971 to about 32% in 1990) and the proportion of children being accompanied by adults (from about 30% of 7 year olds in 1971 to 92% in 1990).
- The age at which children are granted specific freedoms increased—the freedom permitted to a 7 year old in 1971 was permitted to the average 9.5 year old in 1990.
- Parents' primary concern was danger of traffic.
- Parents thought they had far more freedom than their children have.

Dr. Hillman and colleagues primarily attribute the large decline in children's independent mobility to increased motorized traffic. They discuss how road accident statistics are not an adequate or comprehensive measure of road safety and that the primary reason why there have been reduced accident rates in England is due to the fact that children have been pulled off the streets and are no longer exposed to traffic. Children's lack of freedom to move about their neighborhoods is not currently accounted for in the costs of transportation and the authors propose other possible measures of road safety that go beyond mere accident statistics.

Author Affiliation: Mayer Hillman is with the Policy Studies Institute in London, UK.

Country where research was conducted: United Kingdom.

C&NN Research Volume 2

Hillman, M., & Adams, J. G. U. Children's Freedom and Safety. *Children's Environments*, 9(2), 12-33, 1992. This study is available online at: <http://www.colorado.edu/journals/cye/>

Hillman, M., Adams, J., and Whitelegg, J. *One False Move: A Study of Children's Independent Mobility*. London: Policy Studies Institute, 1990. This report is available online at: http://www.psi.org.uk/pdf/2009/onefalsemove_hillman.pdf

Many children do not go out by themselves

This report presents findings from a 2003 survey of over 2,500 children and young people conducted by England's Office of National Statistics. The survey was designed to collect data on children's (8 to 10 years old) and young people's (11 to 15 years old) views on a variety of topics, including their social networks, participation in their communities, and attitudes about their neighborhood. A few of the findings for children (8 to 10 years of age) include:

- 89% of children said they enjoyed living on their street and block a lot or quite a lot; 11% said they did not enjoy living on their street and block.
- 66% of children said they felt very safe or fairly safe walking or playing alone during the daytime; 34% said they did not feel safe.
- For those who felt unsafe walking or playing alone, the fear of abduction or kidnapping by strangers was the most cited reason at 59%, followed by cars and traffic at 23%.
- 33% of children said they went to local shops or parks on their own; 67% said they did not go to local shops or parks on their own.
- 51% of children said their friends played in their home or garden at least once a week.
- When meeting friends outside of their home, 21% of children were accompanied by an adult all of the time and another 52% were accompanied by an adult some of the time.
- 67% of children said they went to clubs outside of school—sports clubs were the most frequently cited at 57%.
- 89% of children are usually transported in the car to go places during evenings and weekends.

In the report, the authors note important variations in responses to this survey by age as well as economic status. For example, older children were more likely to feel safe and to venture out to local shops and parks by themselves. In addition, children in more affluent areas tended to be more positive about their neighborhood than children in more deprived areas.

Author Affiliation: Christine Farmer is with the Office for National Statistics in the UK.

Country where research was conducted: United Kingdom.

C&NN Research Volume 2

Farmer, C. *Home Office Citizenship Survey: Top Level Findings from the Children and Young People's Survey*. Home Office and the Department for Education and Skills, 2005. This report is available online at: <http://www.communities.gov.uk/documents/communities/pdf/452493.pdf>

Parental concerns are more influential than the availability of play spaces in determining children's play opportunities

In this study, Drs. Gill Valentine and John McKendrick discuss the results of a research project they conducted in Northwest England with parents from diverse socio-economic backgrounds who had an 8 to 11 year old child. They conducted a survey with 400 parents and an in-depth interview with 70 of these parents to investigate their opinions about public facilities and play spaces, as well as specific concerns (e.g., safety) that might be influencing children's access to these spaces. In analyzing their data, Drs. Valentine and McKendrick found that most parents were dissatisfied with public play facilities in their neighborhoods and that there were differences in parents' opinions about these facilities based on social class, family status (e.g., single or two parent household), and geographic area (urban vs. rural). Despite this overall perceived lack of

opportunity, however, Drs. Valentine and McKendrick found that parental restrictions play the largest role in determining children's play opportunities and that even if there were enough adequate play facilities, many parents would not allow their children to use them based on their concerns about safety related to traffic and strangers. Additionally, they found that family status (e.g., single or two parent household) impacts children's play experience and that social interactions between mothers play an important role in determining what is acceptable regarding children's outdoor play.

Author Affiliation: Gill Valentine is with the University of Sheffield in Sheffield, UK.

Country where research was conducted: United Kingdom.

C&NN Research Volume 2

Valentine, G. and McKendrick, J. Children's Outdoor Play: Exploring Parental Concerns About Children's Safety and the Changing Nature of Childhood. *Geoforum*, 28(2), 205-220, 1997. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.sciencedirect.com/science/article/pii/S0016718597000109>

Parents identify safety as the biggest barrier to children's independent play

In this study, Dr. Jenny Veitch and colleagues interviewed 78 parents from five primary schools in Melbourne, Australia to investigate children's free-play and their perceptions about what influences children's free-play. The interviews provided rich, in-depth information regarding individual, social, and physical influences on children's play. In their analysis, Dr. Veitch and colleagues found that children primarily engaged in free-play in their yard at home, with a smaller percentage of parents reporting that their child often played in the street and public open spaces. The most important influence on a child's mobility was safety, with 94% of parents stating that safety was their biggest concern. Parents' safety concerns centered around strangers, teenagers and gangs, and road traffic. Other influences on mobility included a child's independence (for example, older children had greater independence than younger children); a child's attitude towards free-play (for example, parents often described their children as being "indoor" or "outdoor"); social networks (such as the absence of young people nearby to play with); and play facilities (almost 50% of parents complained about the lack of age-appropriate play equipment available in parks and playgrounds).

Author Affiliation: Jenny Veitch is with Deakin University in Australia.

Country where research was conducted: Australia.

C&NN Research Volume 2

Veitch, J., Bagley, S., Ball, K., & Salmon, J. Where Do Children Usually Play? A Qualitative Study of Parents' Perceptions of Influences on Children's Active Free Play. *Health & Place*, 12(4), 383-393, 2006. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.sciencedirect.com/science/article/pii/S1353829205000195>

Parental constraints have always been present, but in this generation they seem to exert much greater control on children's play

In this study, Dr. Christine Tandy surveyed 421 children (ages 5 to 12) and 165 parents from suburban primary schools in Newcastle, New South Wales, Australia to investigate changes in children's independent mobility over time by comparing play patterns of schoolchildren in the late 1990s with play patterns of their parents. Dr. Tandy found that children in the late 1990s spent their time predominantly playing at home and in activities that were monitored or controlled by adults as compared to children a generation ago. Despite the dominance of home-based play, children's drawings, however, indicated a strong preference for outdoor activities. Dr. Tandy also found that while children in both generations had parental constraints placed on their activities out of concern for their safety, children a generation ago still had a high degree of mobility and freedom (33.1% of children a generation ago had only a few restrictions with regard to their play space as compared to just 3.1% of children in the late 1990s). Parents themselves recognized this difference and a number indicated that society had changed from one in which it was safe for children to freely play, to one where it is not safe and thus there was a greater need for supervision to ensure children's safety.

