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chapter 10

Healthy Planet, Healthy Children: Designing Nature into the Daily Spaces of Childhood

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Although the epidemics and infectious diseases targeted by public health agencies during the last 130 years have largely been eradicated in the Western, industrial world, preventable lifestyle diseases have replaced them. Postmodern childhood is facing entirely new health threats resulting from rapid, massive cultural changes, including the impacts of new technologies on behavior. More and more of children's time is being "pulled" indoors away from nature by homework, video and computer screens, parental anxiety about stranger danger, and the dangers of automobile traffic (Jago et al. 2005). Richard Louv's book *Last Child in the Woods* has helped to focus public attention on the possible negative consequences for childhood health of these new risk factors. To protect children and support healthy lifestyles, new forms of "inoculation" are required, including changes to the built environments of children's daily lives.

Stimulated and emboldened by the many-layered, wide-ranging contents of *Children and Nature* (Kahn and Kellert 2002) and the empowering thrust of the biophilic building design symposium from which the present book derives, this chapter presents examples of designed environments that support or have the potential to support children's daily outdoor contact with nature and thus ensure the biophilic evolution of our planet and its human citizens. This chapter draws on the latest research findings, which suggest that a healthy, therapeutic effect is experienced by children who are directly exposed to nature (Wells and Evans 2003; Wells 2000; Kuo et al. 1998) and explores the role of physical design in improving the quantity and quality of exposure to nature by integrating it into the built environment. The majority of children worldwide live in urban environments, approximately half of them in urban centers of less than 500,000 population (Satter-

thwaite 2006). Thus our focus is the everyday life of urban children and concern for the quality of the environments where they spend most of their time, where "biophilic design" (supporting and stimulating children's biophilia) has most potency, where access to nature can be guided by design policy in childcare centers, schools, residential neighborhoods, and community facilities such as parks, museums, zoos, and botanical gardens. These topics will be addressed within the scope of this chapter because the fact is that they are not receiving adequate attention in current urban design practice.

SUPPORTING A NEW BIOPHILIC CULTURE BY DESIGN

It is evident that we are at a turning point in history where opportunities for children to explore the natural world, until recently taken for granted, must now be intentionally created (Louv 2005; Rivkin 1995). To some this may seem a contradiction. How can the qualities of naturally occurring phenomena be deliberately recreated? The fact is that there is no other choice but to fully engage the urban planning, landscape architecture, and architecture professions in creating new, nature-based urban development policies to help ameliorate the new lifestyle health issues. On the other hand, solutions cannot be imposed but must evolve through community-based processes to engage stakeholders and users (including children) in creating design solutions (Cele 2006). Middle-age children (definitions of outer limits vary, but roughly between 6 and 12) are skilled and capable of evaluating their surroundings and explaining their likes, dislikes, fears, and perceptions of territorial barriers (Moore 1980)—and to make design proposals to improve their surroundings (see Figure 10-1).

Biophilic design for children is supported by precedents (case study designs that have withstood the test of time) that may inspire community action to help a new biophilic culture to take root. Our hope is that these examples will support the creation of policies to support more inclusive, healthy lifestyles. Compelling examples are needed to inform parents, teachers, early childhood professionals, school officials, neighborhood developers, and all those who want to advance the state of the art and capture the market represented by families seeking healthy, sustainable settings for their children. The selected design precedents cover a range of scales and contexts that reflect a variety of needs across the childhood age span. The examples also address issues of family characteristics and demographics and illustrate the constraints and opportunities for designed natural systems in a variety of urban contexts.

Figure 10-1: During a public housing community design workshop, these resident children are presenting their design proposals to improve the shared open space around their homes.

For biophilic design to be fully effective, it should extend beyond buildings into what Danish urban designer Jan Gehl has called the "life between buildings" (Gehl 2003), to embrace the outdoor habitat of our most important citizens: children. Outdoors is where immersion in nature is more feasible, where young bodies and minds can be engaged with peers in health-sustaining activities with their surroundings. This being so, it is surprising that recent sustainable design literature (Beatley 2000; Hough 1990; Thomas 2003) does not emphasize children as arguably the most important users of sustainable, "green" urban development.

A fundamental assumption of this chapter is that children are born as "biophilic beings," expressed in their intrinsic curiosity to explore and learn from the natural world without fear and intimidation (Kellert 1993). Based on interviews with environmental activists in Kentucky in the United States, and Oslo and Trondheim in Norway, Chawla (2006) presents a compelling theoretical framework and research-based statement addressing the critical role of childhood experience of nature in explaining adult environmental stewardship later in life. Wells and Lekies (2006), interviewed 2,000 adults across the United States to present further convincing evidence supporting the strong connection between environmentalism and childhood experience of nearby nature—especially if "wild." Effective biophilic design must integrate two domains of health: children and planet. Children must spend sufficient time in naturally rich, healthy environments for biophilia to be instilled as a lifelong affect which, in turn, will create a sufficiently large majority of biophilic citizens who love the world so strongly as to become adult environmentalists doing everything in their power to combat global warming and associated environmental issues (Chawla 2006) (see Figure 10-2).

Many barriers presently limit children's access to nature, which may prevent them from growing up with love and respect for the planet and a passion to protect it (Crain 2003). These barriers include the lack of direct experience of natural processes and materials in early childhood when sensory impact is the primary mode of learning; the negative messages from adults who have already lost their biophilic feeling for nature; the lack of use of living environments in schools where children receive primary education at a stage of development when minds and bodies are open to all that the world has to offer and where the seeds of understanding about how the world works are sown; the lack of rich, diverse, accessible sustainable landscapes in the residential districts where children live; and the lack of independent mobility and rich environmental experiences at a neighborhood level.

Currently, built environments often present barriers to children's independent mobility and therefore their experience of nature. To increase the "activity friendliness" of urban neighborhoods for children (de Vries et al. 2007), substantial structural urban design issues must be overcome such as traffic and road/sidewalk configuration, school and park planning, location of shared spaces in residential neighborhoods, location of walk/bike/skate/ski trails, residential density and site planning, and urban planning issues such as increasing walking for young people by ensuring recreation destinations close to home (Frank et al. 2007; Mackett et al. 2004).

Figure 10-2: A local nature reserve or botanical garden can offer rich opportunities for adults and children to share nature together. Knowledgeable, attentive adults can help children expand their awareness and appreciation of the beauty of nature.

In addition to ensuring that children's intrinsic biophilia is activated, developed and supported strongly enough to extend into adulthood, biophilic design simultaneously addresses children's health, a need most

obviously expressed by burgeoning sedentary lifestyle trends, resulting in an obesity crisis for children and adults. The latter may be the most visible and possibly the most serious manifestation of the negative health impact of children's lifestyle changes in the last three decades or so, but it is not the only consequence—as addressed below.

CHILDHOOD LIFESTYLE HEALTH THREATS

Combating Sedentary Behavior

Worrying, negative health changes are affecting the physical, mental, and social functioning of children across the Western, industrialized world, changes so severe that the steady rise in life expectancy during the past two centuries may soon come to an end. A recent study of the effect of obesity on longevity in the United States (Olshansky et al. 2005) suggests that a growing proportion of children born today may die before their parents. In the United States, approximately 18 percent of children under 19 years old are overweight or at risk of being overweight (CDC 2007). These negative lifestyle conditions are even beginning to impact early childhood. In the United States, more than 10 percent of two- to five-year-olds are obese and more than 20 percent are overweight or at risk of being overweight (Ogden et al. 2002). The situation in some southern European countries is even worse. In Spain 13.9 percent of individuals aged two to twenty-four are obese and 26.3 percent are overweight (EEHC 2005).

Levels of movement and energy expenditure necessary for healthy physical development are not feasible when limited to indoor environments. Being outdoors is the best predictor of children's physical activity (Sallis, Prochaska, and Taylor 2000). However, today's children are not getting outdoors enough. This reduction in "free range childhoods" is a major unhealthy lifestyle factor. Although empirical data is lacking on this issue, compelling anecdotal information from concerned professionals, parents, and cultural commentators has accumulated, most recently contributed to by Pyle (1993; see also Chapter 12, which stresses the critical experiential loss resulting from reduced free range access to natural settings), adding force to Richard Louv's compilation of evidence (Louv 2005). Research conducted in the 1970s and 1980s provides substantial, evidence-based benchmarks of children's "range behavior" from an era when it was internally driven by children's maturity levels rather than external constraints of the built environment and adult control (Moore 1986a; Moore, 1980; Moore and Young 1978; Hart 1979).

The Threat of Automotive Traffic

Traffic danger exacerbated by inappropriate street design is the most obvious, measurable factor inhibiting children's outdoor behavior. Pedestrian-friendly residential street design has a long history stretching back to the 1875 layout for Bedford Park, Chiswick, London (Southworth and Ben-Joseph 2003). Innovative residential street designs emphasizing pedestrians and cyclists, including children (Eubank-Ahrens 1980; Francis 1980; Moore 1980), continued to evolve on both sides of the Atlantic (Southworth and Ben-Joseph 2003; Vernez-Moudon 1987; Appleyard 1980; Engwicht 1999). These well-documented precedents have yet to be fully embraced in the United States even though they are safer (Pucher and Dijkstra 2003). But even now, the latest European thinking on residential street design surprisingly underplays children's needs (HMSO 2007). Over the last two decades, children have been driven from residential streets by massive increases in traffic. Have children also disappeared from adult consciousness? They should still be considered the most important users of neighborhood streets (Moore 1991). When encouraged, they will express perceptions and opinions (Cele 2006) that are useful to adult policy makers who are willing to listen.

It is interesting to note that countries such as Denmark, Germany, the Netherlands, and Sweden, where higher levels of functional urban bicycle use are publicly visible, exhibit markedly lower rates of childhood obesity than the United States (Rigby and James 2003). Citizens of all ages can move around freely and safely without polluting the air because of the high-quality pedestrian/bicycle infrastructure designed into the

urban fabric—indicating close collaboration between traffic engineers and urban designers (Figure 10-3). The pressing issue of children's independent mobility could be solved if traffic engineers, residential developers, and urban designers collaborated on child-friendly street design. Paradoxically, it has become increasingly difficult to support the argument in terms of child pedestrian traffic injury and death, because for years, child pedestrians have been disappearing from city streets perceived as dangerous (Hillman, Adams, and Whitelegg 1990). Alternative designs that would bring them back are needed.

Vehicle exhaust is a direct health threat. Although we were unable to identify the relative asthma rates for the countries cited, the Atlanta Summer Olympic Games study demonstrates the relationship between vehicle exhaust and childhood asthma in the United States. During the 17-day Olympic event, peak weekday traffic counts dropped 22.5 percent, peak daily ozone levels dropped 27.9 percent and asthma acute-care events in children assessed from four sources fell between 44.1 percent and 11.1 percent, with the highest level being statistically significant (Friedman et al. 2001). The effect of vehicle exhaust is also an indirect threat by keeping childcare center children indoors on "ozone alert" days.

Figure 10-3: Traffic-free urban trails and greenways expose children to nature and help them learn the joy of bicycle riding at an early age.

Impact on Cognitive Development

In an interview with the *Guardian* newspaper (Crace 2006), psychologist Michael Shayer reported the findings of a study sponsored by the Economic and Social Research Council (ESRC) of more than 10,000 11- to 12-year-old British children. The principal finding was that UK children have fallen two to three years behind in cognitive and conceptual development from where they were 15 years ago. When pushed to explain these findings, Shayer said, "The most likely reasons are the lack of experiential play . . . and the growth of a videogame, TV culture. Both take away the kind of hands-on play that allows kids to experience how the world works in practice and to make informed judgments about abstract concepts." The "rediscovery" of the importance of play in promoting children's health and positive parent-child relations is further supported by the American Academy of Pediatrics (Ginsburg 2007)—although, unfortunately, they do not mention the importance of *outdoor* play. Shayer also does not tie play to the outdoors in his speculations; however, a longitudinal study by Wells (2000) demonstrates a statistically significant correlation between nature and cognitive functioning of a group of low-income children when they moved to "greener" homes (measured by views from windows). If natural scenes viewed from indoors can have a measurable effect, imagine the possible impact of hands-on, outdoor immersion in nature.

Attention Functioning

Since being officially designated by the American Psychiatric Association in 1980, ADD (Attention Deficit Disorder) and ADHD (when "hyperactivity" is also exhibited) have become a hotly debated health issue (DeGrandpre 2001; Diller 1998). Lacking an authoritative, valid, reliable medical diagnosis, ADD/ADHD is typically "diagnosed" using behavioral criteria, some of which bear close resemblance to behaviors we might expect from normally active kids (Eberstadt 1999) cooped up in classrooms, acting as if they were in the woods. The most frightening fact related to ADD/ADHD is that an estimated nearly four million children are daily administered methylphenidate, a psychotropic drug (brand name *Ritalin*, similar in chemical composition to cocaine

(http://learn.genetics.utah.edu/units/addiction/issues/ritalin.cfm) to control ADD/ADHD symptoms. The treatment is so popular in the United States that an estimated 80–90 percent of the world's production and consumption of Ritalin occurs there according to Eberstadt (1999), who cites estimates of production increases of 700 percent since 1990 and a doubling of consumption since 2000. Is there any more powerful statistic that underscores the distorted, misguided way we are beginning to regard childhood?

Outdoors as a Protective Shield for Mental, Social, and Physical Health

On the positive side, mounting evidence suggests that being outdoors in natural surroundings might be viewed as a "preventive treatment" for healthy attention functioning. Empirical studies are beginning to show statistically significant associations between nature (as little as trees seen through apartment windows) and improved attention functioning (Faber Taylor et al. 1998). Even small amounts of nature have been shown to exert a measurable, positive effect on children's attention functioning (Grahn et al. 1997).

Wide-ranging, independent behavior away from adult control can also have a positive social impact on children. Under these circumstances, they are afforded more opportunities for cooperative group play. Outdoors, children have more opportunities to collaborate with each other, whether to organize informal games, build a clubhouse, or go exploring without any particular goal in mind (Moore 1986a). Because such behavior is based on friendship and joint action to carry out projects, it builds democratic skills, facilitates cooperation and collective effort, and can help overcome prejudice against other children with varied backgrounds. Self-directed groups of children playing outdoors together build their own cohesive society and are better able to acquire self-reliance to overcome the challenges that life brings (see Figure 10-4).

Physical and social health and outdoor experiences also strengthen psychological health. A study by Wells and Evans (2003) suggests that nature nearby children's homes might buffer or moderate the effects of stressful life events on children's well-being—even among rural children. A child with trustworthy friends, shared experiences in special places, and heightened self-esteem resulting from territorial control is more likely to maintain good mental health. Grahn et al. (1997) used standardized child development measures to compare the impact of outdoor environments on children in two typical Swedish nursery schools. Both had conventionally equipped outdoor environments but in one school, children also played in a lush woodland where they could spend outdoor time. Developmental measures of these latter children were remarkably different. In addition to improved attention functioning (supporting the later findings of Faber Taylor et al. 1998), Grahn and his team found that the children exposed to a more natural outdoor environment exhibited lower sickness rates (presumably because children get sick by exposure to each other indoors) as well as more advanced gross motor development, improved fitness, and increased imaginative and social play. At the neighborhood level, recent research indicates that in higher density areas, increased amounts of vegetation surrounding a child's residence protects against being overweight (Liu et al. 2007). Could it be that greener neighborhoods are more attractive for children to spend time outdoors?

Figure 10-4: Nature provides children with an inexhaustible supply of renewable play materials, motivating them to think independently, work together democratically to solve problems, and carry out self-initiated projects, with a sense of pride in their accomplishments

These rigorous scientific research findings confirm the positive consequences that can accrue from outdoor play and direct experience of nature in terms of mental and physical health. Mounting evidence supports the notion that exposure to nature could be regarded as an essential childhood preventive health measure or "buffer effect," as discussed by Wells and Evans (2003, 315), who suggest that "environmental characteristics [such as nearby nature] may function as buffers or moderators of adverse conditions, serving as protective factors that contribute to resilience among children." (See Figure 10-5 in color insert.)