Author Affiliation: Christine Tandy was with the University of Newcastle in New South Wales, Australia.

Country where research was conducted: Australia.

C&NN Research Volume 2

Tandy, C. Children's Diminishing Play Space: A Study of Intergenerational Change in Children's Use of Their Neighborhoods. *Australian Geographical Studies*, 37(2), 154-164, 1999.

This study may be available in a library near you or can be purchased online through the publisher at: <http://onlinelibrary.wiley.com/doi/10.1111/1467-8470.00076/abstract>

Focus: Access to Outdoors/Nature

We are becoming an increasingly urban species, however, we know very little about what impacts this change has on children's experience of the outdoors/nature. These studies highlight aspects of children's access to the outdoors/nature.

Adventure playgrounds provide important opportunities for outdoor, unstructured play

In this article, Staempfli provides an overview of adventure playgrounds and their potential to support children's healthy development. She argues that adventure playgrounds are an important, but not often considered, play alternative. Staempfli provides historical background on the establishment of adventure playgrounds and the diversity of adventure playgrounds that currently exist, primarily in Europe. She also highlights the lack of attention that adventure playgrounds have received in North America and Canada, which is thought to primarily be due to concerns about safety and cultural ideas about risk. Staempfli provides an overview of the structure of adventure playgrounds and their use of trained playworkers to mediate play and provide supervision. She also reviews current knowledge about the developmental benefits, both at a personal and community level, of adventure playgrounds, as well as information about

accidents and injuries. Finally, in concluding this article, Staempfli outlines areas of future investigation, as well as the need to build awareness about the importance of adventure play.

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

Country where synthesis was created: Canada.

C&NN Research Volume 4

Staempfli, 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/content/41/2/268.abstract>

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.

Author Affiliation: Alexis Schulman is with the Massachusetts Institute of Technology in Cambridge, MA.

Country where research was conducted: United States.

C&NN Research Volume 3

Schulman, A., & Peters, C. A. (2008). GIS analysis of urban schoolyard landcover in three U.S. cities. *Urban ecosystems, 11*(1), 65-80. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.springerlink.com/content/y6l02680v6354040/>

Children playing in urban areas may experience lower levels of biological diversity

In this study, Dr. Will Turner and colleagues measured biodiversity in five diverse metropolitan areas by calculating species diversity (birds or ferns) in neighborhoods, using the mean biological diversity of all neighborhoods as a baseline. They found that the majority of people in urban areas live with impoverished biodiversity. For example, of the 4.4 million people who lived in the four cities they investigated with bird data, 73.2% of them lived in areas that had biodiversity

levels below the baseline. When Dr. Turner and colleagues used only native species in their analyses, the percentages of people exposed to lower levels of biodiversity increased. In addition, when they used historical neighborhood biological diversity (rather than the mean neighborhood biological diversity) the percentages of people exposed to lower levels of biodiversity also increased (for example, in Tucson it went from 71.2% to 90.8%). Dr. Turner and colleagues conclude that many people experience biological uniformity (i.e., they tend to experience the same species, rather than a diverse mix) in their urban neighborhoods. They also discuss the implications this work has for human health, child development, and how we design our built environment.

Author Affiliation: Will Turner is with Princeton University in Princeton, NJ.

Country where research was conducted: United States.

C&NN Research Volume 2

Turner, W. R., Nakamura, T., & Dinetti, M. Global Urbanization and the Separation of Humans from Nature. *Bioscience*, 54(6), 585-590, 2004. This study may be available in a library near you or can be purchased online through the publisher at: [http://www.bioone.org/doi/abs/10.1641/0006-3568\(2004\)054%5B0585:GUATSO%5D2.0.CO;2](http://www.bioone.org/doi/abs/10.1641/0006-3568(2004)054%5B0585:GUATSO%5D2.0.CO;2)

Focus: Environmental Knowledge & Behavior

While the relationship between children's experiences outdoors/in nature and their environmental knowledge and behavior is not well understood, experiencing and knowing about one's environment is an important foundation to being able to understand various issues and act in an informed and responsible manner.

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.

Country where research was conducted: United Kingdom.

C&NN Research Volume 5

Airbus. (2009). *The Greenwave program: Research results.* This document is available online at: <http://greenwave.cbd.int/partners/supporters>

Children's interest and relationship to nature and vegetation varies by context (urban vs. rural) and gender

Laaksoharju and Rappe investigated the role that vegetation plays in the lives of 9- to 10-year-old Finnish schoolchildren from urban and rural areas. Researchers were particularly interested in examining gender differences, as well as urban and rural differences. As part of this study, 76 children completed a survey about vegetation in their lives, as well as a drawing task to assess their ability to draw a plant and represent its anatomy. In addition, Laaksoharju and Rappe assessed the impact of a small horticultural intervention, where several urban children learned about fruit plants through a series of indoor, hands-on classroom sessions and completed a post-intervention survey. In analyzing the data, researchers found that rural children had closer contact with nature and green plants than urban children and that girls were more interested in vegetation than boys. For example, rural children knew trees by name better than urban children and girls were more interested in learning about plants than boys. With regard to the horticultural intervention, Laaksoharju and Rappe found that children's general knowledge about plants improved somewhat. While this study may be limited due to its small sample size, it provides valuable insight into differences in children's relationship with nature and vegetation. In concluding their article, researchers suggest additional areas of research as well as the need for horticultural interventions that take place outdoors and consider gender differences.

Author Affiliation: Taina Laaksoharju is with the University of Helsinki in Finland.

Country where research was conducted: Finland.

C&NN Research Volume 5

Laaksoharju, T., & Rappe, E. (2010). Children's Relationship to Plants among Primary School Children in Finland. *HortTechnology.* This article may be available in a library near you or can be purchased online through the publisher at: <http://horttech.ashspublications.org/content/20/4/689.abstract>

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: Laura Wray-Lake is with The Pennsylvania State University.

Country where research was conducted: United States.

C&NN Research Volume 4

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 article is available online at:
<http://www.transad.pop.upenn.edu/downloads/wray-lake%20environ%20attitudes.pdf>

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: Petra Lindemann-Matthies is with the University of Zurich in Switzerland.

Country where research was conducted: Switzerland.

C&NN Research Volume 4

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: <http://www.springerlink.com/content/j41h20g7u64484t2/>

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.

Author Affiliation: BBC Wildlife Magazine.

Country where research was conducted: United Kingdom.

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More information on this study can be found online at: <http://www.discoverwildlife.com/>

With economic growth comes loss of ecological knowledge

Ecological knowledge, accumulated knowledge about nature, is an important factor in people's ability to manage and conserve the environment. S.E. Pilgrim and colleagues conducted a cross-cultural, large-scale study to investigate whether there is an association between economic growth and ecological knowledge. The authors examined two levels of ecological knowledge (the names of living components of ecosystems and the functions and uses of these components) within a diversity of communities from India, Indonesia, and the United Kingdom. Using ethnobotanical surveys with photographs of local species, Pilgrim and colleagues interviewed more than 1,000 people across the three countries, documenting their ability to identify local plant species and their uses. The authors found a strong negative correlation between ecological knowledge and income levels—as income increased, ecological knowledge decreased. They also found that as a community's wealth increased, the difference in knowledge between the most and least knowledgeable community members and the difference between old and young people's knowledge increased. These findings suggest that as communities become wealthier, ecological knowledge becomes concentrated in fewer people and that these people tend to be either older members of the community or experts. Pilgrim and colleagues caution that as more of the world becomes urbanized, ecological knowledge will become increasingly threatened, communities' connectivity to their local environment more distant, and the capacity of local communities to manage their environment will decline. This study has important implications

for conservation efforts and demonstrates the importance of protecting the knowledge and capacities of local people.

Author Affiliation: Sarah Pilgrim is with the University of Essex in the UK.

Country where research was conducted: India, Indonesia, and the United Kingdom.

C&NN Research Volume 3

Pilgrim, S. E., Cullen, L. C., Smith, D. J., & Pretty, J. (2008). Ecological knowledge is lost in wealthier communities and countries. *Environmental Science & Technology*, 42(4), 1004-1009.

This study is available online at:

<http://www.opwall.com/Library/Opwall%20library%20pdfs/Journal%20publications/pilgrim%20ecological.pdf>

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.

Author Affiliation: Andrew Balmford is with the University of Cambridge in the UK.

Country where research was conducted: United Kingdom.

C&NN Research Volume 2

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://bioteach.ubc.ca/TeachingResources/GeneralScience/PokemonWildlife.pdf>

Benefits to Children from Contact with the Outdoors & Nature

This section highlights research focused on the benefits derived from children's experiences of the outdoors and nature. While some studies document benefits directly, this section also highlights studies on related factors that provide insight into this topic. Research is grouped into several main focal areas.

Focus: Literature Reviews & Overview Documents

These articles summarize literature related to outdoor/nature contact and children's health and well-being.

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.

Country where synthesis was created: United Kingdom.

C&NN Research Volume 5

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.hphpcentral.com/research/nature-childhood-health-and-life-pathways>

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.

Country where synthesis was created: United States.

C&NN Research Volume 5

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/>

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.

Country where synthesis was created: Australia.

C&NN Research Volume 5

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

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.

Country where synthesis was created: United Kingdom.

C&NN Research Volume 5

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/1471-2458/10/456>

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.

Country where synthesis was created: Scotland.

C&NN Research Volume 4

Muñoz, S. A. (2009). Children in the outdoors: a literature review. Sustainable Development Research Centre. This report is available online at:
<http://www.apho.org.uk/resource/item.aspx?RID=93474>

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.

Author Affiliation: Stuart Lester and Martine Maudsley are with Playwork Partnerships at the University of Gloucestershire in the UK.

Country where synthesis was created: United Kingdom.

C&NN Research Volume 3

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/playday_campaigns/2006_play_naturally.aspx

Unstructured free play brings cognitive, social and health benefits to children

Unstructured free play in the out-of-doors brings a host of benefits to children —from being smarter to more cooperative to healthier overall. This well-documented article by two physicians builds a strong case for the importance of unstructured free play in the out-of-doors for all age

groups, and especially young children. While concerned about the “obesity epidemic” in young children, the authors say that the health benefits from outdoor play are only one aspect of the overall benefits. They suggest that the concept of “play” is more compelling and inviting to most adult caregivers, parents and guardians than “exercise.” The authors cite cognitive benefits from play in nature, including creativity, problem-solving, focus and self-discipline. Social benefits include cooperation, flexibility, and self-awareness. Emotional benefits include stress reduction, reduced aggression and increased happiness. Children will be smarter, better able to get along with others, healthier and happier when they have regular opportunities for free and unstructured play in the out-of-doors.

Author Affiliation: Hillary Burdette is with the Children’s Hospital of Philadelphia.

Country where synthesis was created: United Kingdom.

C&NN Research Volume 1

Burdette, H. L., & Whitaker, R. C. (2005). Resurrecting free play in young children - Looking beyond fitness and fatness to attention, affiliation, and affect. *Archives Of Pediatrics & Adolescent Medicine, 159*(1), 46-50. This study is available online at: http://www.childrenandnature.org/uploads/Burdette_LookingBeyond.pdf

Focus: Mental Health Benefits

These articles examine relationships between children’s contact with the outdoors and/or nature and their psychological and cognitive performance and functioning, including their performance at school.

Urban and rural brains respond differently to stress

Over the years, a number of studies have found that city living increases the risk of certain mental health problems, such as mood and anxiety disorders, and is thought to be linked to stresses in the urban social environment. In this study, Lederbogen and colleagues placed 32 healthy German volunteers from urban areas, towns, and rural areas under stress and used functional magnetic-resonance imaging (fMRI) to scan their brains and examine their neural processes. In addition to examining where participants currently live (city, town, or country), researchers also assessed where participants grew up along the country to city spectrum. In analyzing the data, Lederbogen and colleagues found that urban and country residents’ brains handled the stress from the experiment differently in that different parts of their brains were activated. Researchers discovered that people living in the country had the lowest levels of activity in their amygdalas, structures responsible for processing and memory of emotional reactions such as environmental threats, while people living in towns had higher levels, and people living in the city had the highest levels of activity in their amygdalas. In addition, Lederbogen and colleagues discovered that whether people grew up in the city or country differentially impacted their perigenual anterior cingulate cortex (pACC), structures in the brain that helps regulate the amygdalas. Researchers found that people who spent more time growing up in the city had a more active pACC under stress, regardless of where they currently live.

Importantly, Lederbogen and colleagues conducted two other similar experiments, one using a different stress test and the other using a different sample of participants, and found the same results. In addition, researchers examined the functional connectivity between the pACC and amygdala and found that urban upbringing was associated with reduced connectivity, while current urban living had no impact, highlighting the importance of early urban exposure on brain processes. While this study may be limited due to its small sample size and inability to prove a causal relationship, it provides an important new understanding of the neural effects of different living environments on social stress processing.