Boosting the Immune System

A further benefit of interaction with the outdoor natural environment is its association with the development of the human immune system. Research findings are beginning to demonstrate that the ubiquitous use of "germ-fighting" chemicals at home and in other environments used by children may have negative consequences, leading pediatric professionals to hypothesize that children are growing up with inadequately boosted immune systems. This may partly explain the dramatic growth of childhood asthma and other allergic ailments (Check 2004). The growing dependence on and easy availability of antibiotics may be part of the problem. Decreased immune stimulation ("training of immune system") through improved hygiene, fewer infections, fewer parasite infestations, et cetera, has resulted in the "hygiene" or "jungle" hypothesis suggesting that an overemphasis on hygiene may have reached a point of diminishing returns (Ring 2005). It is possible that exposure to nature, which in essence is nonsterile, may be a beneficial boost to a child's immune system, providing extra protection against illness.

How Does Nature Have an Effect?

The apparent health connection with outdoor nature (even in small doses) prompts speculation about possible explanations, ranging from the inherited preference for the "fractal array" of nature (see Chapter 1) and speculative predictions about children's relationships with nature based on evolutionary biology theories (Heerwagen and Orians 2002). Interpretation based on the biophilia hypothesis suggests that children are drawn to the natural outdoors because it is pleasurable and gives them a sense of well-being, expansive freedom, and agency or control over events (at the same time supporting health-enhancing, preventive behaviors). For children to reap the full benefit of being outdoors, opportunities for outdoor engagement with nature must be available as part of daily life, integrated with children's emerging developmental needs. This is especially true of very young children because their neurological and physical development is so rapid in the early years of life.

Out to Play

In middle childhood, schools and neighborhoods (containing the pathways and place destinations of children's home-based territories) must afford children sufficient daily physical activity for good health; they are therefore crucial targets for planning and design policy (Moore 1986a) (see Figure 10-6). Experientially rich territories can motivate the maturing child to get out and about, to explore and develop as a whole person, moderated by variables such as urban context, building density, and parental values and perceptions of safety; street traffic;

Figure 10-6: Children enjoying early morning exercise on the "peripheral trail" through the longleaf pine forest of Blanchie Carter Discovery Park, Southern Pines Primary School, Southern Pines, North Carolina. The children are members of the Walking (and running) Club, led by the school nurse every morning before school.

availability of playmate siblings and peers; and locations of schools, parks, open spaces, shops, and other local amenities relevant to children's interests. The cure for the lifestyle maladies of contemporary childhood seems glaringly obvious and simple: outdoor play in nature. Although this is easier said than done, great potential exists for counteracting sedentary lifestyle trends and the negative health consequences of inadequate time outdoors exposed to nature by reaffirming the benefits through empirical research and design based on the findings.

PROGRESSING AN INTERDISCIPLINARY, ACTION-RESEARCH STRATEGY

Environment and behavior (E&B) research has a 40-year track record and a developed repertoire of methodologies to study the sedentary lifestyle issue and help build the evidence base necessary to develop design solutions. Children's environments research, a subfield of E&B, has developed a substantial conceptual framework and methods that can be applied to this effort. Theories of territoriality, home range development, behavior setting, and affordance, currently applied by leading researchers, continue to offer potential for generating useful knowledge. Methods of direct observation of behavior and objective measurement of physical activity, combined with qualitative, child-friendly methods (drawings, child-taken photographs, journals, semi-structured interviews, child-led safaris), are appropriate data-gathering tools to measure children's behavior and perceptions. Multimethod quantitative/qualitative exploratory research offers the most potential for identifying relevant variables and measures. However, additional work is required to develop valid, reliable measures of the physical environment at a level of differentiation useful for design.

Action research is a viable strategy to adopt in the face of the tremendous need to rapidly generate new knowledge to serve as the evidence base for new designs. Correlation research already under way is generating an understanding of key associations to improve design decision-making. However, new, radically different designed environments with increased "ecological validity"[1] must be built and tested to assess their support of healthy lifestyles for children. Innovative models already exist on the ground (presented later). They represent key case study research opportunities for developing an understanding of early and middle childhood behavior and physical designs required to counteract unhealthy lifestyle trends.

LINKING SUSTAINABLE DESIGN AND HEALTHY CHILD DEVELOPMENT

Sustainable design has made tremendous technical strides in the design of buildings but less so in site design and the broader linking of urban planning to its ecological context so that the natural systems of the region become a daily experiential component of residential life and thus local culture. Until sustainable development is considered as a culture-building process, success will be limited. In this regard, the biophilic design of children's outdoor environments could provide a means for integrating technical and cultural domains through play, learning, and educational processes.

Many of the precedents to be discussed below may seem straightforward from a technical design perspective; however, they challenge the conventional wisdom of accepted practice relating to children's environments. Implicitly, they express a progressive education philosophy building on the traditions of Dewey, Montessori, Froebel, and others. Sometimes they contradict health and safety standards based on the conventional epidemiological (toxic environment) paradigm that overlooks the positive health-enhancing effect that "exposure" to the environment can have for children (Frumkin 2001).[2] They may also raise issues of liability in the conservative arena of risk management, reinforced by the lack of research evidence supporting the safety of such environments.[3] They will challenge entrenched attitudes about the scale of spending required to improve the biophilic quality of children's environments.

The precedents are "outdoors" because that is where children need to be to fully experience nature

and benefit from its preventive health effects. New architectural forms are needed that emphasize continuous indoor-outdoor daily contact with natural systems. This is particularly true of cold climates, where glazed outdoor-indoor spaces would allow children daily interaction with plants in schools and childcare centers—as in a botanical glasshouse. A few precedents already exist (see Figures 10-7 and 10-8).

Figure 10-8: "Play partners" in the greenhouse engage children in learning about fascinating species such as the "sensitive plant." Glazed architecture can provide rich settings to serve children in child development centers and schools.

INSTITUTIONALIZED CHILDHOOD: THE POTENTIAL OF A NEW CULTURAL REALITY

The majority of young children are now growing up in institutions. Almost three-quarters of preschool children with working parents today spend part of each weekday in some form of childcare arrangement (Capizzano et al. 2000). The new reality of children as young as three months old spending long hours in childcare centers has arrived with little questioning of the possible developmental consequences of such a sudden, radical change in early childhood environments. Young children are spending the majority of their time in a new type of family with biologically unrelated adults and similarly aged children in new, nondomestic architectural forms. This is not necessarily a negative situation for child development. Indeed, research has identified positive benefits (Palacio-Quintin 2000), especially for children from socially deprived environments (Garces et al. 2002). The childcare center may be regarded as a new form of community care. However, with exceptions, typically little attention is given to the learning potential of the physical environment—both indoors and outdoors.

Figure 10-7: The Greenhouse at the Hammill Family Play Zoo, Brookfield Zoo, Brookfield, Illinois, provides a year-round setting for children and families to experience a rich variety of plants—including a banana tree. Each year the fruit is harvested by the children, who join the "banana parade" to feed them to the gorillas.

Early childhood architecture, including landscape design, could be celebrated as a subfield of the design professions with extraordinary potential for positively influencing environmental engagement and child development. And yet, childcare center buildings not only rarely match this promise but barely meet basic functional requirements such as providing floor level windows, interior daylight penetration, and ample transitional settings between indoors and outdoors. Outdoors, conventional playground equipment is typically provided rather than a dynamic, natural learning environment, which through play processes could offer new experiences each day instead of the repetition of static settings.

EARLY CHILDHOOD: WELCOME TO PLANET EARTH

For children, the "sedentary lifestyle" crisis means lack of opportunities for movement and play (Burdette and Whitaker 2005; Pellegrini and Smith 1998). In this regard, childcare centers offer an enormous opportunity for raising children in a "preventive environment" designed to support active lifestyles and healthy nutritional habits, connecting children and nature through design, beginning in the first year of life. When physical activity is emphasized in the preschool years, research suggests that it will track throughout childhood (Moore 2003) (see Figure 10-9).

Imagine designing an outdoor environment where a child's first birthday is not only a celebration of an individual's accomplishments in the 12 months since birth but also a celebration of the first steps of sensory integration with the world that will be the child's home for the rest of her life. Childcare centers can initiate cultural transformation which, while focused on the future, also must echo the history of our human ancestors from whom we have inherited our biophilia—and our responsibility to transmit it to future generations. From this perspective, the term "childcare center" hardly conveys the larger vision of childhood, community, and planet. "Child Development Center" (already used by some centers) would be an improvement, with "Earth Education" as a progressive extension of the center role. (See Figure 10-10 in color insert.)

Figure 10-9: A group of toddlers play with fallen leaves, experience their sensory properties, and explore their behavior on the curved surface of a hollow log—a type of activity that educational psychologist Michael Shayer (Crace 2006) suggests can boost cognitive development.

In 1992, the first author was asked to design an "infant garden" in a childcare center that served families of staff and faculty at North Carolina State University. At that time, the importance of contact with the natural world was hardly mentioned in the literature apart from the risk of insect stings and injury from poisonous plants. Then, as now, very little *design* research literature was available (Striniste and Moore 1989) along with limited practice-based texts. The second edition of Greenman's (2005) *Caring Spaces, Learning Places*, offers the most recent design advice on outdoor environments for infants and toddlers.

The lack of research models of best practice eventually resulted in the creation of a model site at a child development center located near North Carolina State University. Designed by the first author and constructed with two colleagues (then students in landscape architecture and horticultural sciences). The renovated site was completed in 1997 and has since served as a research site (Cosco 2006). At this center (and at other local centers where results from the first site were subsequently applied), infants and toddlers spend more time (usually more than an hour) outdoors each day in shady, diverse environments, immersed in natural settings in daily contact with plants and the animal life that they support. Preambulatory children (less than a year old) are commonly observed reaching out, grasping, touching, and smelling the variety of reachable plants.

A study by Yarrow, Rubinstein, and Pedersen (1975) observed that from birth children's attention is directed towards responsive environments, especially those that are diverse and complex (Figure 10-11). Once children begin to walk, their range of attention can rapidly expand to embrace the natural world, if provided. Yarrow et al.'s experimental laboratory findings are reflected in observations at two of the Natural Learning Initiative's (NLI)[4] naturalized research sites (including the one discussed above), where animals that attract attention (insects, amphibians, and birds) daily engage children's fascinated attention (Kaplan and Kaplan 1989).[5] Evi-

Figure 10-11: This very young child is fascinated by the fragrance of the sprig of rosemary he has picked from an adjacent planter. The smooth log provides a clean work surface above the surrounding sandy ground to support his exploration. Notice the fallen leaf clutched in his left hand as a prized possession.

dence of biophilia is readily observable, even by children under two—if their environment is designed to afford child-nature contact.

However, such affordances of nature depend on the natural diversity of children's immediate surroundings. A baseline assessment of outdoor quality in North Carolina childcare centers (Cosco and Moore unpublished report) showed that on average they contained three times as many manufactured components as natural components (mainly individual shade trees, grass, and woodchip safety surfaces). Field verification of these findings reinforced the conclusion that lush outdoor childcare environments are exceedingly rare.[6] As North Carolina is considered a progressive state in terms of childcare (at the time of writing, a statewide Committee on Outdoor Learning Environments is in session), it may be fairly assumed that other regions of the United States are certainly no better than North Carolina in the naturalized quality of their outdoor environments.

DESIGN FOR PHYSICAL HEALTH

Cosco (2006) conducted a comparative empirical study of three preschool (three- to five-year-olds) outdoor designs: one containing mostly manufactured equipment, a second containing a *mix* of natural and manufactured components, and a third containing manufactured equipment and natural areas segregated from each other. The second preschool play area supported higher levels of physical-activity play than the other two. Cosco concluded that its relatively dense mix of behavior settings (one of which was a broad, curvy, hard-surface, wheeled toy trail) and the number of children playing together at a given time, stimulated more social interaction, which, in turn, led to more active play than did the other two sites. She identified "*setting compactness* (higher numbers of children sharing multiple activities—in this case also surrounded by plants and wheeled toys)" as an attribute that may help explain the higher levels of activity (Cosco 2006, 123). This attribute is further linked to the more general phenomenon of "*additive effect* [our emphasis] of the layout of the site and its attributes (objects and events) on children's activities" (Cosco 2006, 120), explained by affordance theory (Gibson 2002). The specific role of vegetation integrated into setting design can be viewed as part of the additive effect or "buffer" (Wells and Evans 2003), acting as a crucial moderator in children's settings, positively affecting both the diversity, duration, and impact of outdoor play (Grahn et al. 1997). Building on these pioneering scientific studies, NLI is presently engaged in a multi-site study to confirm additive effect variables in outdoor preschool play areas that motivate or afford higher levels of physical activity and other types of play.

From a policy perspective, the greening of child development centers would seem a rather simple step. Instead of investing scarce financial resources exclusively in manufactured equipment and mulch (Cosco and Moore unpublished report), funds could be spent on relatively inexpensive trees, shrubs, perennial plants, and natural objects such as rocks and salvaged tree limbs. The play and educational value of these settings far exceed, dollar for dollar, settings such as climbing structures that lose attraction for some children if they must use them every day, year round (Moore and Wong

1997). This is not to deny that particular types of manufactured items have important functions. Indeed, items designed to support dramatic play, such as playhouses and various types of vehicles (trains, fire engines, and trucks), retain their attractiveness, especially when surrounded by pickable ingredients that "hunter-gatherer" children can use in dramatic play scenarios (see Figures 10-12 and 10-13).

To succeed, a greening strategy must engage the educational staff. However, many early childhood educators are not trained to work with children in outdoor environments. In response, some creative centers have hired a gardener as an assistant "outdoor teacher" to rectify this lack of expertise. However, as long as outdoor areas are labeled as "playgrounds" and are not seen as an integral part of the educational environment for both playing and learning, then the introduction of nature-play, will continue to be a challenging goal.

Maximum Exposure to Nature: Outdoors All Day

At "outdoors-in-all-weather nursery schools" and "forest kindergartens," children stay outdoors all day in all seasons. These alternative models started in Denmark in the 1990s and soon spread to the rest of Scandinavia and Germany. Although no English-language comprehensive study of forest kindergartens has been identified, Keller (2006) lists four basic principles (translated from the German) that sum up the approach:

1. Nature, with its vast sources for play, provides space for the emergence of a child's fantasies, curiosity and creativity.
2. Direct contact with nature allows the minds of children to develop a sensitive appreciation for the earth.
3. The forest provides an ideal place for children to move freely about, thereby developing trust and gaining self-confidence.
4. In free play, above all, but also through daily routines, children gain competence in social relationships and in resolving conflicts. (http://www.whatcomwatch.org/php/WW_open.php?id=718)

There are now more than 500 forest kindergartens in Germany alone (Keller 2006). Forest kindergartens take the concept of education outdoors to its logical limit. In some models, the kindergarten consists of a small, one- or two-room, building housing an administrative office, storage for accoutrements and supplies for forest adventures, not always including a toilet other than the woods. Children meet there at the beginning of the day to collectively decide on a plan for the day (or half day, depending on age), assemble the gear

Figure 10-12: Vines and climbing plants can transform an otherwise bland chain-link fence to become, in this case, a cascade of creamy blossoms ready for early spring harvest by hunter-gatherer children—to be used as a "pizza" ingredient in the restaurant car of the nearby play train.

Figure 10-13: Naturalized play train chuffing through a forest

needed, load it into a cart and backpacks, and take off into the forest to discover whatever befalls the group.

In 2005, the first author visited a forest kindergarten in a nature preserve in Munich, Germany. (See Figures 10-14 and 10-15 in color insert.) Upon approaching the site (a 10-minute walk into the forest), the quality of the atmosphere and the body language of the three- to five-year-olds were immediately striking. The group of 15 or so children were busily engaged in free-form activity in a clearing adjacent to the base building (two wagons constructed of timber), in the buffer of surrounding woodland, and down in the nearby creek. There, a five-year-old girl was sitting on a narrow sandbank surrounded by water, dabbling her feet in the flowing water, gently singing to herself. Certainly the teachers had an eye on her, but from a long distance. The girl was lost in a personal reverie for 15 minutes or more. Surely, such "spots of time" are never forgotten (Chawla 2002, quoting Wordsworth).