Author Affiliation: Florian Lederbogen is with the University of Heidelberg in Germany.

Country where research was conducted: Germany.

C&NN Research Volume 5

Lederbogen, F., Kirsch, P., Haddad, L., Streit, F., Tost, H., Schuch, P., et al. (2011). City living and urban upbringing affect neural social stress processing in humans. *Nature*, 474(7352), 498-501. This article may be available in a library near you or can be purchased online through the publisher at: <http://www.nature.com/nature/journal/v474/n7352/full/nature10190.html>

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

Country where research was conducted: United States.

C&NN Research Volume 5

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://onlinelibrary.wiley.com/doi/10.1111/j.1758-0854.2011.01052.x/pdf>

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.

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

Country where research was conducted: United States.

C&NN Research Volume 3

Faber Taylor, A., & Kuo, F. E. (2008). Children with attention deficits concentrate better after walk in the park. *Journal of Attention Disorders OnlineFirst*. This study may be available in a library near you or can be purchased online through the publisher at:

<http://jad.sagepub.com/content/early/2008/08/25/1087054708323000.abstract>

Nearby nature reduces stress in children

This study, reported in 2003, by Cornell associate 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.

Author Affiliation: Nancy Wells is with Cornell University in Ithaca, NY.

Country where research was conducted: United States.

C&NN Research Volume 1

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 may be available in a library near you or can be purchased online through the publisher at: <http://eab.sagepub.com/content/35/3/311.abstract>

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.

Author Affiliation: Nancy Wells is with Cornell University in Ithaca, NY.

Country where research was conducted: United States.

C&NN Research Volume 1

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 may be available in a library near you or can be purchased online through the publisher at: <http://eab.sagepub.com/content/32/6/775.refs>

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.

Country where research was conducted: United States.

C&NN Research Volume 5

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/pr/product.jsp?id=55249>

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.

Country where research was conducted: United States.

C&NN Research Volume 4

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://pediatrics.aappublications.org/content/123/2/431.abstract>

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: Dorothy Blair is with Penn State University.

Country where synthesis was created: United States.

C&NN Research Volume 4

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.tandfonline.com/doi/abs/10.3200/JOEE.40.2.15-38>

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: Rodney Matsuoka is with National Taiwan University.

Country where research was conducted: United States.

C&NN Research Volume 4

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>

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.

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

Country where research was conducted: Canada.

C&NN Research Volume 3

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/resources/schools/research-policy.sn>

Focus: Physical Health Benefits

These articles examine linkages between the design of children's environments, children's outdoor/nature-related behavior and their physical health, including physical activity, development, and functioning.

A lot of children's recreational physical activity takes place outdoors and with friends

Dunton and colleagues examined where and with whom children engage in recreational exercise and sports. Researchers analyzed 4 years of data from a large, nationally representative time use survey. As part of this survey, children between the ages of 15 and 18 participated in a telephone interview where they described their activities for a 24-hour period, as well as where and with whom each activity occurred. In analyzing data for over 850 children, Dunton and colleagues found that the majority of children's recreational physical activity occurred with friends/acquaintances/other (50%), alone (19%), or with family members (18%). In terms of location, researchers found that children's recreational physical activity occurred at: other/unspecified locations (29%), school (24%), outdoors (22%), home (16%), and at someone else's house (8%). With regard to gender, Dunton and colleagues discovered that girls were more likely to exercise with family than boys, while boys were more likely to exercise with friends/acquaintances/other and outdoors than girls. With regard to age, researchers found that 18-year-olds were more likely to engage in recreational physical activity alone and less likely to engage in physical activity at school. While this study may be limited by its reliance on self-reported information and the categories researchers used to describe social and environmental contexts, it provides valuable insight into where and with whom children participate in recreational sports and exercise. Based on their study, Dunton and colleagues recommend that program and planning efforts focus on encouraging peer-based and outdoor activities to support children's recreational physical activity.

Author Affiliation: Genevieve Dunton is with the University of Southern California.

Country where research was conducted: United States.

C&NN Research Volume 5

Dunton, G. F., Berrigan, D., Ballard-Barbash, R., Perna, F. M., Graubard, B. I., & Atienza, A. A. (2010). Adolescents' Sports and Exercise Environments in a US Time Use Survey. *American Journal of Preventive Medicine, 39*(2), 122-129. This review may be available in a library near you or can be purchased online through the publisher at: <http://www.ajpmonline.org/article/S0749-3797%2810%2900318-1/abstract>

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.

Country where research was conducted: Netherlands.

C&NN Research Volume 5

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://psycnet.apa.org/journals/hea/30/1/84/>

Children with higher levels of independent mobility participate more in a range of physical activities

Children's physical activity behavior may vary based on context (e.g., whether it is school based exercise or active commuting to school). In this study, Page and colleagues investigated whether children's independent mobility (children's ability to move around their neighborhood on their own), perceptions of the environment, and distance from home to school were related to the frequency with which they participated in three different types of physical activity—outdoor play, structured exercises and sports, and active commuting to school. Researchers used data from a large study of over 1,300 10- to 11-year-old children from 23 schools in a large UK city. As part of the study, children completed computerized questionnaires about their outdoor play, exercise/sport activity, and travel from home to school, as well as their independent mobility and perceptions of their environment. Researchers examined children's local (travel to best friend's house, local shops, and park or playground) as well as area (travel to swimming pool, library, cinema, arcade, bus stop, sports and shopping center) independent mobility. In analyzing the data, Page and colleagues found that boys reported taking part significantly more often in outdoor play and exercise/sport activities than girls. Researchers also found that boys had significantly higher local independent mobility and perceptions of personal and traffic safety

than girls. With regard to factors influencing children's outdoor play, exercise/sport activities, and active commuting to school, Page and colleagues found the following:

- *Outdoor Play:* Boys played outside more if they scored higher in independent mobility (local and area) and social norm (more children around to play with). Girls played outside more if they scored higher in area independent mobility, social norm, and traffic safety.
- *Exercise/Sports Activities:* Boys participated in more exercise/sport activities if they scored higher in local independent mobility, personal safety, and had easier access to facilities. Girls participated in more exercise/sport activities if they had easier access to both school and friend's homes, access to a broader range of facilities, and more space to play both inside and outside the home.
- *Active Commuting to School:* Boys actively commuted to school more often if they scored higher in local independent mobility and reported having greater accessibility to school and friend's homes and other destinations. Girls actively commuted to school more often if they scored higher in local independent mobility. Finally, both girls and boys actively commuted more to school if they lived closer to school.

While this study may be limited due to its reliance on self-reported information and is correlational (not causal), it demonstrates the important relationship between independent mobility and increased levels of different types of physical activity and provides valuable information that can help inform physical activity interventions for girls and boys.

Author Affiliation: Angie Page is with the University of Bristol in the UK.

Country where research was conducted: United Kingdom.

C&NN Research Volume 5

Page, A. S., Cooper, A. R., Griew, P., & Jago, R. (2010). Independent mobility, perceptions of the built environment and children's participation in play, active travel and structured exercise and sport: the PEACH Project. *International Journal of Behavioral Nutrition and Physical Activity*, 7. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.ijbnpa.org/content/7/1/17>

Pregnant women living in areas with more trees had better birth outcomes

Donovan and colleagues investigated the effect that urban trees might have on adverse birth outcomes, including preterm birth and small for gestational age. Researchers examined all single live births in Portland, Oregon in 2006 and 2007 where the woman lived in a single-family home (approximately 5,700 women). Researchers also classified the amount of trees around each woman's home. In examining the relationship between tree cover and birth outcomes, Donovan and colleagues found that women who had more trees within 50 meters of their home, and who lived close to a private open space, had a significantly lower risk of having a baby being born that was small for gestational age. In fact, researchers found that a 10% increase in tree cover reduced the number of small for gestational age births by 1.42 in 1,000 births. Donovan and colleagues found no significant relationship between tree cover and preterm birth. While it is not known how trees might improve birth outcomes, researchers discuss several possible mechanisms, including stress reduction, improved social contacts, and increased physical activity. This study may be limited due to its observational nature, but through its large sample size and

control of numerous individual and neighborhood factors, it highlights a valuable new area for future research on nature-health connections.

Author Affiliation: Geoffrey Donovan is with the USDA Forest Service in Portland, Oregon.

Country where research was conducted: United States.

C&NN Research Volume 5

Donovan, G. H., Michael, Y. L., Butry, D. T., Sullivan, A. D., & Chase, J. M. (2011). Urban trees and the risk of poor birth outcomes. *Health & Place, 17*(1), 390-393. 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/30519/description

Children who spend more time in outdoor sport activities and less time watching TV have better retinal microvascular structure

The condition of small (micro) blood vessels is critical to good health. Retinal blood vessels provide a unique opportunity to study microvascular health noninvasively and have been linked to cardiovascular disease risk factors and blood pressure. In this study, Gopinath and colleagues examined relationships between children's physical activity, sedentary behaviors, and retinal microvascular size. Researchers had the parents of almost 1,500 6-year-old children from 34 different schools in Sydney, Australia complete surveys regarding their children's physical activity (outdoor and indoor) and sedentary behavior. Researchers also took digital photographs of children's eyes and measured retinal vessel diameter. In analyzing the data, Gopinath and colleagues found that, on average, children spent 36 minutes per day engaged in physical activity and 1.9 hours per day engaged in screen time. In examining relationships between children's physical activity, sedentary behaviors, and retinal microvascular size, researchers found that children who engaged in more physical activity outdoors had better retinal vascular diameter (wider arterioles), while children who engaged in more screen time had worse retinal vascular diameter (narrower arterioles). Interestingly, researchers did not find a significant relationship between indoor sporting activities and children's retinal vascular diameter. Gopinath and colleagues also discovered that the size of arterial narrowing associated with each daily hour children watched TV was fairly comparable to a 10-mm Hg increase in systolic blood pressure. This study may be limited due to its reliance on parent reports and relationships examined are correlational (not causal). While additional research is needed to understand these relationships, researchers discuss how retinal arteriolar narrowing could be a potential indicator of future cardiovascular disease and thus efforts to decrease the amount of time children watch TV and increase the amount of time children spend in outdoor activities could be particularly valuable to improving children's health.

Author Affiliation: Bamini Gopinath is with the University of Sydney in Australia.

Country where research was conducted: Australia.

C&NN Research Volume 5

Gopinath, B., Baur, L. A., Wang, J. J., Hardy, L. L., Teber, E., Kifley, A., et al. (2011). Influence of Physical Activity and Screen Time on the Retinal Microvasculature in Young Children.

Arteriosclerosis, Thrombosis, and Vascular Biology, 31(5), 1233. This study may be available in a library near you or can be purchased online through the publisher at:
<http://atvb.ahajournals.org/content/31/5/1233.abstract>

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.

Country where research was conducted: Taiwan.

C&NN Research Volume 5

Han, K. T. (2009). Influence of Limitedly Plants on the Psychology, Behavior, and Health of Students at a Junior High School in Taiwan. *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/content/41/5/658.abstract>

Children who play more outside and watch less TV have lower BMIs

Kimbrow and colleagues investigated linkages between outdoor play and TV watching and children's weight status, as well as linkages between the quality of children's residential environments and their activities. Researchers examined data for over 1,800 5-year-old children in major U.S. cities that took part in a large, longitudinal study on child well-being. Kimbro and colleagues examined children's body mass index (BMI), physical and sedentary activities as reported by mothers, various background and neighborhood characteristics, neighborhood social cohesion as reported by mothers (e.g., whether people are willing to help their neighbors), and physical conditions of the residential environment as measured by researchers (e.g., amount of litter nearby). Researchers found that 19% of children were overweight (between the 85th and 95th percentile) and 16% were obese (95th percentile or higher). Interestingly, Kimbro and colleagues found that children in the highest and lowest socioeconomic brackets had the lowest BMIs, while children in the middle socioeconomic brackets had the highest BMIs. Researchers also found that, on average, children played outside about 2 hours a day and watched television for more than 2.5 hours a day. In examining relationships between outdoor play, TV watching

and children's weight, Kimbro and colleagues discovered that children who played more outdoors had lower BMIs, while children who watched more TV had higher BMIs. Researchers also found that the higher the ratio of outdoor time to television time, the lower the child's BMI. Kimbro and colleagues also investigated socio-demographic differences in children's outdoor and TV watching behavior. For example, researchers found that Black and Hispanic children spent less time outside than White children, but more time watching TV than White children. In examining the relationship between the quality of children's residential environments and activities, Kimbro and colleagues discovered that children whose mothers had higher perceptions of neighborhood social cohesion, played outside more, spent fewer hours watching TV, and made more trips to the park or playground. Interestingly, the researchers found that children living in public housing and areas with poorer neighborhood physical conditions played outside more and yet also watched more TV. Based on previous studies, Kimbro and colleagues suggest that children living in public housing and areas with poorer neighborhood physical conditions may have more unstructured time than children living in other conditions and thus are able to fill this time with more outdoor play as well as more television watching. While this study may be limited due to its reliance on mother-reported information and its inclusion of more poor and urban children, it provides a valuable addition to the literature regarding the role that children's environments have on their active and sedentary behavior.

Author Affiliation: Rachel Tolbert Kimbro is with Rice University in Houston, TX.

Country where research was conducted: United States.