In the United States, the nearest equivalent to the forest kindergartens is the growth of preschools located in nature centers. The Nature Preschool at the Schlitz Audubon Nature Center near Milwaukee, Wisconsin (www.schlitzaudubon center.com), is one of a small but growing number of nature-based preschools in the nation committed to both environmental education and active learning. The broad curriculum is based on seasonal changes and includes art, music, perceptual and cognitive skill development, large and small motor skill development, natural science exploration, and daily outdoor discovery in the center's 185 acres of diverse habitats. The children are able to experience the freedom of a seemingly limitless natural world. Playing and learning adventures occur throughout the center's prairie, forests, ponds, and marshes. The natural world is used as both theme and material in the education of the whole child. The stated goal is to develop the child's ability to work independently and cooperatively, to act in a caring and responsible way toward their environment and others, and to foster a love of nature.

Children ages three to five in the Audubon Nature Preschool (www.audubonnaturalist.org/cgi-bin/mesh/education/nature_preschool), located in the Edwin Way Teale Learning Center at the Woodend Sanctuary, Chevy Chase, Maryland, roam a 40-acre nature sanctuary. There they explore the wonders of the natural world through a balance of self-directed and teacher-directed activities in ecologically diverse aquatic, forest, and meadow habitats.

The Four Seasons Kindergarten in Ringe, Denmark (www.kompan.com/sw23720.asp), is a small nature-based early childhood facility. Constructed in 1997, it serves 30 three- to six-year-olds who are children of employees of Kompan, a leading international manufacturer of playground structures. Indoor facilities are provided by a 212 sq m "house." However, according to the kindergarten website, the children spend 80 percent of their time outdoors in a 3,000 sq m landscaped play garden. Each day, the children participate in tasks around the house, garden, or hen coop together with the five caregivers. They sit by the bonfire; draw on the veranda; or build with real hammers, nails, and saws. Gardening and cooking are part of the daily life of the kindergarten undertaken by caregivers and children together. When parents pick up the children in the afternoon they are dirty—from playing outdoors, tired—from playing outdoors, and happy—from playing outdoors.

The nature preschools of the United States and the Scandinavian/German forest kindergartens offer substantial models of nature-based early childhood, which need to be within reach of all communities to inspire progress towards full immersion of children in nature. Those seeking to promote nature pedagogy need to join forces with early childhood educators to develop a strategy and action plan to green the nation's childcare centers. This means not only buildings and outdoor spaces designed to satisfy LEED[7] standards and user criteria but also locations adjacent or within open spaces, forest preserves, parks, and greenways. The latter provide two-way access for walking and biking—for dropping off and picking up children as well as for exploring away from the center. Furthermore, both childcare centers and schools need to consider "green design" from the perspective of children's own need to explore and discover the natural world through play. Children themselves can contribute ideas by participating in the design process. Adult opinions vary regarding at what age children are sufficiently mature for this role. In executing NLI design assistance projects, we have found that by

the age of four children can contribute worthwhile ideas and/or voice pros and cons of design proposals by other participants in the process.

Sun Exposure: A Word of Caution

Increasing, scattered evidence suggests that being outdoors for relatively long periods each day is beneficial to the health of the majority of young children (Fjørtoft 2001; Grahn et al. 1997). However, overexposure to direct sunlight can be a substantial health risk (Geller 2006), particularly in the middle part of the year. Boldemann et al. (2006, 306) stress, "Overexposure to ultraviolet radiation from the sun, particularly in childhood, is estimated to cause 80–90 percent of all skin cancers in Western societies." . . . sunburn is particularly hazardous to young children, as the skin does not "forget" the damage; however, sun exposure can be counteracted by design. Boldermann and colleagues showed, as we might expect, that reduced levels of sun exposure were associated with the presence of trees and shrubs in child development center play areas.

RETHINKING SCHOOL SITES

At five years old, school attendance in the United States is mandatory. By definition, school buildings and grounds should play a crucial role in biophilic design strategy. Fundamental to this notion is the concept of the elementary school as a center of neighborhood life, close enough to the majority of homes that children can make the trip back and forth on foot or by bicycle. The school grounds should serve as a space for learning and for children's play before and after school (Moore and Wong 1997; HMSO 2006; Beaumont and Pianca 2002). However, several barriers—longstanding and recent—constrain this objective. For decades, racial integration policies and the development of "magnet schools" in the United States have resulted in children being bussed to schools in locations outside their own residential neighborhoods, which means that school neighborhood friendship networks cannot be formed. More recently, in spite of research supporting the benefits of small neighborhood schools (Slate and Jones 2005; McRobbie 2001), in the name of economic efficiency elementary school sites have been dislodged from their walkable base in the neighborhood (Beaumont and Pianca 2002) and combined with middle schools on larger school campuses, increasing the school "carbon footprint."

Above all, schools should be safe and healthy environments for children, indoors and outdoors (Frumkin, Geller, and Rubin 2006). However, even though school buildings have moved to the forefront of "green building" design, the thinking about outdoor spaces remains unchanged from the perspective of users (especially children) and their educational potential as diverse, green habitats. School outdoor areas are still designated as "recess playgrounds," where children are expected to expend energy before going inside for academic work. Countering this view, the Toronto District School Board (http://ecoschools.tdsb.on.ca) regards schools and their grounds as eco-educational resources, as health-promoting outdoor environments, and as places for children's creative engagement with nature (Bell and Dyment 2006; Dyment 2005). However, this view is missing from the LEED approach, which focuses almost exclusively on building design, mainly from a technical costs and benefits point of view (Kats 2006). Attention to outdoor design is missing from the equation; even sustainable site-related issues such as stormwater management (and their educational potential) are overlooked.

Particularly alarming, and underreported, is the fact that an increasing number of school districts are curtailing or eliminating recess because it takes time away from academic studies (http://www.ipausa.org/recess-research.htm). This policy not only inhibits healthy child development but also is against international law in all UN member countries (except the United States, which has not ratified the Convention on the Rights of the Child). According to one news report, "As many as 4 out of 10 schools nationwide, and 80 percent of the schools in Chicago, have decided there is no time for recess. Instead of romping in playgrounds, kids are being channeled into more classes in an effort to make their test scores rise on an ever-higher curve . . .

(Schudel 2001). This regrettable policy has been contested and surely will eventually need to be rescinded and replaced with the opposite strategy to move educational programs outdoors and at the same time create attractive, usable, safe outdoor spaces for after-school activities—close to home.

Green building design policies related to schools need to expand in two directions before the theme of "green playing and learning" addressed in this chapter is sufficiently covered. First, green building design policies need to give equal prominence to both interior spaces *and* school grounds; second, they need to give equal weight to the behavioral requirements of users as they do to green technology requirements. To achieve its purpose of conserving the planet for the enjoyment of future generations, sustainable development practice must fully activate an educational role—especially in the design of institutions (including their outdoor spaces) where young people could learn not only *about* the natural world but also *in* and *through* the natural world (Moore and Wong 1997) (see Figure 10-16).

Examples reflecting this view have existed on the ground for decades as a result of an international move-

Figure 10-16: A naturalized outdoor classroom can immerse children's learning processes in nature as well as reduce demands on interior, air-conditioned space. Roof covering is a translucent, waterproof, ultraviolet-light-resistant fabric. As they work, children can enjoy the experience of rain pouring down around them or the play of sunlight and shadow of foliage vibrating in the wind over their heads.

ment, including groups in the United States, pushing the potential of school outdoor environments as places for education and enjoyment. Research evidence strongly suggests positive outcomes for children attending schools with naturalized sites. The first author's 10-year documentation of the naturalization of the Washington Environmental Yard, an inner-city schoolground in California, in terms of its impacts on the educational program and the children's daily experiences of the natural world, is a rich source of the multiple "playing and learning" roles of natural communities (Wechsler et al. 2003; Zask et al. 2001; Moore and Wong 1997). The Washington Environmental Yard responded to a special set of circumstances, where the boundaries of the possible could be pushed substantially. One of the most important outcomes was the demonstration of the motivational power of education outdoors. Many of the classroom teachers extended the mandated state curriculum into a rich outdoor environment on the schoolground as well as into the surrounding neighborhood and learning sites in the broader community. Children with varied learning styles were motivated to become engaged in learning when confronted by multiple hands-on opportunities because they triggered excitement and provided memorable grounding for later, more cognitive phases in the learning process. Research findings from the Washington Environmental Yard indicate the powerful impact of the on-site, outdoor natural educational resources on children's long-term affective relationship to their school (Moore and Wong, 1997). For children engaged every day both during and after school hours, the natural richness of the school grounds provided a well-understood added value and sense of pride in their school.

At another Berkeley school, Martin Luther King Jr. High, a team led by Alice Waters, a former Montessori teacher and well-known restaurateur, removed a huge area of asphalt and replaced it with a school garden. Healthy nutrition and meal preparation by the children using the produce from the garden focuses on explicit curriculum objectives and health outcomes (http://www.edibleschoolyard.org/about.html). Murphy's (2003) empirical investigation of the Edible Schoolyard demonstrated positive impacts across several dimensions, including academic achievement, psy-

chosocial adjustment, understanding garden cycles and sustainable agriculture, ecoliteracy, and sense of place. In their investigation of the impact of adults' experience of plants and gardening as children, Lohr and Pearson-Mims (2005, 476) concluded that, "Childhood experiences with nature influence adult sensitiveness to trees and that influence is very strong." This suggests that hands-on gardening and engagement with plants at an early age in child development centers and schools (where the children are), may be a crucial strategy for building an ethic of caring and protection for the natural world.

An international movement to restore school grounds as educational resources has been under way for decades in North America, Europe, and other regions of the world (Moore 2006). The Coombes School, near Reading in southern England (www.thecoombes.com), provides an advanced public education model of outdoor learning (Jeffrey and Woods 2003; see Figures 10-17 and 10-18). By collaborating with the school community, the teaching staff, led by Susan Humphries, created an extraordinarily diverse system of natural settings on the school grounds. (See Figure 10-19 in color insert.) The Coombes provides a fully evolved example of best practices so progressive that the documented model has been translated into Swedish (Olsson 2002).

Figure 10-17: One of a multitude of seasonal curricular events at the Coombes School is harvesting and comparing the tastes of the many varieties of apples planted on the school grounds in the last 30 years.

Figure 10-18: Apples taken to the classroom become the subject of a classification and group analysis lesson—before being stewed

The educational and health-promoting role of the designed landscape is supported by research (Titman 1994; Kirkby 1989) and by the work of the Boston Schoolyards Initiative (http://www.schoolyards.org/education.htm), the Learning Landscapes Alliance (http://thunder1.cudenver.edu/cye/lla/about.html), and the Evergreen Foundation (http://www.evergreen.ca/en/; Dyment 2005). These sources of evidence all point to the same conclusion: schoolgrounds can be designed as natural learning environments that offer educational value and broad learning opportunities (Wechsler et al. 2003; Moore and Wong 1997; Zask et al. 2001; Murphy 2003; Moore and Cosco 2007), especially for learners whose style is not well adapted to indoor learning environments (Moore and Wong 1997). These innovations in indoor/outdoor education design have been under way for decades, pushing against the deeply embedded assumption that mandated learning objectives can only be implemented indoors, and demonstrating that hands-on learning outdoors can be more effective than an exclusively pressure-cooker approach (Lieberman and Hoody 1998). Heeding these results, the Blanchie Carter Discovery Park (BCDP) at Southern Pines Primary School, Southern Pines, North Carolina, was founded by a parent group to increase children's creative outdoor play and learning options—socially and environmentally (see Figures 10-20 and 10-21 in color insert). Children participated in the process in many different ways (see Figures 10-22, 10-23, and 10-24).

Figure 10-22: Blanchie Carter Discovery Park original master plan. The dual-use park was named after a former principal of Southern Pines Primary School and serves the school during school hours and the local community at other times. The multipurpose playing field is used by the junior soccer league. From the main school entrance (lower right), primary pathways distribute users to main settings. A peripheral trail provides travel around the entire circumference of the site and is used by the Walking Club every morning. Gazebos provide major landmarks for curricular and social activities. Groves of shade trees have grown up around the manufactured equipment settings. The labyrinth, added later, is located in the top left corner. A stream and wetland/pond have yet to be developed.

Figure 10-23: After a campout on the school grounds, Robin Moore facilitates an early morning Celtic tree blessing with the children.

The rise in schoolyard bullying (which could be interpreted as a symptom of underlying childhood social-psychological malaise) has yet to prompt a national movement to make schoolgrounds socially inhabitable. To do so will require the massive addition of natural resources on the nation's schoolgrounds and redirected outdoor education teacher training programs focused on schoolgrounds as educational and social resources (Wechsler et al. 2003; Moore and Wong 1997; Zask et al. 2001). Children and nature lobbies must convince local school boards to adopt biophilic policies to design schoolgrounds to support interdisciplinary environmental education—not only to meet criteria for sustainable development but also as places where children can learn to live together peacefully. Creation of BCDP had such a strong positive impact on the social relations between the children that the "time-out log" became a play object, as it was no longer needed for punishment.

SCHOOLGROUNDS AS NEIGHBORHOOD PARKS

Although the concept of the school park has been implemented in many municipalities, research has been limited to a number of case studies that indicate the potential of these sites as attractive places for children to interact with nature. Findings from a study of the model Washington Environmental Yard, using several meas-

Figure 10-24: Southern Pines Primary School hosts a red cockaded woodpecker workshop in the Blanchie Carter Discovery Park longleaf pine reserve.

Figure 10-25: The labyrinth at Blanchie Carter Discovery Park (built by two intern student playworkers from Leeds Metropolitan University, UK) is a place where children interact with nature and with each other; shown here during the early morning Walking Club.

ures, demonstrated children's strong affiliation with "biotic" elements such as ponds, streams (and all things aquatic), trees/shrubs, flowers, dirt, and sand compared to "abiotic" elements such as play equipment and asphalt (Moore 1986b). In a study of children's views of a schoolyard and other public places in Los Angeles, Loukaitou-Sideris (2003) found that nature-like elements (including grass, trees, and flowers) were the most frequently mentioned (42.9 percent) elements.

School parks, especially when located in older, denser, walkable urban neighborhoods, potentially offer significant exposure to nature for children—a function that is now more pressing for two reasons. First, the rising cost of urban land is making it more difficult for cities to acquire park sites; therefore, if school and park systems partner to combine capital and maintenance budgets, schoolgrounds/parks can be developed and maintained to a higher level of quality. Second, the rapid growth of families with both parents working has resulted in growing pressure for school sites to provide after-school programs for children. However, care must be taken to prevent such programs from becoming "school-after-school."

A key strategy is to make the outdoor environment so compelling that children will clamor to go outside (see Figure 10-25). In contrast to the rigid academic, indoor strictures of the school day, outdoors can provide diverse opportunities for group activity and creative expression in natural settings that equally attract children and program staff—who must be professionally trained to use the opportunities for after-school creative enjoyment.

However, such a profession does not exist in the United States. In other countries the field is well established under various titles including playworker (UK), social pedagog (Scandinavia), animator (France, Spain, and Latin America), and cultural worker or cultural animator (Germany). These professional groups are given teacher training at the college or university level to work in a broad variety of nonformal education community contexts. In spite of the lack of such professionals in the United States, our experience suggests that if the program environment is sufficiently conducive, creative community professionals will be motivated to become engaged because of the creative opportunities offered. A wonderful example of this was Project PLAE (Playing and Learning Adaptable Environments), held on the Washington Environmental Yard, where children of all abilities and ages participated in a summertime program of arts and environment workshops facilitated by local artists (Moore and Wong 1997, chap. 14).