C&NN Research Volume 5

Kimbro, R. T., Brooks-Gunn, J., & McLanahan, S. (2011). Young Children in Urban Areas: Links Among Neighborhood Characteristics, Weight Status, Outdoor Play, and Television-Watching. *Social Science & Medicine*. This study may be available in a library near you or can be purchased online through the publisher at <http://www.sciencedirect.com/science/article/pii/S0277953611000281>

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.

Country where research was conducted: United States.

C&NN Research Volume 5

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.sciencedirect.com/science/article/pii/S1353829210001528>

Children who spend more time outside are more physically active

Time spent outside is one potential factor that may influence children's physical activity. While previous studies have examined the relationship between time spent outside and children's physical activity, they have been limited due to their reliance on methods that use self-report, parent report, or direct observation. In this study, Cooper and colleagues used global positioning system (GPS) receivers to record the outdoor location of over 1,000 11-year-old children in the UK and matched this information with data from accelerometers that measured children's physical activity. Children wore the GPS units and accelerometers after school for four days. In analyzing the data, Cooper and colleagues found that children spent, on average, about 42 minutes outside after school each day. Researchers also found that children spent more time outdoors in the summer than in the winter months and that there were no significant differences between boys and girls with regard to time spent outside. In terms of physical activity, Cooper and colleagues found that physical activity was 2-3 times higher outside than inside, physical activity outdoors was higher in the summer than in the winter months, and that there was no seasonal variation in physical activity that took place indoors. In examining the relationship between time spent outside and physical activity, researchers found that the more time children spent outside, the more physically active they were. This study may be limited due to user operation of the instruments as well as misclassification of indoor/outdoor locations, however, it provides further evidence of the important linkage between children's time spent outside and their physical activity levels. This study also demonstrates the potential of combining GPS and accelerometer data to advance our understanding of this relationship.

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

Country where research was conducted: United Kingdom.

C&NN Research Volume 5

Cooper, A. R., Page, A. S., Wheeler, B. W., Hillsdon, M., Griew, P., & Jago, R. (2010). Patterns of GPS measured time outdoors after school and objective physical activity in English children: the PEACH project. *International Journal of Behavioral Nutrition and Physical Activity*, 7. This study may be available in a library near you or can be purchased online through the publisher at:
<http://www.ijbnpa.org/content/7/1/31>

Children have higher physical activity levels in greenspace as compared to non-greenspace

Wheeler and colleagues investigated children's physical activity after school in outdoor greenspace, outdoor non-greenspace, and indoors. Researchers examined over 1,000 10- to 11-year-old children's after school physical activity locations and levels by having children wear accelerometers for 7 days and global positioning system receivers for 4 days between the end of school and bedtime. In analyzing the data, Wheeler and colleagues found that children spent only 13% of their time outdoors and most of this time was spent in non-greenspace (11%) as compared to greenspace (2%). Researchers discovered, however, that 30% of children's physical activity and 35% of their moderate to vigorous physical activity occurred outdoors, with more intense physical activity occurring in greenspace as compared to non-greenspace, especially for boys. For example, boys were 1.37 times more likely (and girls 1.08 times more likely) to engage in moderate to vigorous physical activity in greenspace as opposed to non-greenspace. While this study may be limited due to potential misclassification of indoor and outdoor time, the researchers' use of objective measurement instruments and a large dataset helps improve our understanding of the role of specific land uses in supporting children's physical activity. As a result of their research, Wheeler and colleagues suggest that both green and non-green urban environments may be important to children's physical activity.

Author Affiliation: Benedict Wheeler is with the University of Bristol in the UK.

Country where research was conducted: United Kingdom.

C&NN Research Volume 5

Wheeler, B. W., Cooper, A. R., Page, A. S., & Jago, R. (2010). Greenspace and children's physical activity: A GPS/GIS analysis of the PEACH project. *Preventive Medicine, 51*(2), 148-152. This article may be available in a library near you or can be purchased online through the publisher at: <http://www.sciencedirect.com/science/article/pii/S0091743510002288>

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

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

found that 90% of respondents reported that their school ground appeals to a wider variety of student interests after greening; 85% reported that their school ground now supports a wider variety of play activities; and 84% reported that since greening, their school ground encourages more exploration of the natural world. While this study may be limited due to its reliance on retrospective self-report, it provides important insight into the benefits of green school grounds and their potentially significant role in complementing more traditional school ground areas and improving the quality and quality of elementary school children's physical activity.

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

Country where research was conducted: Canada.

C&NN Research Volume 4

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/content/23/6/952.abstract>

Children in greener neighborhoods have lower body weight changes

Bell and colleagues examined the medical records of 4,000 three- to sixteen-year-old children that lived in Marion County, Indiana, received care from a particular clinic network between 1996 and 2002, had height and weight measurements for two consecutive years, and lived at the same residential address for at least two years. The majority of participants in this study were non-Hispanic black and enrolled in Medicaid (an indicator of socioeconomic status). Bell and colleagues geocoded each participant's address using a Geographic Information System and measured greenness at these locations using satellite images and a vegetation index. The researchers speculated that neighborhood greenness might serve as an indicator of children's access to spaces that promote physical activity or increased time outside. In analyzing the study data, Bell and colleagues found that the amount of vegetation in a child's neighborhood was inversely correlated with their Body Mass Index (BMI) score at the year two measurement. That is, in general, the more vegetation a child had in their neighborhood, the lower their body weight changes. The researchers also found that children in more vegetated settings were less likely to have a higher BMI over 2 years as compared to children in less vegetated settings. Importantly, Bell and colleagues controlled for a number of other factors in their analyses, such as residential density. While the study is observational and thus cannot causally link neighborhood greenness and body weight changes, this research highlights the role that neighborhood vegetation could play in policies and programs aimed at preventing childhood obesity.

Author Affiliation: Janice Bell is with the University of Washington.

Country where research was conducted: United States.

C&NN Research Volume 4

Bell, J. F., Wilson, J. S., & Liu, G. C. (2008). Neighborhood greenness and 2-year changes in Body Mass Index of children and youth. *American Journal of Preventive Medicine, 35*(6), 547-

553. This study may be available in a library near you or can be purchased online through the publisher at: [http://www.ajpmonline.org/article/S0749-3797\(08\)00734-4/abstract](http://www.ajpmonline.org/article/S0749-3797(08)00734-4/abstract)

Neighborhood parks play an important role in promoting physical activity in children

Although the American Academy of Pediatrics has recommended that children be physically active for at least 60 minutes a day and limit sedentary activity to less than 2 hours a day, many children do not meet these recommendations. In this article, Victoria Floriani and Christine Kennedy review the latest research findings with regard to the promotion of physical activity in children. For example, the authors discuss a number of studies which have found that access to a neighborhood park or playground is associated with higher levels of physical activity in children and that specific park amenities, such as lighting after dark, may be important in facilitating park use. Floriani and Kennedy also summarize research on sedentary behavior and how evidence, while often inconclusive, indicates that the less time children spend in sedentary behaviors, the more physically active they may be. In addition, the authors highlight recent research exploring the relationship between mental health and physical activity. While there is still much to be learned about this relationship, preliminary research has found a positive relationship between higher levels of physical activity and positive mental health outcomes, such as increased feelings of self-efficacy and confidence. Floriani and Kennedy conclude the article by encouraging pediatric health care providers to discuss physical activity with their patients and strategize with them on ways to incorporate activity into their daily lives.