NEIGHBORHOOD PARKS

In Moore's studies of urban childhood territories (Moore 1986a), neighborhood parks emerged as important places where children can escape from the restrictions of home, meet up with peers, have fun, enjoy nature, and learn about themselves and the world around them—especially the natural world. In drawings of their favorite places, natural elements (including parks) were the most frequently mentioned (Moore 1986a, 43). In her study of children's use of Los Angeles public spaces, including two parks, Loukaitou-Sideris (2003) found that of the elements most liked by the children a third (33.3%) were naturelike (grass, lake, trees, flowers, ducks, sand). A study by Milton, Cleveland, and Bennett-Gates (1995) shows how an urban park can offer a natural learning environment with unanticipated outcomes that included changed perceptions in students of themselves, of each other, of teachers, and of the park itself. The findings of Burgess, Harrison, and Limb's (1988) study of London parks strongly indicate the potential of local parks—especially where the "wild" landscape dominates—as attractive places for children and families to spend time together outdoors (see Figures 10-26, 10-27, and 10-28). These scattered findings suggest the need for increased research to build a solid field of literature to underpin the potential of parks as a crucial local resource for play, learning, and community development (Moore, 2003).

Figure 10-27: The broad, curvy pathways in Kids Together Park, surrounded by a rich landscape, stimulate children's active play, while accompanying parents can relax nearby.

Figure 10-26: Kids Together Park, Cary, North Carolina, demonstrates how manufactured play equipment, elegant arbors, and a natural landscape can be designed together to create a relaxed, intimate, comfortable place for users of all ages

Figure 10-28: Large rocks designed into a park in Nantes, France, add a natural landscape challenge for children and an opportunity for interaction with caregivers.

COMMUNITY NATURE DESTINATIONS

In the last two decades on both sides of the Atlantic, several new models of community institutions have developed that have increased options for families seeking natural places to spend time together. New types of nonformal education institutions, including children's museums, children's zoos, children's gardens, and botanic gardens, together with established models such as adventure playgrounds and urban farms, offer extended opportunities for adventurous outdoor nature experiences and active living in the wider city environment, (see Figure 10-29). For most families, they serve as destinations beyond residential neighborhoods. Children must be taken by adults (parents, school staff, summer camp counselors), and in low-income neighborhoods may have no means of access.

Brevard Zoo in Melbourne, Florida, has partially solved this problem by building three public school classrooms, to immerse "at-risk" fifth-graders in the zoo as their learning environment (www.brevardzoo.org/education/zoo_school). Not surprisingly, the positive effect on some of the students in both academic achievement and personal growth has been remarkable (see Figure 10-30). However, the evidence is purely anecdotal (personal communication with the zoo director). In spite of the continuing investment in nonformal education environments, such as zoos, there is a dearth of research literature available that might offer stronger support for integrating formal and nonformal education systems. A hopeful sign is the Good to Grow initiative by the Association of Children's Museums (http://www.childrensmuseums.org/index.htm) to promote outdoor spaces in children's museums, which presently are found in ap-

Figure 10-29: Families enjoy nature together at Hammill Family Play Zoo stream, designed as a safe, secure setting for all ages.

Figure 10-30: Classrooms in the trees at Brevard Zoo, Melbourne, Florida, enable the curriculum for at-risk fifth-graders to be conducted at the zoo. (See www.brevardzoo.org/education/zoo_school.)

proximately a quarter of children's museums in the United States.

PROVIDING FOR CHILDREN'S NEEDS IN RESIDENTIAL ENVIRONMENTS: BEYOND PLAYGROUNDS

Since the early decades of the twentieth century, when municipalities first began to recognize the issue of children on busy streets, it has been assumed that city parks and playgrounds at regular intervals are the solution to the "problem" of children's play. One contemporary study of children's play concludes: "There is an uncritical and widely accepted belief among adults that children need places in which to play and that the playground is the space that best fulfills this need. An undercurrent of paternalistic concern (it's for the kids) and self-interest (it keeps them off-the-street [for which read 'my street'] sustains this commitment to neighborhood playgrounds" (McKendrick 1999, 5). Not only does the emphasis on the playground confine the legitimate (in adult eyes) locale of play to one particular setting, the ubiquitous, non-site-specific products of play equipment manufacturers dominate such settings, separating children from nature and the contextual landscape of their home region (Herrington 1999). It is argued by Woolley (2006) that entire urban open space systems have potential relevance for the independent movement of children around the city—if this potential was thought through from the beginning, as it was in some of the postwar British and Nordic New Towns (see below).

Another study recognizing children's need to have access to the wider urban landscape concludes: "Can enrichment of the small, local and generally confined spaces that are the playground, essential as that enrichment is, ever compensate for impoverishment of the broader environment that constitutes the child's more general universe and playscape?" (Cunningham and Jones 1999, 12). In spite of recent actions such as the *Childstreet* conferences and resulting Delft Manifesto on a Child-Friendly Urban Environment (www.urban.nl/childstreet2005/programme.htm), adult views that children's needs are best met by the provision of a specific, bounded, equipped play place persist. However, naturalistic studies of what children actually *prefer* reveal a marked preference for access to, and modification of, natural undesigned areas (Hart 1979; Moore 1986a). Even within the boundaries of a playground environment, marked differences exist between children's and adult's expectations. When asked by parents at Village Homes, Davis, California, to assist in the design of a playground for their children, and later to do the same at a local school, landscape architect Mark Francis discovered that " . . . children preferred challenging alternative and fantasy elements which incorporated loose parts and water and changed over time. Adults wanted more traditional play environments which are safe, neat, and fixed, with no water and clean edges" (Francis 1988, 69).

Despite its self-image as a child-oriented society, it is rare in the United States for a residential neighborhood to be designed with the needs of children—its least mobile and most vulnerable members—at the forefront of planning and policy decisions. A study conducted in 1976 of children's play in Oakland, California, concluded: "when it comes to the built environment of inner cities, children's needs are largely unrecognized and unmet or disregarded. . . . The constraints of the neighborhood environment can deprive children of a basic right of childhood—the right to experience and explore the world around them safely, spontaneously, and on their own terms" (Berg and Medrich 1980).

Thirty years later, little has changed. Despite the fact that studies over the last three decades have documented how children's use and enjoyment of their neighborhood has been severely curtailed (Gaster 1991; Lynch 1977; Hart 1986), there was virtually no change in public policy responding to this phenomenon until the rise of childhood obesity focused on lack of exercise as a partial explanation for this physical problem. Even this has not resulted in any radical call for change in how our neighborhoods are planned. Rather, emphasis has focused on the modification of existing streets for "walkability," the provision of sports programs, and programs to encourage walking to school such as the Walking School Bus. David Engwicht, its Australian inventor, suggests that its adoption around the world in programs organized by adults to accompany children to and from school is losing sight of the original intention: to support children's *independent* mobility (http://www.lesstraffic.com/index.htm). If children were genuinely

involved in the planning, they would no doubt highlight the difference between going to school and returning home from school, a time for dawdling along the way to explore and play with friends.

A hopeful sign of a reactivated children's environments discourse is the range of recent publications pressing for an understanding of children's needs beyond "home, school, and playground" and for the right of children to have access to the whole urban environment. Recent books on this topic have emanated from northern Europe (*Children in the City* [Christensen and O'Brien 2003]); from Australia/New Zealand (*Creating Child Friendly Cities* [Gleeson and Sipe 2006]); from the UK (*Children and their Environments* [Spencer and Blades 2006]); and from an international group of authors (*Growing Up in an Urbanising World* [Chawla 2002a]).

PREFERRED PLAY ACTIVITIES: CHILDREN'S VIEWS

Only about half the days of the year are school days (even in year-round programs). The design of the neighborhood environment close to home is therefore crucial in terms of children's freedom to play outdoors with ready access to nature. Many studies have shown that the provision of equipped play areas or designed park space is not sufficient to meet children's needs for exploratory social and imaginative play (Van Andel 1990; Bjorkild-Chu 1977; Parkinson 1985; Moore, 1986a; Wheway and Millward 1997). Given the choice, children interact with all aspects of the neighborhood environment, and it is the relative diversity of such environments and the available access to them that are the most important factors for child development.

It is critical that residential neighborhoods and developments where children live have safe access to such diversity, especially so for girls, who after the age of eight or nine tend to have a significantly smaller home range than boys (Tranter and Doyle 1996; Moore 1986a). For children in industrially developed countries, the last few decades have seen a marked decrease in independent mobility. Studies in the UK (Hillman and Adams 1992), Australia (Tranter 1993), and the Netherlands (Van der Spek and Noyon, 1995) record steep declines in children's mobility and in the case of the Dutch study, a parallel decline in environmental awareness. In the UK in 1971, 80 percent of seven- and eight-year-olds were allowed to go to school without adult supervision. By 1990, this figure had dropped to 9 percent (Wheway and Millward 1997, 17). Mobility is not only important for a child's physical development, but it also is essential in promoting self-esteem, a sense of identity, and the capacity to take responsibility for oneself (Kegerreis 1993; Noschis 1992). Two elements fuel this change: "stranger danger," or parents' fears of child molestation, et cetera; and danger from traffic. Ironically, the traffic peak caused by parents dropping off and picking their children up from school is part of the traffic danger problem (Hillman 1991).

One of the impediments to the development of child-friendly neighborhoods may well be that the very qualities that are aesthetically pleasing to adults can be detrimental to children's needs. For example, a study of the effect of the physical environment on the play patterns of children in four Oakland, California, neighborhoods found that in the neighborhood with the lowest density and the hilly verdant terrain favored by upper-middle-income home buyers, children felt painfully isolated from each other and lacked access to places for spontaneous, unplanned play. In contrast, children living in more urban, higher-density (and flatter) neighborhoods tended to have a greater range and autonomy; friendship patterns were more casual, less structured, and tended to involve a greater age range.

Although children in all four neighborhoods had some access to parks and school playgrounds, many did not consider these "their own" and sought out unplanned, undeveloped open space. "These unplanned areas, which often were nothing more than a vacant lot or a garbage-strewn stream, met certain needs that developed play space could not. At the very least they offered privacy—for these were places where often no one *but* a child could go or would want to go. This should not be surprising, for it reflects children's desires to have something that is theirs, at a time when virtually everything else—houses, shops, streets, public transportation—is built for or 'belongs' to grownups"(Berg and Medrich, 340).

A study of children's play in two rural Welsh communities recorded that woodland featured prominently in children's accounts of favorite places to play. A wooded area provided a place to explore and also facil-

itated imaginative play, providing raw materials such as branches, bark, sticks, and leaves that triggered creativity. "Indeed, the imagery drawn upon in many games outside in the woods, in community spaces, or private spaces within their homes, drew heavily on this setting" (Maxey 1999, 22). A 10-year-old girl, when asked why she liked the woods best, responded, "Because there is lots to do, we can hide and build dens, we have a swing. . . . I like to see the animals collect things and . . . well, we just do what we want, we don't have to [pause] you know, do what we're told" (Maxey 1999).

Nature not only comprises green growing things but also two other elements that are significant to children: water and animals. In a Danish study, 88 children living in settings ranging from cities to villages were given cameras and asked to take pictures for one week of what they were doing and what was meaningful to them (Rasmussen and Smidt 2003). As well as elements of green nature (trees, shrubs, flowers, sand dunes, etc.) and places where they played (mounds, dens, campfire sites, tree swings, etc.), animals featured prominently—both those kept at home or school (mice, guinea pigs, rabbits) and those known in the neighborhood (cats, dogs, chickens, ducks, birds, horses). While urban or suburban green spaces may not be appropriate for farm animals, through the deliberate creation of habitat the presence of birds, insects, and small mammals can be guaranteed. Inclusion of creeks, natural or man-made ponds, wetlands, et cetera, can encourage habitation by fish and amphibians.

Besides elements of green nature, another natural element that is particularly attractive to children is water—whether standing in a pond, lake, marsh, or retention pond; or flowing in a creek, river, gutter, et cetera. As well as being a natural element that children find endlessly fascinating to touch, explore, float things on, et cetera, it also of course attracts wildlife. Wildlife corridors and greenways that are also creek valleys can influence the basic structure in neighborhood design, improve wildlife value (Hellmund and Smith 2006) and sustainability, and provide children with the added attraction of water in a near-home environment (Arendt 1996). But there are other ways in which water can be found in near-home play locations. As Google will tell you, the San Francisco Bay Area and Seattle's King County appear to be the national leaders in the "daylighting" of creeks buried in pipes decades ago. Children are major beneficiaries of these initiatives, especially when in public parks and schoolgrounds; for example, Blackberry Creek, Thousand Oaks School, Berkeley, was daylighted in 1995 (initiated on the ground in 1971 with a small, artificial ground level creek built by the first author and UC–Berkeley students to "mark" the creek hidden underground). In 2005, the living creek and its educational use by the school was appraised positively by Gerson, Wardani, and Niazi (2005).

Innovations in stormwater management are creating other opportunities for children to find water for play close to home (Jencks 2007). On residential blocks that are part of the Green Street program in Portland, Oregon, one parking lane is converted to a bioswale, with stormwater passing through an area of native plants and rock berms bringing nature into the neighborhood. Neighbors have to apply to be part of the program and to maintain the swale. At High Point, a Hope VI public housing scheme in Seattle, a complete retrofit included a 34-block water retention system with porous concrete, trees, and wide strips with native planting between the sidewalk and the parking lane, all draining to an on-site retention pond. Even in highly urbanized neighborhoods, creative infrastructure solutions can provide elements for children's water play. In the German city of Freiburg in Bresgau, the "baechle" or "little streams" provide small water courses where children float paper boats beside city streets (Lennard and Lennard 1992).

In a growing number of participatory studies, when children are asked what might be done to improve the environment of their neighborhood, they have many perceptive and practical comments including calming traffic, improving maintenance, creating places for different age groups from toddlers to teens, and providing more natural amenities, particularly trees (Chawla and Malone 2003; O'Brien 2003; Morrow 2003). In a study researching 12- to 15-year-old children's subjective experience of two neighborhoods in a town 30 miles from London, several children described the lack of wild places where they could play and make dens (Morrow 2003). A 12-year-old boy mentioned he didn't like the sprawling suburban neighborhood where he lived, "cos it's so built up, there's not much to do and like, where my sister lives, she lives in [another town], and just

across the road there's a big forest, and my brother likes to go over there with their dog, and they'd be out for hours and hours, and that's what I like when I go there." (Morrow 2003, 170).

Another boy in the same neighborhood, Bart, age 13, described how a local park the children had dubbed "Motorway Field" could be improved: "Motorway Field is like a long strip, and at the end, there is this round bit. There's a few trees there, but it'd be nicer if . . . they planted more trees there, so it was like a little mini-forest where people can build dens, that won't be kicked in and stuff, so there's more variety of things to do" (Morrow 2003, 174). All the children interviewed described "not having enough to do" in terms of appropriate facilities, activities, and places to go. In this study and others (for example, Percy-Smith 2002), it is ironic that when children's views about their neighborhoods in the inner city and in a more affluent suburban location are compared, it is children in the latter who are more likely to find their environment "boring."

PREFERRED PLAY ACTIVITIES: ADULT RECOLLECTIONS

When adults recall their favorite places of childhood, the great majority are outdoor locations (Cobb 1977; Cooper Marcus 1978; Chawla 1986; Louv 2005) and very often involve natural features (trees, streams, bushes, rocks, sand, woodland), and even in very urban settings, play with natural "loose parts" (leaves, seeds, twigs) is a most fondly remembered episode (see Figure 10-31).

In the middle years of childhood (about age 6 to 12), finding or creating special places in the landscape appears to be a common experience for children of all cultures. The power of the memory of such places in adulthood suggests that they play a unique and powerful role in the shaping of the self (Sobel 1990). In analyzing the special-place experiences of more than 100 adults and 200 children, Sobel noted the following recurrent descriptors: special places are found or created by children on their own; they represent an organized world for the child; they are secret, safe, and owned by their creators; in turn, such places empower their builders.

It is essential that we leave wild or semiwild places in

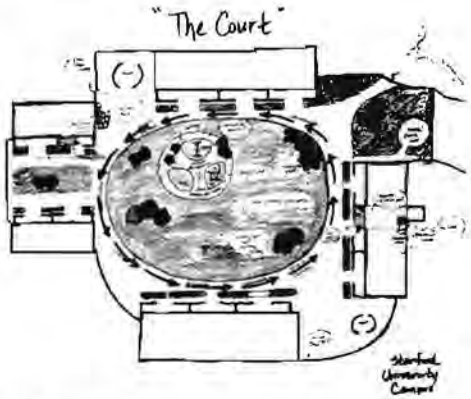

Figure 10-31: Shared outdoor space at Stanford University married students' housing, recalled as her favorite childhood place by a Berkeley architecture student.

our residential areas where such child-created spaces can naturally occur. Providing a playground, buying a playhouse, or building a tree-fort *for* your child just doesn't measure up. Not only does a child-created or found place contribute to a child's sense of autonomy and independence, recollections from adulthood indicate that they also provide a sense of solace in difficult times. In a paper discussing environmental autobiographies collected at three universities in the United States and Australia, Dovey includes a number of quotations that illustrate this point (Dovey 1990). One person recalled: "The willow tree in our backyard was our favorite thing from about four until it was cut down when I was eight. . . . It was the center of my childhood fantasies. The branches served as whips for horses, swords for duels, hair for mermaids. . . . When I was angry or upset I used to sit far above the world swaying in the breeze in the comfortable curve of its topmost branches." Another wrote: "One of my favorite places to go and tell my worries to was the big apple tree in my backyard. It was my refuge and for once I was able to talk and have someone that would always agree with what I was saying."

NEW BIOPHILIC FORMS OF RESIDENTIAL NEIGHBORHOOD

Residential neighborhoods designed on biophilic principles need a fine-grained integration of nature into

children's everyday lives. Neighborhood nature can be integrated into private spaces around homes (some large enough for food production and biodiversity), and flow out into the public realm of residential streets, local commercial areas, neighborhood parks, schoolgrounds, open spaces, greenways, protected reserves, urban stream corridors, and "leftover" unbuildable wild spaces.[8] In the semipublic realm, community gardens, the grounds of childcare centers, gardens attached to community facilities such as health care facilities, libraries, recreation centers, and college campuses can be designed to offer contact with nature for children (Moore 1986a).

Levels of access depend on stage of maturity and degree of independent mobility (which is constantly changing across child populations); ideally, as many opportunities as possible for daily exposure to nature should be made available within the bounds of residential neighborhoods. Four models of child-friendly layouts, together with case studies, are discussed below.

1. CLUSTERED HOUSING AND SHARED OUTDOOR SPACE

A special case is made here for shared outdoor spaces within housing areas—a form that offers particular opportunities for exposure to nature and for children's independent mobility. We are speaking here of a particular form of outdoor space within a cluster of residential buildings (single-family homes, row houses, walk-up apartments, lofts, etc.) directly accessible to the residents of those buildings without crossing a street. Such spaces are neither private (like backyards or balconies) nor fully public (such as streets or parks) but something in between. Immediate residents share these spaces and either participate in their maintenance or pay a fee for the upkeep (usually the latter). Historic precedents of this form of a cluster of buildings enclosing an area of shared outdoor space include the monastic cloister garden; Oxford and Cambridge college quadrangles; 1920s California bungalow courts; 1960s Planned Unit Developments; and historic gardens and squares of cities in the United States and the UK such as London, Edinburgh, Baltimore, Boston, and New York.

Contemporary forms can be found in many medium-density housing developments (in both urban and suburban locations), as well as in cohousing and ecovillage developments (Bang 2005). In all such schemes, traffic and parking (in the form of garages or grouped parking lots) is kept to the periphery, and the living spaces of the surrounding dwellings face into the green heart of the block (see Figure 10–32). Private outdoor spaces in the form of backyards or patios provide a buffer between private and shared space, and a gate or break in a hedge or planting permits easy access from one to the other. Providing the space alone is not enough. Care must be taken in detailing circulation, planting, and furnishings so that the shared space includes pathways, open lawns for active play or sunbathing, shaded seating clusters for social meetings, play areas for younger and older children, and areas of shrubbery and unkempt areas where children can explore and make dens, et cetera. Space permitting, vegetable garden plots may be included for those lacking sufficient private space around the home (as in most cohousing communities).

The chief beneficiaries of shared open space are children. Systematic observational studies reveal that where the residences around such space are for families, more than 80 percent of the users of the outdoors are likely to be children (Cooper Marcus 1974; Cooper

Figure 10-32: Shared green space surrounded by row houses and apartments provides ample opportunities for children's nature contact. Cohousing, Wageningen, the Netherlands

Marcus 1993; Moore and Young 1978; Cooper Marcus and Sarkissian 1986). In summary, the advantages of such space include:

1. Providing green views from home, which have been associated with positive psychological benefits (Ulrich 1999).
2. Offering children a traffic-free play area within sight and calling distance of home (Cooper Marcus 1974).
3. Reducing the anxiety of parents so they are more likely to let their children out to play in such spaces (compared to neighborhood streets or parks) since two of the greatest parental fears are eliminated: traffic and "stranger-danger" (Cooper Marcus 1974).
4. Facilitating spontaneous play between friends living nearby during brief periods (before the evening meal or after homework), when trips farther away from home are unlikely.
5. Including planting designs that can provide diverse wildlife habitats for birds, insects, small mammals, and amphibia, thus enriching the nature experience of both children and adults.
6. Strengthening a sense of community, ownership, and caring often lacking in contemporary urban/suburban neighborhoods (Cooper Marcus 2003).

Shared open space provides a vehicle for community development and the building of social capital beyond the nuclear family at a level less than the unfeasible prospect of a whole neighborhood. While the direct benefits to children are rather obvious, there are indirect benefits, which include use by older residents (particularly those who may live alone and/or do not own a car) who offer potential intergenerational social relationships with resident children. Provision of shared outdoor space serving housing for both families with children and older adults, for example, in assisted living, if carefully designed with their disparate and shared needs in mind, could be well-accepted and appreciated. An example of this approach is the Village of Woodsong, Shallotte, North Carolina, a traditional walking neighborhood "designed for tending to the basic rites of life" (www.villageofwoodsong.com/inde). A village center, mixed housing types, narrow streets, a park specifically designed for children, a woodland trail connection to the local elementary school, continuing care residences, a range of outdoor spaces, and natural areas provide for socializing, working, shopping and recreation within walking/biking distance. Indirect, angled alleyways are designed as secondary "secret" play routes for children. Collectively, the easily accessible, shared spaces of Woodsong are aimed at village-wide social integration. The development is still under construction so it is still too early to know if this design objective has been met.

Where shared outdoor spaces have been designed into family housing developments they have often been remarkably successful, especially in providing for safe play close to home, and in facilitating a sense of community. The examples below illustrate these points in a variety of forms.

Completed in 1964, St. Francis Square was the first of many similar medium-density garden-apartment schemes built in San Francisco during the era of urban renewal. The client for the 299-unit project (the Pension Fund of the ILWU) challenged the designers (Robert Marquis, Claude Stoller, and Lawrence Halprin) to create a safe, green, quiet community that would provide an option for middle-income families wanting to raise their children in the city. Built as a co-op, St. Francis Square occupies an 8.2-acre, three-block site in the city's Western Addition, and it has an overall density of 36.5 units per acre. Its design is based on a pedestrian-oriented site plan, with parking on the periphery and three-story apartment buildings facing onto three landscaped interior courtyards (see Figure 10–33).

The shared outdoor space, which is owned and maintained by the co-op, is critical to this community. Its trees screen the view of nearby apartments, reducing perceived density, and its grassy slopes, pathways, and play equipment provide attractive places for children's play. Sitting outside with a small child, or walking home from a parked vehicle (or from one of the three shared laundries), adult residents frequently stop to chat with one another. The courtyards at St. Francis Square are, in effect, the family backyard writ large. Behavior mapping data gathered in 1969 showed an overall child-to-adult ratio across the site of 7:3 and in the courtyards, a ratio of between 5:1 and 7:1 (see Figure 10-34). If these

Figure 10-33: St. Francis Square, San Francisco, is a successful inner-city, medium-high-density housing neighborhood for families with children. Parking is located on the periphery of the site and dwellings face onto three landscaped interior courtyards.

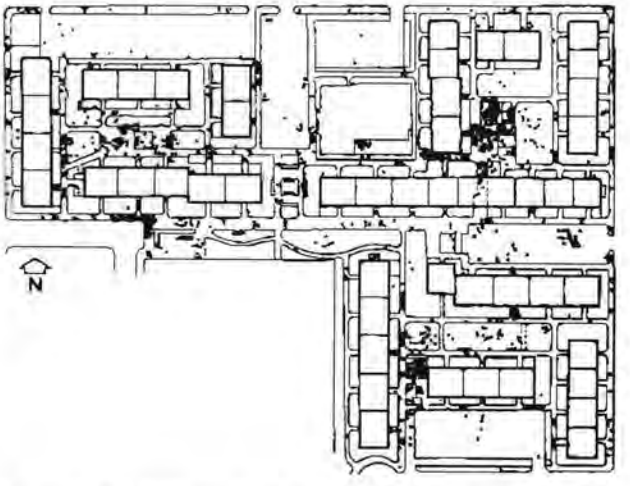

Figure 10-34: Aggregate map of people seen outdoors, 8 a.m. to 8 p.m., St. Francis Square, San Francisco. Solid black dots represent children; open circles represent adults. Observations were conducted on one weekday morning, one weekday afternoon, and one weekend morning, in June 1969. The proportion of children to adults in the shared interior courtyards is between 5:1 and 7:1.

spaces were public parks, parents would likely not allow their children to play there alone, and residents would be less likely to help maintain the courtyards, question strangers, or help neighbors in need.

The findings of a postoccupancy evaluation of St. Francis Square conducted by the second author in 1969–1970 were confirmed and expanded by a further year of observation when she lived there with her family (1973–1974).[9] Numerous site visits since the original study, plus conversations with the current management, confirm the basic findings of almost 30 years ago about why the shared outdoor space at St. Francis Square is highly valued and well-used by residents: (1) narrow entries between buildings clearly mark the passage from the public space of street and sidewalk to the shared space; (2) the size of the courtyards (c. 150 × 150 ft.) and the ratio of the height of adjacent buildings to the distance between them (c. 1:6) gives them a human scale; (3) the courtyards are bounded by the units they serve, and almost all units have views into the outdoor space (facilitating child supervision); (4) attention and financial resources were focused on the quality of the courtyard landscaping; (5) fences provide a clear distinction between private outdoor patios and the shared space of the courtyards; and (6) easy access is provided from apartments and patios to the courtyards (see Figure 10-35 in color insert).

Southside Park is a 25-unit urban infill cohousing development in inner-city Sacramento, California, designed by Mogavero Notestine and Associates in consultation with the 67 residents (40 adults and 27 children). Completed in 1993, it contains 14 market-rate, 6 moderate-income, and 5 low-income condominiums. The site plan was inserted into Sacramento's existing street grid, with most of the houses clustered around an interior green (see Figure 10-36). The remaining houses (two rehabbed Victorians and several new units) were arranged in a smaller cluster across an alley. Front porches mark house entries from the street, while back porches and patios look out onto the common green (see Figure 10-37 in color insert). Residents eat meals together several times a week in the 2,500 sq. ft. common house.

Informal observations conducted during several visits confirm what residents and designers hoped for. Children play on the common lawns, pathways, and in the play-equipment area; adults meet and converse while outdoors with their children, using the common laundry, working in the raised garden beds, walking

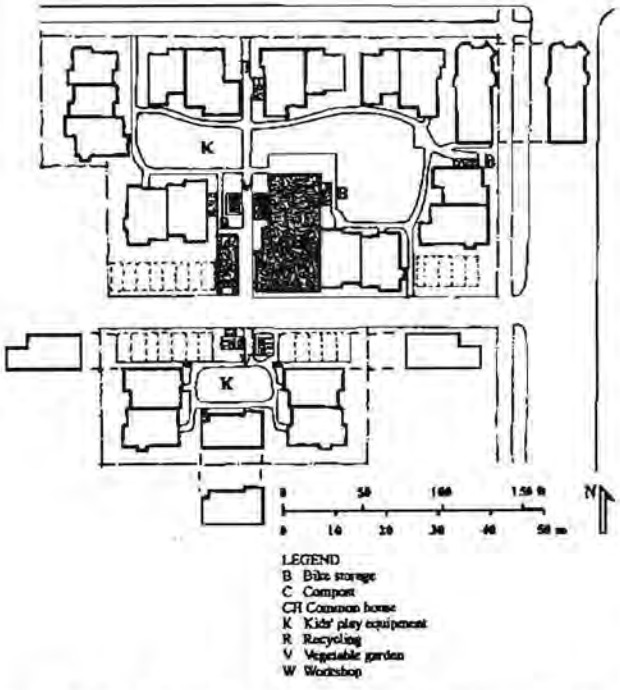

Figure 10-36: Southside Park cohousing site plan; Sacramento, California, designed by Mogavero Notestine and Associates

back and forth to their cars, or congregating at the common house. As at St. Francis Square, the sense of community and the range of children's outdoor play opportunities at Southside Park are supported by a layout that controls traffic flow and offers a central pedestrian green. Interestingly, the street-facing porches at Southside Park are used by residents for privacy, since the shared outdoor space on the interior of the block is such a social space. Cohousing, originally a grassroots phenomenon instigated by groups of individuals seeking a more neighborly and child-friendly lifestyle, has now been adopted into the mainstream and is delivered through top-down as well as bottom-up processes in northern Europe and, to some extent, in North America (Williams 2005).

While St. Francis Square and Southside Park were purpose built, it is possible to modify an existing urban block so that the interior becomes a shared green space. The Meadows occupies a city block in Berkeley, California. From 1963 to 1973, a lecturer in real estate at the University of California acquired 27 properties around a block, most of which were single-family residences built between 1900 and 1920. In 1971, in a conscious experiment to create a unique residential environment, he began removing backyard fences on the interior of the block as well as unused garages, extraneous outbuildings, and paved areas, replacing them with grass, flowers, shrubs, trees, and walkways to create a parklike shared space. The residents, who were all his tenants at the time, retained semiprivate patios, lawns, or planted areas close to their dwellings. The block was named The Meadows by its residents.

A study by Cavanna (1974) compared this block with an adjacent control block with regular fenced backyards using a questionnaire, behavior traces survey, and a systematic record of outdoor activities. In contrast to residents of the block where the fences had not been removed, residents of The Meadows had more social contacts (see Figure 10-38), felt safer in the areas around the houses, had a higher opinion of their neighborhood, spent more time outdoors at the back of the house, and considered their backyard environment to be more open, attractive, and better maintained. While this study was conducted almost 30 years ago, recent visits to this block revealed that the backyard fences have not been replaced, even though most dwellings are now owner-occupied (see Figure 10-39

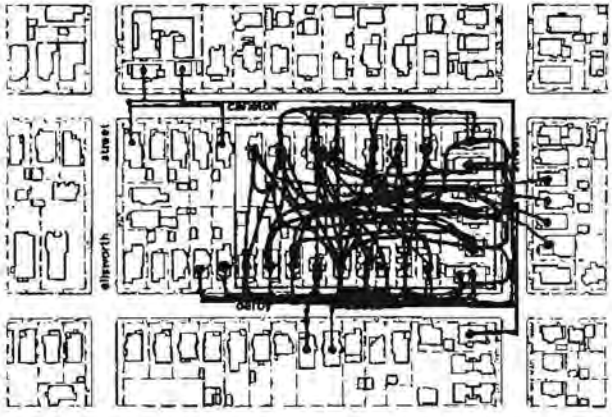

Figure 10-38: The Meadows, Berkeley, California. Composite of the total number of social contacts.

in color insert). The central open space has mature trees, areas of grass, shrubbery, vegetable gardens, and a sand box, and is well used for children's play, studying, sunbathing, barbecues, basketball, and gardening. Residents maintain their own private (but unfenced) yards and patios, as well as adjacent portions of the shared outdoor space.