Author Affiliation: Victoria Floriani is with the University of California, San Francisco.

Country where synthesis was created: United States.

C&NN Research Volume 3

Floriani, V., & Kennedy, C. (2008). Promotion of physical activity in children. *Current Opinion in Pediatrics*, 20(1), 90-95. This article is available online at: http://sf-recpark.org/ftp/uploadedfiles/wcm_recpark/SPTF/Floriani.pdf

Spending time outdoors, among other factors, is associated with higher levels of physical activity in preschool children

Physical activity provides important health benefits to children. Unfortunately, not much is known about the prevalence of preschool children's physical activity levels and the factors that most influence physical activity in this age group. In this paper, T. Hinkley and colleagues review 24 studies published between 1980 and 2007 that investigated factors related to physical activity levels in preschool children. The authors examined a total of 39 different variables, such as gender and time spent outdoors, and coded the results to identify consistency/inconsistency across studies. In the end, Hinkley and colleagues found support for the following findings: 1) boys are more active than girls, 2) a child's age and body mass index are not related to physical activity, 3) children who have parents that participate in physical activity with them are more active than children who have parents that do not participate with them in physical activity, and 4) children who spend more time outdoors are more active than children who spend less time outdoors. The authors also found that psychological, cognitive, emotional, and behavioral variables have not been studied enough to yield conclusive results with regard to their

association to physical activity levels in preschool children. Hinkley and colleagues review the strengths and weaknesses of studies to date, compare their results to those found for older children and adolescents, and highlight future research needs in order to better understand the many factors that influence preschool children's physical activity.

Author Affiliation: Trina Hinkley is with Deakin University in Australia.

Country where synthesis was created: Australia.

C&NN Research Volume 3

Hinkley, T., Crawford, D., Salmon, J., Okely, A. D., & Hesketh, K. (2008). Preschool children and physical activity - A review of correlates. *American Journal of Preventive Medicine*, 34(5), 435-441. This study may be available in a library near you or can be purchased online through the publisher at: [http://www.ajpmonline.org/article/S0749-3797\(08\)00155-4/abstract](http://www.ajpmonline.org/article/S0749-3797(08)00155-4/abstract)

Street trees may help prevent early childhood asthma

The prevalence of childhood asthma in the U.S. has increased dramatically in the past 20 years and is particularly high in poor urban communities. While the exact cause for this increase remains unknown, environment and lifestyle changes are believed to be possible contributors. Trees may help prevent asthma by changing local air quality or by encouraging children to play outdoors, exposing them to a variety of microbes. In this study, G.S. Lovasi and colleagues investigate whether there is an association between street trees and childhood asthma by examining data, grouped by specific hospital geographic areas, on the prevalence of asthma for 4-year-old and 5-year-old children, hospitalizations as a result of asthma for children younger than 15, number of street trees, census data, and proximity to pollution sources. In analyzing the data, the authors found that higher street density was associated with a lower prevalence of childhood asthma, but that there was not a significant association between street trees and hospitalizations. In their analysis, Lovasi and colleagues controlled for a number of other factors that may have influenced the results, such as proximity to pollution sources and sociodemographic characteristics. Based on these findings, the authors estimate that an increase in tree density of 343 trees per square kilometer would be associated with a 29% lower prevalence of early childhood asthma. It is important to note that this analysis does not demonstrate that trees cause or prevent asthma for an individual child. While the results of this study are encouraging, additional research is needed to better understand the effects of trees on the prevalence of childhood asthma.

Author Affiliation: Gina Schellenbaum Lovasi is with Columbia University in NY.

Country where research was conducted: United States.

C&NN Research Volume 3

Lovasi, G. S., Quinn, J. W., Neckerman, K. M., Perzanowski, M. S., & Rundle, A. (2008). Children living in areas with more street trees have lower prevalence of asthma. *Journal of Epidemiology and Community Health*, 62(7), 647-649. This study may be available in a library near you or can be purchased online at: <http://jech.bmj.com/content/62/7/647.abstract>

Spending time outdoors helps prevent myopia in 12-year-olds

In recent decades, myopia or nearsightedness has become increasingly common in young children. While the cause(s) of myopia remain unknown, environmental factors, such as reading that requires children to focus at a close distance, are thought to play an important role. Using data from the Sydney, Australia Myopia study, K. A. Rose and colleagues investigate the relationship between near work, midworking distance, and outdoor activities with the prevalence of myopia in 6- and 12-year-old children. Between 2003 and 2005, 1,765 6-year-olds and 2,367 12-year-olds received a comprehensive eye exam and completed questionnaires about their activities during weekdays and weekends (parents completed the questionnaires for the 6-year-old children). The authors grouped children's activities into near work (e.g., drawing and reading), midworking distance (e.g., watching television and using the computer), and outdoor activities (e.g., bicycle riding and outdoor sport). After adjusting for a number of potentially confounding factors (e.g., parental myopia and ethnicity), Rose and colleagues found that while there was no association between the prevalence of myopia and activity among 6-year-olds that higher levels of total time spent outdoors were associated with a lower prevalence of myopia among 12-year-olds. The authors found that 12-year-olds with the highest levels of near work activity and lowest levels of outdoor activity were two to three times more likely than their peers to develop myopia, whereas 12-year-olds with the lowest levels of near work activity and highest levels of outdoor activity were less likely than their peers to develop myopia. The authors also found that participation in sports did not seem to be a significant factor in explaining this protective effect. Rose and colleagues suggest that light intensity may be an important factor in explaining the impact of outdoor activity on the development of myopia and that additional research is needed to help understand this relationship.

Author Affiliation: Gina Schellenbaum Lovasi is with Columbia University in NY.

Country where research was conducted: Australia.

C&NN Research Volume 3

Rose, K. A., Morgan, I. G., Ip, J., Kifley, A., Huynh, S., Smith, W., et al. (2008). Outdoor activity reduces the prevalence of myopia in children. *Ophthalmology*, 115(8), 1279-1285. This study may be available in a library near you or can be purchased online at: <http://www.ajo.com/>.