Although one might assume The Meadows to be a unique innovation, many similar historic examples exist. In Boston's South End, for example, Montgomery Park comprises one-third of an acre entirely enclosed by 36 brick row houses. Established as a formal garden by the original builder of the houses in 1865, by the mid-twentieth century it had become run down, and the shared space had been virtually abandoned. From the 1970s on, however, a new group of residents removed debris, improved drainage, planted a lawn and perennial borders, took down fences, lobbied to have phone lines buried, removed a service road that circles the park, and restricted access from adjacent streets by installing locked gates. By the 1990s, the orientation of most of the buildings was toward the back, with a brick pathway delineating the border between private backyards and shared space. The lush interior of the block is now equipped with movable garden furniture and is used for informal dining, children's play, annual potlucks, weddings, birthday parties, and garden tours (Morris 2001).

A recent article in the *Atlantic* monthly surveyed how variations on The Meadows and Montgomery Park may provide ways of redesigning conventional suburban blocks where the residents—especially those with children—are looking for more neighborly lifestyles, and for settings for play that are safer and more stimulating than conventional sidewalks (Drayton 2000).

To achieve the successful outcomes of the examples described above requires a carefully considered layout with regard to traffic flow, pedestrian circulation, and the location of shared open space, as well as attention to design details. The lack of such attention rendered the shared space in many postwar public-housing projects and the suburban Planned Unit Developments of the 1960s nonfunctional. Unfortunately, those who criticized such spaces for being poorly maintained no-man's-lands assumed (wrongly) that they could never work (Coleman 1985). There is ample evidence that the outdoor activity of resident children and adults, and a related sense of community, can be increased by careful attention to design. Not only do housing schemes with shared outdoor space *work*, people who can choose where and how to live actively seek them out. For example, of the hundred or so cohousing communities in North America completed or in the planning stage, all feature site plans where units face onto shared outdoor space as defined above.

Further evidence for the success of schemes with interior block green space has been compiled by Community Greens: Shared Parks in Urban Blocks, a nonprofit initiative based in Arlington, Virginia (www.communitygreens.org). Community Greens notes that homes in developments that abut shared outdoor space sell, generally, at prices 5–15 percent higher than the competition and the sales rate is also faster—two factors that benefit home builders' bottom lines. One developer in the northwest, Jim Soules of the Cottage Company, specializes in cottage homes that surround such shared green space. In fact, Soules will *only* develop these kinds of projects. Says Soules, "I will never build another project without a community green. Residents open their door to a private park . . . it's an emotional experience. That is what people are interested in" (Kate Herron, personal communication to Cooper Marcus, 2007). The communities in which Jim Soules operates have adopted a "cottage housing code" which allows small homes of about 1,000 sq. ft. to be built in neighborhoods of typically larger homes, providing that the development includes a community green, at least 50 percent of the homes abut the green, no home is more than 60 feet from the green, a minimum of 400 sq. ft. per dwelling unit of open space is provided, and the green is encompassed by houses on at least two sides.

In 2007, the City of Portland Bureau of Planning sponsored a design competition for "Family-Friendly Courtyard Housing," because they saw the need for fostering higher-density housing configurations that provide quality living environments for families with children. The competition guidelines state: "Common higher-density ownership housing types, such as

small-lot row houses and detached houses, do not allow for outdoor spaces of sufficient size to serve the needs of families with children. Housing oriented to shared courtyards present opportunities for large useable, outdoor spaces that are not possible in the form of private yards at higher densities."

There are demographic, economic, and psychological reasons why residential layouts that balance vehicular needs, pedestrian use, and shared outdoor space are particularly appropriate at this time. With increasing numbers of families where both parents are employed, safe, communal play space *right outside* the house is especially useful (see Figure 10-40). Gone are the days, for most families, when the mother was home all day to walk or drive children to a nearby park. The potential sociability of a traffic-free, green area at the heart of a community is also appealing to the increasing number of single-person households (both young and elderly).

Because shared spaces are in protected locations and used by residents, a crucial point is that they can be managed to a higher level of natural diversity and aesthetic enhancement than more public spaces. As residents control shared space management, it means that functions of the space can be adjusted to match user needs as they change. The residents of the St. Francis Square co-op, for example, have made numerous changes to their shared spaces over the past 40 years. With a reduction in the number of children living there (the original families who raised their children there have no desire to move away), a play equipment area was recently removed and replaced by a small Japanese garden created and constructed by residents. Outside of private dwellings and their associated private outdoor space, there are relatively few opportunities for small groups to have the same sense of accomplishment through hands-on manipulation of the local environment. The social benefits of greening activities have been well documented over several decades (Plas and Lewis 1996). Evidence from interviews in communities with shared outdoor space indicates that such "working together" provides a profound sense of shared responsibility and community (Cooper 1970, 1971; Cooper Marcus 2003).

Figure 10-40: Shared greenspace, where children can play and adults meet, is increasingly important at a time when both parents may be working or a single parent is raising children alone. Co-op housing, False Creek neighborhood, Vancouver, British Columbia, Canada

Resistance to the Provision of Shared Outdoor Space

Shared outdoor space in clustered housing can be found functioning successfully for both adults and children in everything from urban cohousing retrofits, to new urban and suburban affordable housing, to urban loft schemes, to sought-after bungalow courts dating from the 1920s. If the provision of shared outdoor space in clustered housing makes so much sense in terms of children's needs, what are the impediments to its more widespread adoption, particularly in new suburban developments? The opposition comes largely from the proponents of new urbanism who emphasize the importance of a return to the grid, and green space being provided almost exclusively in public parks and squares. New urbanist thinking places the aesthetics of the streetscape as a very high priority. Hence, parking is most often provided in rear-access alleys or in the interior of the block. While there is an urban form designated as the "square block" in new urbanist literature (Steuiville and Langdon 2003, 1–11), and this could potentially result in the kind of clustered housing described above, the insistence that parking be provided off-street frequently results in this interior open space being filled with cars. For example, at Britton Courts, a new urbanist development of affordable housing for families in San Francisco, the interior of the block is

filled with parking and is designated as a "Parking/Play Court." It is sad indeed when the needs of the car and the aesthetics of the streetscape take precedence over the needs of children. Although there are examples of small new urbanist courtyard schemes with interior hardscape, the development of neighborhoods such as St. Francis Square, Southside Park, or The Meadows with spacious areas of shared green space on the interior of the block would be virtually impossible under current new urbanist form-based codes.

Add to this the unsubstantiated statements such as that by a leading new urbanist proponent that "shared outdoor space at the back never, ever works" (Duany 2001), and the future of this form of housing is in jeopardy. For example, the site plan for an affordable housing scheme in Windsor, California, incorporated shared green outdoor space and was welcomed by its client, who had previously noted the success of Cherry Hill (discussed below). However, the City Planning Commission, citing new urbanism principles, insisted that the site must have a through street, that shared outdoor space "doesn't work," and that housing clustered around such a space creates "a ghetto" (Durrett, personal communication, 2005). Such misunderstandings of the social implications of site planning are disturbing, particularly in a lower-income setting where residents may not be able to sustain wider social networks or take their children to areas of public recreation or to natural settings such as nature reserves and parks. There is much progress yet to be made in professional education to counteract the prevailing level of ignorance in these matters. Collectively, supporters of biophilia-based neighborhoods need to present arguments to the proponents of new urbanism that there are other important options for residential settings where children and families predominate besides the standard houses-facing-onto-streets.

2. CUL-DE-SACS AND GREENWAYS

Another way in which safe access to nature can be ensured in a residential neighborhood is to create a site layout where local streets end in cul-de-sacs that abut a greenway or local park. Children can then move safely to a green area from their homes without crossing a street. The greenway itself might be a pedestrian or cycling connection to a local school, shops, or larger park (see Figure 10-41).

A systematic observational and interview study of children's informal play on twelve housing estates in the UK (Wheway and Millward 1997), noted that the favorite activity was being "on the move"—walking, running, cycling, meeting others, stopping for a while, moving on. When asked about their favorite play spaces, children consistently referred to green open spaces (parks, fields). If there was a single tree or a copse of trees, these were very popular for climbing, swinging,

Figure 10-41: Provision for safe, hard-surface play on a cul-de-sac (foreground) and access into a semi-natural greenway with walking and bike paths to other neighborhoods and urban amenities (Davis, California). Note connectivity to another cul-de-sac across the greenway.

or just "hanging out." Green areas and trees were cited as favorite places by 73 percent of the children; equipped play areas by only 21 percent. Cause for hope is the similarity of these results to the field data gathered by the first author in three contrasting neighborhoods in 1977 (Moore 1986a). In spite of dramatic changes in lifestyles, children still are searching for the same natural outdoor spaces as a generation ago.

Wheway and Millward's (1997) findings, together with requests from a majority of parents for their children to be within sight and calling distance of home, prompted the authors to recommend traffic-calmed cul-de-sac site plans with footpath networks to open spaces and play areas, permitting children's access to as large an outdoor environment as possible. "The ideal estate [development] would be designed so that children would be able to move freely throughout the neighbourhood, able to enjoy a wide variety of social interactions and opportunities for physical, imaginative and creative play" (Wheway and Millward 1997, 60).

In a U.S. study of cul-de-sacs in four northern California towns, a rigorous statistical analysis revealed that children who live on cul-de-sacs play outside in their neighborhood more often than children who don't, and moving to a cul-de-sac is associated with an increase in children's outdoor play (Handy et al. 2007). An extension of this study interviewing parents (and some children) in a fifth town reported that the neighborhood is an important setting for play for all children, but that 75 percent of those living on cul-de-sacs reported being highly active versus 55 percent of children on through streets. Traffic and strangers were cited as concerns by parents on both cul-de-sacs and through streets, but traffic was less of a concern for parents on cul-de-sacs. Forty percent of parents on through streets expressed concern about traffic, whereas 100 percent of parents on cul-de-sacs said that what they liked most about their street was safety from traffic. Thirty-five percent of parents on through streets asked for infrastructure to decrease traffic speed, versus zero percent of those on cul-de-sacs (Handy et al. 2007).

The cul-de-sac and greenway approach to residential neighborhood planning had its beginning in the English Garden City movement. The largest twentieth-century application can be seen in the postwar era in the British New Towns (for example, Stevenage), in the suburbs around Stockholm, Sweden (e.g., Vällingby and Fårsta) and in Tapiola, the New Town outside Helsinki, Finland. In all cases, green fingers radiate out from town centers, permitting safe pedestrian and bicycle access from homes to school, after-school centers, play areas, shops, services, and the subway. Importantly, in terms of children, many green areas were neither developed nor designed (except for pathways), leaving broad expanses of natural landscape, woodland, forest, and rocks (in Sweden and Finland) as inviting areas for exploration and play (see Figure 10-42). In Sweden, this form of planning occurred both because access to nature is a highly regarded cultural value and because, in the immediate postwar years, there was a labor shortage in Sweden promoting planning policies that created child-friendly environments, which encouraged women to return to the labor force.[10]

Figure 10-42: Layout of a Stockholm suburb allows children to expand their territory naturally and continuously as they mature cognitively and become more skilled in negotiating their environment. Woodland greenway provides plentiful contact with nature.

Figure 10-43: Layout of Village Homes, Davis

Figure 10-44: A shaded cul-de-sac with mature trees provides a setting for potential nature contact close to home (Village Homes, Davis).

Access to a cul-de-sac *per se* does not necessarily guarantee access to nature; however, where the dead-end abuts a green area, or where the cul-de-sac itself loops around an area of greenery, safe access to nature is maximized. Two case studies described below illustrate this point.

Village Homes is a 244-unit neighborhood on a site of 60 acres completed in 1982 on the outskirts of the university town of Davis, California, 60 miles north of San Francisco (see Figure 10-43). Its designers, Michael and Judy Corbett, document how it began as a "hippie subdivision" derided by banks and the local real estate industry, but now has become the most desirable neighborhood in Davis (Corbett and Corbett 2000). Village Homes uses shared outdoor space as a successful aesthetic and social basis for neighborhood design. Individual houses are accessed from cul-de-sac streets with their backs facing onto pedestrian greenways, all leading to a central green. The long, narrow (23 ft.), tree-shaded, dead-end streets keep the neighborhood cooler in summer, save money on infrastructure, eliminate through traffic, and create quiet and safe spaces for children to play and neighbors to meet (see Figure 10-44). An extensive pedestrian common area at the heart of the neighborhood includes spaces for ball games and picnics, community-owned gardens, vineyards, and an orchard. Greenways provide access for bicycles and pedestrians traversing the neighborhood. Drainage swales instead of storm sewers collect storm water runoff in a system of linear wetlands, which greatly enhance the wildlife habitat and exploratory play opportunities between the backs of the houses and reduce summer irrigation costs by one-third. Neighborhood pathways follow the swales and connect to the main greenways (see Figure 10-45).

Figure 10-45: Family out for a walk on one of the many greenways in Village Homes, Davis

This attractive environment, although accessible to outsiders, is definitely *not* a public park. Bounded by inward-facing residences, it provides a green heart to the neighborhood, a safe and interesting network of open spaces for children and adults. A study of neighboring revealed that residents report having three times more social contacts, and twice as many friends as residents of a nearby conventional control neighborhood (Lenz 1990, quoted in Francis 2003). With the recurring problem of children's diminishing independent mobility, Village Homes remains an outstanding example of territorial continuity, enabling each child to gradually expand her territory from private front yard or backyard (up to age 5 or so), to cul-de-sac street (age 5 to 7), to back swale pathway (age 8 to 10), to main greenway system (age 10 upwards), and from walking to bicycle (variable ages; see Figure 10-52). Not only does Village Homes offer each child a hierarchical movement system that affords independent mobility from an early age, but as an extra bonus it offers experience of a rich, diverse landscape along the way.

A systematic observation study of children's use of communal open space at Village Homes conducted in 1981 (see Figure 10-46) revealed that the great majority of activity (65 percent) occurred in green open spaces (bike paths, green belts, drainage swales, turf areas). The second most frequently used area was street space (20 percent), the quiet, shaded cul-de-sacs with slow-moving traffic (Francis 1984–85). In a later account of Village Homes, Francis notes: "What is unique about Village Homes from a child's perspective is the diversity of places provided, from streets to play areas to natural areas, and the almost seamless access provided to these places" (Francis 2003, 56).

The importance of Village Homes for children is illustrated by recollections of Christopher Corbett, son of the developers, who grew up there: "Growing up in Village Homes gave me a sense of freedom and safety that would be difficult to find in the usual urban neighborhood. The orchards, swimming pool, parks, gardens, and greenbelts within Village Homes offered many stimulating, exciting, joyful places for

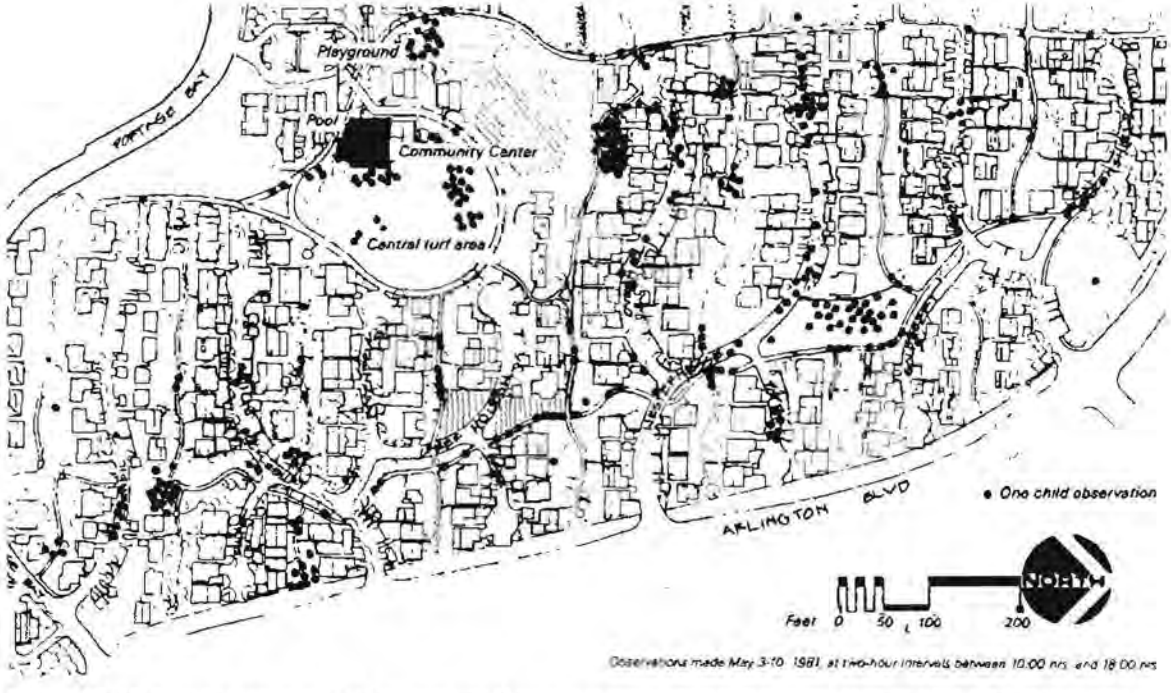

Figure 10-46: Behavior mapping study of children's use of outdoor space in Village Homes, Davis, conducted by Mark Francis in 1981

me to play with my friends" (Corbett and Corbett 2000, 21).

Interestingly, in Francis's 1981 study, when children were asked to describe their favorite places at Village Homes, the most sacred were wild or unfinished places such as building sites and places with names such as "willow pond" and "clover patch." "These findings argue for neighborhood design that retains open space in its natural state, which children can manipulate to suit their own needs" (Francis 1984–85, 37; see Figure 10-47). Only 13 percent of the children observed by Francis were seen at an amenity at Village Homes specifically designed as a playground. When a team of Berkeley graduate students interviewed residents of Village Homes and two nearby subdivisions with similar layouts also in Davis, people named the cul-de-sacs and greenways as their favorite aspects of the neighborhood environment (University of California 2003). (See Figure 10-48 in color insert.)

Figure 10-47: Child playing in a drainage swale in the early days of Village Homes. Design enabled daily contact with nature from the beginning.

Citywide Greenway Networks

While Village Homes' network of cul-de-sacs linked to greenways is widely cited, and rightly so (see Figure 10-49), it is not unique. At DC Ranch, a master planned community near Phoenix opened in 1997, a common open space is located at the end of each cul-de-sac in lieu of the pie-shaped house lots that typically terminate such streets. The common open spaces link to a 13-mile system of paths and natural preserves with pedestrian underpasses providing safe passage for children under major streets (Gause 2002, 64). Reston, Virginia, at its inception in 1962 the largest new town in the United States, includes over 55 miles of trails with footbridges over vehicular streets, linking residential streets with each other and to extensive nature preserves (Gause 2002, 182).

Stream valleys, drainage swales, and ribbons of natural landscape with pedestrian and bike trails form the open space frameworks of these and a number of other successful U.S. new towns and master-planned communities created in the last 40 years. These include The Woodlands, near Houston; Columbia, Maryland; New Albany and Easton, Ohio; and Bonita Bay, Florida. The early-eighties planning of the last, for example, included the natural systems analysis of the site, preservation of

Figure 10-49: One of many greenways crisscrossing the city of Davis, California. "Elk" sign at right indicates path leading to a cul-de-sac that abuts the greenway.

hundreds of acres of wildlife habitat and innumerable small ponds and lakes, and the creation of 12 miles of bicycling and walking paths crisscrossing the community between a street system ending in cul-de-sacs, and leading to waterfront parks, playgrounds, hiking trails, boardwalks, et cetera (Gause 2002). An integrated system of environmental management includes applying xeriscape principles, restricting pesticide application, leaving snag trees undisturbed to provide habitat, and planting native grasses. A 50 percent increase in listed species was revealed by a wildlife survey conducted both before and seven years after the construction of a golf course. Although this is an upscale community and no information exists on children's use of the outdoor areas, the sensitive physical planning and environmental management offers a landscape model where child-nature contact could potentially be optimized.

Compared to contemporary towns and development based on new urbanist principles, these earlier planned communities used ecological planning and design as major determinants in creating land use patterns and street systems. Stream corridors and sensitive conservation areas were preserved; street patterns, often winding, with cul-de-sacs, were determined by natural elements of the site. In contrast, many of the early and influential new urbanist developments, such as Kentlands, Harbor Town, and Celebration, while certainly respecting the natural qualities of their sites, employ an apparent one-size-fits-all street pattern of bent grids and axials, eschewing cul-de-sac-greenway combinations.

A variation on providing nearby nature in the interior of an urban block, or a cul-de-sac abutting a greenway, is the provision of a green area at the center of a cul-de-sac. While not ideal, since a roadway separates houses from the natural area, with traffic-calming measures (narrow approach road, bulb-outs, speed bumps) the potential for accidents is minimized. If planted in a naturalistic fashion and ideally including at least one mature tree, such an area can provide nature contact very close to home.

One community designed in this fashion is Cherry Hill, a 29-unit development of townhouses for low- and moderate-income families with children in Petaluma, California, a small town north of San Francisco. The first residents moved into the project, built by the nonprofit Burbank Housing Development Corporation, in January 1992. The site was planned as a safe environment for the many children expected to live there. The project manager had read about the *woonerf* (a Dutch term roughly translated as "residential precinct," or "home zone" in the UK) used to calm traffic in northern Europe, and asked the designers to pursue the idea. They created a site plan with a narrow (22-ft.), one-way loop access road around a central green—in effect, a very large cul-de-sac (see Figures 10-50 and 10-51). Four paved courtyards off the loop permit cars to drive up to each house and provide hard-surface play areas. As in European examples, pedestrians and vehicles at Cherry Hill appear to coexist safely without sidewalks, since a narrow roadway, speed bumps, and the dead-end nature of the street pattern regulate the speed of cars. Unlike in neighborhoods with standard street grid patterns (such as those promoted by the new urbanists), no cars enter Cherry Hill except those belonging to residents or known visitors.

The success of these design decisions was confirmed by a study conducted by architecture graduate students in April 1993 under the direction of the second author (Cooper Marcus 1993). Interviews were administered to 17 of the 29 households, and 7.5 hours of behavioral observation were conducted in the shared outdoor spaces. Eighty-eight percent of the interviewed sample

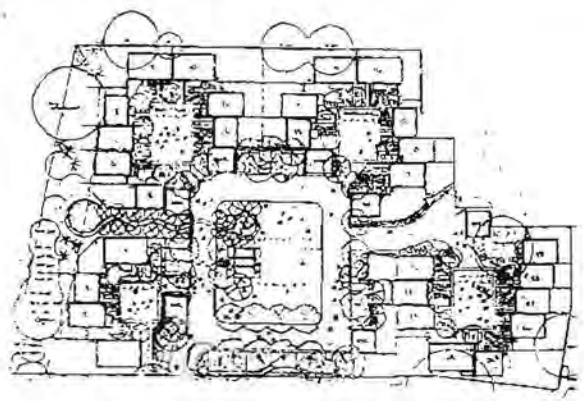

Figure 10-50: Cherry Hill, Petaluma, California, behavior map. Use of shared outdoor spaces by children and teens (aggregate of 7½ hours of observation, April 17–23, 1993).

Figure 10-51: Central greenspace at Cherry Hill, Petaluma, California, affordable family housing

socialized with other families in their immediate courtyard and almost two-thirds with families elsewhere in Cherry Hill. Eighty-eight percent reported they would recognize a stranger walking in Cherry Hill. Two-thirds were very satisfied with the site plan, citing safety for children, convenience, and feelings of intimacy and community as major reasons. Seventy-one percent rated a sense of community as "strong" or "very strong."

Behavior mapping of outdoor activities in 1993 revealed a heavy use by children, both of the traffic-calmed streets and of the central green area. (See Figure 10-50.) During daylight, nonschool hours, children were observed engaging in such activities as inline skating, rolling on a grassy slope, going around the loop on scooters, watching adults working on cars, clustering around an ice cream truck, collecting leaves, and digging for worms. Two sections of the roadway have been formally designated for games—four-square and basketball. It is reasonable to assume that most of these children's play activities could not be accommodated in a standard grid-pattern neighborhood with through traffic and no shared outdoor space. Significantly, half the parents said their children watched less TV since moving to Cherry Hill. The other half said they had no TV, or that their children watched about as much as before. Since being outdoors is a major correlate of children's physical activity (Sallis, Prochaska, and Taylor 2000), we may assume above average levels of physical activity in Cherry Hill children.

In Northpark, one of the newest "villages" in southern California's vast Irvine Ranch community, cul-de-sacs include landscaped islands (though not as large as those at Cherry Hill) breaking up the usual sea of asphalt. Instead of being terminated with a house, each cul-de-sac is linked by a pathway to sidewalks on adjacent streets, thus creating a child-pedestrian friendly network (Gause 2002, 105). While a small landscaped island in a cul-de-sac may seem a minute detail at the scale of a whole planned community, it can create the opportunity for nature contact close to home at the scale of a small child. Recalling favorite childhood places, a number of design students remembered significant features, especially trees, in just such spaces (Cooper Marcus 1978).

While it is clear that cul-de-sacs provide a safe and accessible locale for children's play close to home, a movement encompassing new urbanists, traffic engineers, planners, and some municipalities is successfully lobbying for eliminating their presence in new developments despite their popularity with home buyers (Efrati 2006). In a *Wall Street Journal* article titled "The Suburbs Under Siege," Amir Efrati notes: "Thanks to a growing chorus of critics, ranging from city planners and traffic engineers to snowplow drivers, hundreds of local governments from San Luis Obispo, Calif., to Charlotte, N.C., have passed zoning ordinances to limit cul-de-sacs or even ban them in the future. In Oregon, about ninety percent of the state's 241 cities have changed their laws to limit cul-de-sacs, while 40 small municipalities outside Philadelphia have adopted restrictions or an outright ban." Opponents argue that cul-de-sacs exacerbate traffic on nearby collector streets and that reimposing the grid redistributes traffic and encourages people to walk and not get into their car for every errand. This ignores the fact that when the dead-ends of cul-de-sacs are connected by walking and bike paths (forming a pedestrian "grid"), people are probably *more* likely to walk, as in Davis, California, though as yet there is only anecdotal evidence to support this (see Figure 10-52). In a study looking at cul-de-sacs in four northern California towns, data reveal that there is little difference between the proportion of people walking who live on unconnected cul-de-sacs as compared with those living on through streets (Handy et al. 2007).

Figure 10-52: A teen on in-line skates at Village Homes can expand her territory to virtually the whole of Davis, California, via an interconnected network of greenways. Note bridge crossing the drainage swale, a favorite play space of younger children.

The arguments for eliminating cul-de-sacs have everything to do with traffic engineering and with new urbanist arguments for erasing anything that resembles the conventional suburban layouts of the 1950s through 1980s. However, the free market tells another tale. As already mentioned, homes on cul-de-sacs tend to sell faster than other homes, and often command a higher price. Let us hope more municipalities follow the lead of Rock Hill, South Carolina, which changed its rules in 2007 banning cul-de-sacs, "requiring developers to cut pedestrian paths through their bulb-like tips to connect them to other sidewalks and allow people to walk through neighborhoods unimpeded" (Efrati 2006).

Rarely are the needs of children addressed by the proponents of new urbanism beyond the provision of neighborhood parks or playgrounds at regular intervals. While these amenities are certainly important, in the current atmosphere of parents' fears of traffic and stranger-danger, parks are not a viable alternative to outdoor play space for young children within sight of home.

Benefits of Greenways

A key component of a neighborhood well suited to the needs of children is one where it is easier (and safer) to walk or cycle than to drive. Greenways permitting movement between and through residential neighborhoods provide one such solution. If we can designate land as a wildlife corridor for the free movement of large mammals such as mountain lions, can we not equally regard our children as a precious species and provide for their safe movement through our increasingly hazardous environments? To summarize, some of the potential benefits of greenways for children and families include the following:

Greenways Are Accessible to Many

A greenway potentially provides a higher degree of nature contact than a traditional square park because of its linearity and high ratio of edge to area. After studying the use of local and long-distance green trails, Gobster (1995) recommends the creation of fine-grained networks of "mini-greenways" and "ribbons of nature" within urban environments. Having surveyed nearly 3,000 users of 13 greenway trails in metropolitan Chicago, he found that people using local trails (where the majority of users lived within five miles) used them more frequently to make shorter trips, including commuting, than those using regional or state trails located further from home. Hellmund and Smith suggest an upper limit of one mile from the farthest residence—two miles between trails—as an appropriate goal for a fine-grained network of local greenways (Hellmund and Smith 2006, 191).

A long-range, visionary project in Los Angeles involves converting the Los Angeles River (at present, mostly culverted) into a national urban wildlife refuge,

bringing nature close to a large number of low-income families. This is part of an even more far-reaching project (which may take half a century or more) aimed at bringing wild nature within a quarter mile of every child in Los Angeles (Hester 2007).

Greenways Can Provide Walking and Cycling Linkage to Other Outdoor Spaces

In a definitive study of greenways, Hellmund and Smith (2006) recommend they should be combined with neighborhood-scale "minigreenways" and "pocket parks" to provide green space at multiple scales. An example of this can be found in the greenways created under the tracks of the Bay Area Rapid Transit system in Albany, California.

Greenways Can Be Used as Outdoor Classrooms

Schools could bring students to greenways to study local flora, monitor water quality, interview greenway users, et cetera. In the West Philadelphia Landscape Project, middle school and university students studying the Mill Creek neighborhood discovered a long-buried stream as the cause of flooding and subsidence. Having attracted the attention of the Philadelphia Water Department, a stormwater detention facility incorporating a wetland, water garden, and outdoor classroom was created in a vacant lot next to the school (see http://web.mit.edu/wplp/home.htm). Projects such as this are critical in raising the awareness of youth with regard to local ecology. This awareness can have long-term implications. David Sobel conducted a study of environmentalists to discover what in their past inspired them to care about the environment. The two main reasons were "many hours spent outdoors in a keenly-remembered wild or semiwild place in childhood or adolescence, and an adult who taught respect for nature" (cited in O'Shaughnessy 2000, 123).

Potential Conflicts Between Providing Child-Friendly and Wildlife-Friendly Green Spaces in Cities

Landscape ecologists generally refer to two basic types of green habitats in cities: patches and corridors. The patch is a relatively homogeneous nonlinear area that differs from its surroundings (Hellmund and Smith 2006, 46). The analogy in terms of site planning for human use would be what we have termed here shared outdoor space. A corridor is a strip of land of a particular type that differs from the adjacent land on either side, especially valued as a conduit for wildlife movement (Hellmund and Smith 2006, 46). Social planning analogies would include greenways, linear parks, riparian trails, et cetera, providing for human movement and connecting different neighborhoods.

The conflict between the design of green spaces for children's use and as wildlife habitats includes the following:

1. In the case of shared outdoor space in clustered housing, to optimize use by children and to maximize the potential for parents seeing a green space as safe, it needs to have distinct edges and be visible from adjacent homes. This suggests a round, square or rectangular shape with no hidden corners. Richard Forman has proposed that as a natural habitat an "ecologically optimized" patch should have enough roundness to ensure an interior habitat but with tentacle-like corridors extending out to facilitate plant and animal movement in and out of the patch (Hellmund and Smith 2006, 57). This shape would probably reduce its potential as a child-friendly landscape (unless the out-of-sight tentacles were closed to human use) as parents of young children might fear they had wandered away.

2. The vertical structure of the edge of a patch or a corridor with a variety of heights of shrubs, low trees, and high canopies is very important to birds and other wildlife. However, the understory may block the views from houses into the green space, making parents reluctant to let their children play there alone. An edge with no understory vegetation may increase its use by children but create a less-than-perfect wildlife habitat.

Possible Negative Unintended Consequence of Greenway Provision

Views to greenery are highly valued and may translate into higher house prices. A study of a master planned

community near Seattle recorded that adult residents highly valued views to (but not necessarily use of) greenways adjacent to their homes (Kearney 2006). Creation of a greenway in an existing urban fabric can result in gentrification. For example, property values along the as yet incomplete Rose Kennedy Greenway (part of Boston's Big Dig project) increased 79 percent from 1988 to 2004, compared to a 41 percent increase citywide (Hellmund and Smith 2006, 163). In cases like these, it is possible that lower-income families with the least resources to drive to natural areas for recreation are also the least likely to be able to afford to live close to existing or newly created greenways.