Play in natural environments improves kindergarten children's motor abilities

Fjørtoft examined the impact of kindergarten children's play environment on their motor development in Telemark, Norway. As part of this study, one kindergarten group, consisting of 46 children, was provided opportunities to play in a nearby 19 acre forest for one to two hours a day, while the other kindergarten group, consisting of 29 children from two kindergartens, continued to play on traditional playgrounds for one to two hours a day. Fjørtoft conducted a pre-test of all children's motor fitness, followed by a 9 month observational period and post-test. With regard to children's motor abilities, she found that play in the natural environment improved all motor abilities except flexibility. In the comparison group, however, children's motor fitness improved in only 3 of the 9 motor tests. When examining differences between the two groups, Fjørtoft found the experimental group to be significantly better than the comparison group in terms of balance and coordination.

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

Country where research was conducted: Norway.

C&NN Research Volume 2

Fjørtoft, I. (2004). Landscape as playscape: the effects of natural environments on children's play and motor development. *Children, Youth and Environments, 14(2)*, 21-44. This article is available online at: http://www.colorado.edu/journals/cye/index_issues.htm.

Open public spaces are children's favorite places for physical activity

To better understand factors that influence children's physical activity, Rehrer and colleagues had 173 12- to 13-year children from a high school in Dunedin, New Zealand draw a series of maps about their favorite and least favorite places for physical activity, where they went on a particular Sunday, and where they went on the previous school day. In addition, children described why they liked or avoided certain places and how they got to these places. In analyzing the data, Rehrer and colleagues found that open public spaces were children's favorite places for physical activity, with 37% of students citing a beach close to school and 33% citing a nearby park as their favorite places. The most common reasons children liked these places were because of the ability to do specific physical activities, the ability to have fun, and having friends to do an activity with. With regard to least favorite places, researchers discovered that an industrial harbor area, other schools, and cemeteries were children's least favorite places for physical activity. The most common reasons children disliked these places were because of bad people/bullies, it didn't support physical activity, traffic, danger, and they were boring. With regard to children's activities on a Sunday, Rehrer and colleagues found that children made more visits to specific built environments than green spaces and that the majority of children used a car for transport instead of walking or biking. Researchers also found some gender differences. For example, more girls than boys found good weather, living close to facilities, and having friends to do physical activity with important. While this study may be limited due to its small sample size and focus on students from one high school, it provides a valuable contribution to the literature because it focuses on children's perspectives and demonstrates the role of both environmental and social factors in encouraging children's physical activity.

Author Affiliation: Nancy Rehrer is with the University of Otago in New Zealand.

Country where research was conducted: New Zealand.

C&NN Research Volume 5

Rehrer, N. J., Freeman, C., Cassidy, T., Waters, D. L., Barclay, G. E., & Wilson, N. C. (2011). Through the eyes of young people: Favourite places for physical activity. *Scandinavian Journal of Public Health*. This study may be available in a library near you or can be purchased online through the publisher at: <http://sjp.sagepub.com/content/39/5/492.abstract>

Focus: Other Health Benefits

These articles highlight other health benefits from children's contact with the outdoors and/or nature.

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: Helen Little and Shirley Wyver are with Macquarie University in Australia.

Country where synthesis was created: Australia.

C&NN Research Volume 4

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 is available online at:

http://www.earlychildhoodaustralia.org.au/australian_journal_of_early_childhood/ajec_index_abstracts/outdoor_play_does_avoiding_the_risks_reduce_the_benefits.html

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.

Author Affiliation: Stephen Kellert is with Yale University in New Haven, CT.

Country where research was conducted: United States.

C&NN Research Volume 1

Kellert, Stephen R.; with the assistance of Victoria Derr. “A National Study of Outdoor Wilderness Experience.” New Haven: Yale University, 1998. This study is available online at: <http://rendezvous.nols.edu//content/view/1713/739/>

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.

Author Affiliation: Stephen Kellert is with Yale University in New Haven, CT.

Country where research was conducted: United States.

C&NN Research Volume 1

Faber Taylor, A., Kuo, F. E., & Sullivan, W. C. (2002). Views of nature and self-discipline: Evidence from inner city children. *Journal Of Environmental Psychology*, 22(1-2), 49-63. This study is available online at: http://lhhl.illinois.edu/girls_self-discipline.htm

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.

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.

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Country where research was conducted: United States.

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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://cab.sagepub.com/content/44/1/31.abstract>

Children's emotional affinity towards nature is a strong predictor of their willingness to protect the environment

Müller and colleagues examined the relationship between children's emotional connection or affinity towards nature and their willingness to protect the environment in two different European societies, Germany and Lithuania, and contexts, urban and rural. Researchers had over 400 high school students in 11th and 12th grades from urban and rural environments in Lithuania and Germany complete a survey to assess their emotional affinity towards nature, awareness of environmental risks, current contact with nature, and willingness for pro-environmental commitment. In analyzing the data, Müller and colleagues found that children's emotional affinity towards nature was a significant predictor of children's willingness for pro-environmental commitment. With regard to direct nature contact, researchers found that children's contact with nature did not have a direct relationship to their willingness for pro-environmental commitment, but rather impacted willingness for pro-environmental commitment indirectly through the development of emotional affinity towards nature. In addition, Müller and colleagues discovered important inter-individual and cross-societal differences. For example, girls were more connected to nature, spent more time in nature, were more aware of environmental risks, and expressed more willingness for pro-environmental commitment than boys, while Lithuanian children had a higher affinity towards nature than

German children and children living in rural areas spent more time with nature than those from urban areas. In concluding their article, Müller and colleagues highlight the need for additional research to better understand how nature affinity is developed and effective ways to support children's contact with nature to ensure children build emotional connections and develop a desire to protect nature.

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Country where research was conducted: Germany and Lithuania.

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Müller, M., Kals, E., & Pansa, R. (2009). Adolescents' emotional affinity toward nature: A cross-sectional study. *Journal of Developmental Processes, 4(1)*. This article is available online at: <http://www.psych.utah.edu/people/people/fogel/jdp/journals/6/journal06-06.pdf>

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 is 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.

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Country where research was conducted: United States.

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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/>

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.

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Country where research was conducted: United States.

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Wray-Lake, L., Flanagan, C. A., & Osgood, D. W. (2010). Examining trends in adolescent environmental attitudes, beliefs, and behaviors across three decades. *Environment And Behavior*, 42(1), 61-85. This study may be available in a library near you or can be purchased online through the publisher at: <http://eab.sagepub.com/content/42/1/61.abstract>

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.

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Country where research was conducted: Scotland and United Kingdom.

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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/content/40/1/111.abstract>

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."

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Country where synthesis was created: United States.

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Chawla, Louise. "Learning to Love the Natural World Enough to Protect It," in Barn nr. 2 2006:57-58. © 2006 Norsk senter for barneforskning. This study may be available in a library near you or can be accessed online through the publisher at: <http://www.ntnu.edu/noseb/research/barn>

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.

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Country where synthesis was created: United States.

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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>