Urban Promenades: An Alternative Model

While greenways passing through natural or barely altered landscapes provide good potential settings encouraging nature contact, in terms of nature access along urban pathway systems, the *urban promenade* is another but rare model. Setagaya Ward, Tokyo, known for many urban design innovations (see Useful Websites below), contains two well-known examples: the Kitazawagawa River Nature Path and the Yoga Promenade. The former (see Figure 10-53) is a broad curving pathway several blocks long, lined with cherry trees, which follows one side of a reconstructed urban stream brought to grade level and fed by the clean effluent of a local sewage treatment plant. The warm water and its high nutrient content ensures vigorous plant growth along the stream channel. The Yoga Promenade, designed by Group Zo, is a longer urban pedestrian pathway built to connect a subway station to the Setagaya Art Museum. While not as verdant as the Kitazawagawa River Nature Path, it offers many vegetated segments, an urban stream popular with local children, and a variety of aesthetic features and enhancements such as uniquely designed playful "lounging" street furniture, pavers inset with poems, and planting with poetic inscriptions. The Yoga Promenade is integrated into the urban fabric in a way that offers accessibility, including for children riding bicycles, to many community facilities along the way in addition to the art museum (see Figure 10-54).

3. ALLEYS

Residents in some inner-city neighborhoods are beginning to view converted back alleys as another potential site for children's play and nature contact. For example, in 2003, a group of residents in Baltimore's Patterson Park neighborhood, along with Community Greens and other NGOs, began the process of turning underutilized city property—the littered, neglected alleys behind their homes—into safe places for children to play and adults to unwind. After a lengthy process of resident envisioning, petition signing, legal maneuvering, and fundraising, two pieces of legislation were created that give city residents the option to gate and green their alleyways. The first piece of enabling legislation, passed in 2004, changed the city charter of Baltimore, empowering the city to gate a right-of-way (e.g., an alley) and lease it to abutting homeowners. The second piece of legislation, a 2007 ordinance, outlines many provisions and requirements of gating and greening. The ordinance stipulates that 80 percent of homeowners living on a block must agree and sign a petition to gate and green an alleyway if existing traffic is not im-

Figure 10-53: Kitazawagawa River Nature Path, Setagaya Ward, Tokyo, follows a reconstructed urban stream brought to grade level and fed by the clean effluent of a local sewage treatment plant. The warm water and its high nutrient content ensures vigorous plant growth along the stream channel.

Figure 10-54: The Yoga Promenade, an urban pedestrian pathway built to connect a Tokyo subway station to the Setagaya Art Museum

peded. If existing traffic is impeded, then 100 percent of occupied homes need to sign the petition. (Abandoned homes are not counted in the "voting pool.")

Remarkable changes have occurred on the first block in Patterson Park where alley gating and beautification have taken place. Garbage pickup has moved to the front; crime and littering have been eliminated; and a garbage-strewn no-man's-land has been converted with planters, potted plants, benches, and a barbecue grill into a space well used by adults and children, which is viewed as an extension of everyone's home. (See Figure 10–55 in color insert.) (In this case, parking was accommodated on the street before the alley closure.)

While ungated alleys are not ideal settings for children's nature contact, in existing high-density urban settings, evidence shows that they are often used by children in creative ways (Moore and Young 1978; Moore 1986a). In more suburban settings, proponents of new urbanism promote the use of alleys to allow houses to be sited closer together and to ensure that curb cuts and garages do not mar the streetscape. While some such alleys (e.g., at Celebration, Florida) *do* contain green elements and possibly function as casual play areas, others are designed as stark utilitarian spaces. The advertising literature of some developers espousing new urbanism in Santa Fe, for example, refers to alleys as places for children to play. It is hardly credible that a setting for cars, trash cans, recycling bins, and power lines somehow serves children's healthy development. Common sense suggests that children who grow up amid natural settings (such as the creeks, fruit trees, wildlife, and gardens of Village Homes) will be rewarded with more nature contact and more positive health outcomes. One has to wonder if residents living on suburban alleys in new urbanism–inspired neighborhoods will, some time in the future, turn to the solution of gating and greening these spaces as have the residents of the Baltimore neighborhoods cited above.

4. *WOONERVEN* AND HOME ZONES

Studies by Moore (1991) and others demonstrate the historic importance of streets for children's social life. Reflecting this fact, a fourth model of neighborhood design promoting children's safe outdoor play and potential nature-contact is one that had its birth in northwest Europe. The *woonerf* or "residential precinct" was first developed in the Netherlands to curb speeding traffic on inner-city, grid-pattern streets. The street is transformed by means of speed bumps, bulb-outs, planters, trees, benches, play spaces, et cetera, into a space for pedestrians where local traffic has access at only very low speeds. Pedestrians and cars share the paved space of the street (with no specific sidewalks), with pedestrians having legal priority. Entrances to the shared zone are clearly marked; through traffic is discouraged, while residents have auto access to the front of dwellings (Pressman 1991). (See Figure 10–56 in color insert.)

The success of the first *woonerf* schemes in Delft triggered the spread of this urban form to other Dutch cities, then to suburban Dutch neighborhoods. The shared street concept became accepted and established through guidelines and regulations in the Netherlands and Germany (1976); England, Denmark, and Sweden (1977); France and Japan (1979); Israel (1981); and Switzerland (1982) (Ben-Joseph 1995). Studies and surveys of shared streets in Europe, Japan, Australia, and Israel have found reductions in traffic accidents, increased social interaction and play, and a high degree of

satisfaction by the residents. A carefully observed study of activity on two streets in a mixed-use, high-density, inner-city neighborhood in Hannover, Germany, before and after conversion to *woonerven*, documented an increase in children's outdoor play after the conversion (Eubank-Ahrens 1991). While this does not necessarily translate into nature contact, inclusion of trees with an understory of bushes or planting beds for residents to maintain, would provide nature contact during the increased outdoor play.

A recent rebirth of the *woonerf* movement in the UK, where these play-streets are called home zones, is generating a number of child-friendly models in urban neighborhoods. A recent study of such UK developments discusses the evolution of street life as explored by Levitas (1986), and how the use of streets quite closely reflects the values and priorities of society. "She highlights the dominant view that streets have become seen as links rather than a locus, and that increasingly the street is recognized for its transit capabilities rather than its ability to provide for a range of rich and diverse human behavior" (Levitas 1986, 232, quoted in Biddulph 2003, 218).

There are no fully developed "home zone" examples in the United States, primarily due to opposition from traffic engineers, road-building companies, and fire and police departments. The principal impediment is the fact that the Institute of Traffic Engineers has never adopted the concept. As one expert remarked: "As long as they do not back it up or publish suggested guidelines, public officials (and especially the city's legal department) will not endorse it. . . . Most countries in Europe and Asia have adopted guidelines for the design and construction of such spaces" (Ben-Joseph, personal communication, 2007). However, this is a model that should be still considered as an ideal way of creating safe outdoor play close to home in built-up neighborhoods where there is no possibility of creating inner-block green space, and where there are no alleys to gate and convert.

Ben Joseph considers that the concept holds true, even for new urbanist developments that advocate interconnected street networks. "Increased accessibility on all streets raises the likelihood of cut-through traffic and of speeds inappropriate to residential neighborhoods—the original impetus for abandoning the grid . . . more than sixty years ago. Shared streets in a connected system can eliminate the deficiencies of the grid. Speed will be reduced and through traffic by non-residents discouraged, yet connective factors . . . will be much more numerous than in the typical hierarchical, disconnected street system" (Ben-Joseph 1995, 512).

LEED NEIGHBORHOOD DEVELOPMENT AND ACCESS TO NATURE

The Natural Resources Defense Council has partnered with the U.S. Green Building Council and the Congress for New Urbanism to certify exemplary neighborhood development through the LEED for Neighborhood Development rating system. Pilot projects are being reviewed in 2007 to test the strengths and weaknesses of the rating system.

A few features covered in the rating system mirror recommendations made in this chapter. For example, the possibility of creating a *woonerf* is mentioned, and under "Street Network," where cul-de-sacs are created, at least 50 percent are required to have through-connections for pedestrians and cyclists. While habitat conservation, restoration and management are covered in detail, nothing is specifically mentioned regarding human access to these areas. Parks, squares, plazas, et cetera, are mentioned in terms of their required size and dimensions, and their proximity to the project being reviewed, but there is no discussion of the quality of their design or any required components. Such a rating system for public green spaces may well result in the same minimally detailed and furnished flat green parks seen in many contemporary new urbanist developments that offer little in the way of nature contact for either adults or children. There is no mention or recognition in this rating system of the value of shared outdoor space, as defined above.

To gain credit for "School Proximity," the project being reviewed needs to be located or designed so that at least 50 percent of dwelling units are within a half-mile walking distance to the school, but the rating system does not help to encourage nature-contact in

school grounds, on the walk to and from school (e.g., via a greenway), at a childcare center, or in any other setting where children may spend part of their day.

The LEED for Neighborhood Development Public Health Report (www.greenbuildingcouncil.org) provides an excellent overview of the current debate and research regarding public health and planning, focussing largely on cardiovascular health and air pollution, traffic accidents, physical activity and urban form, but (sadly) has very limited acknowledgment of children's needs and no mention of the psychological or spiritual value of access to nature.

It is essential that those of us committed to the principles of biophilic planning and design become vocal during the 2008–2009 public comment period for the postpilot version of the LEED for Neighborhood Development, so that access to nature becomes an intrinsic component of those neighborhoods rated as exemplary through this review process.

CONCLUSIONS

There are clearly many socioeconomic and locational factors affecting whether natural areas are sought out and used by children. For example, in a small, relatively safe California city, 14- to 18-year-olds sought out natural areas where they could be alone or with friends in an informal, unsupervised way (Eubanks Owens 1988). In a crime-ridden area of Los Angeles, however, children ages 9 to 11 almost unanimously rejected parks and other public spaces as the domain of gangs and "bad people," despite the fact these areas were created (by adult decision-makers) for their recreation (Buss 1995). But it is important to note that in the extensive international research of the Growing Up in Cities project, when children's views were solicited concerning how their environment functioned for them in 8 urban communities in the 1970s, and 16 researched since 1995, "safe, clean green spaces with trees, whether formed or wild, extensive or small . . ." was one of nine positive indicators of community quality from the children's perspective (Chawla and Malone 2003).

This, together with the studies of different models of child-friendly neighborhoods discussed above, and the repeated negative indicators cited by children (heavy traffic, violence, bullies, gangs, litter, pollution and lack of places to play and meet friends) provide us with some parameters for planning children's access to nature in residential settings:

- A natural or quasi-natural area needs to be created or protected within sight and calling distance of a majority of homes occupied by families with children. This area needs to facilitate as many varieties of play as possible, from spaces where digging in, or molding, dirt or sand is encouraged (preferably with access to water nearby); to semiwild areas where dens might flourish; planting beds for gardening; trees for climbing; paths for wheeled toys; equipment for swinging, sliding, climbing, et cetera (see Figure 10-57).
- Access from homes needs to be safe, not requiring a street crossing wherever possible. Studies of children's perceptions of their own neighborhoods repeatedly cite the problem of traffic in limiting mobility and access to places they want to go (Hillman 1993; Davis and Jones 1996, 1997; Morrow 2003; O'Brien 2003; Wheway and Millward 1997).
- The space needs to be well-maintained (no litter, no pollution) without the removal of those "loose parts" valuable in creative play.
- Adults and children alike need to understand that this is a legitimate locale for children's play.

Figure 10-57: Shared outdoor space must provide for as great a variety of children's activities as possible, from digging in sand or dirt, to climbing or riding a bike, to creating a den under a bush or examining insects or leaves (St. Francis Square, San Francisco)

- The space needs to provide for all age groups, from toddlers to late-teens, without any one group or gender dominating the use of the space and intimidating others.[11]
- Where possible, the space needs to link via a greenway path and bikeway system to other natural areas and to schools, local shops, library, et cetera.

SUMMARY

Children's lack of safe access to wild or semiwild nature does not bode well in terms of inspiring and motivating a coming generation of environmental stewards. Urban environmental design and landscape architecture partnered with allied fields (public health, urban planning, parks and recreation, horticulture) have a crucial role to play in alerting society to this concern, as well as turning the tide on sedentary indoor lifestyle trends and the negative health consequences, beginning in the first year of life.

Crucial policy areas, new urban forms, and innovative settings and components need to be developed and tested. They include school locations, neighborhood pathway networks, their application to trips to and from school, shared open space in residential areas, housing patterns with child-friendly outdoors including child-friendly streets, neighborhood parks and local open space, nonformal education facilities such as botanical gardens, greenways, and urban trails and urban promenades. Empirical research is urgently required to fully understand the environment-behavior relations in these settings to inform responsible practice—as well as to provide evidence to counter some of the still unsupported claims of new urbanism. Most important, the quality of the place where the majority of U.S. children spend their early childhood—childcare centers—must become a central focus of biophilic design.

Although the task will never be complete because of the dynamic nature of postmodern culture, in the last several decades, well-developed, evidence-based precedents have accumulated that offer best practice guidance for the design of children's everyday environments. Such models can help us imagine what an urban environment would be like if it were designed to fully support the biophilic development of children and thus the future health of our planet, our place in the universe.

ENDNOTES

1. By ecological validity we mean that the environments being investigated must exhibit sufficient physical diversity that a broad range of human response is elicited. Unless research includes new types of environments attempting to respond to the health crisis through design innovation, the knowledge base will remain static and narrow.
2. An example in the first author's experience was the mandated removal by the local public health department of a beautiful bog garden constructed as a preschool play and learning setting in a childcare center preschool area, on the grounds that it could "harbor vermin." The only animals observed there, however, were dragonflies, other flying insects, and birds.
3. Safety regulations for children's play environments until now have been driven by data gathered in hospital emergency rooms (NEISS–National Electronic Injury Surveillance System) and product-related data gathered by the U.S. Consumer Product Safety Commission (CPSC). Understandably, the role of government is to protect citizens from harmful products, which become the focus of attention when unintended injury rates get public attention (as was the case with public playgrounds in the 1970s and 1980s). The problem is that we assume that environments that don't show up in the statistics are safe. Furthermore, legal liability has distorted our view of children's environments. Perceived safety and liability tend to be the central focus in decisions about provision, instead of play value and developmental outcomes. See Moore (2006) for extended discussion of this issue.
4. The Natural Learning Initiative (NLI) is a research, design assistance, and professional development unit of the College of Design, North Carolina State University. NLI was founded in 2000 with the purpose of promoting the importance of the natural environment in the daily experience of all children, through environmental design, research, education, and dissemination of information. For more information, visit www.naturalearning.org.
5. Since most of these animals are far more agile than children under two years old, there is very little chance that they can be touched, let alone caught or mouthed. By age three to

five, preschool children have learned where small animals live and enjoy hunting and catching them. For this age, teachers are crucial role models with the task of facilitating respectful, caring behavior toward animals (Myers 2007).

6. Completed survey responses (n=326) were received from approximately 10% of the licensed childcare centers in North Carolina. Based on the results, the 25 highest-scoring centers were visited in the field. Of these, only three or four could be labeled as exemplary outdoor environments according to the quantity and quality of natural settings.
7. LEED (Leadership in Energy and Environmental Design) is part of the U.S. Green Building Council (USGBC), a 501(c)(3) nonprofit composed of more than 10,000 member organizations from the building industry united by a common purpose: to transform the building marketplace to sustainability. The Green Building Rating System(tm) is the nationally accepted LEED benchmark for the design, construction, and operation of high-performance green buildings.
8. Such spaces are typically unprotected and vulnerable to development as urban land prices rise. Hence the concept of "designed" vacant lots as part of the local public open space system.
9. There are now many fewer children living at St. Francis Square, as parents who raised their children there in the 1970s and 1980s have opted to stay on as "empty nesters."
10. Meanwhile in the United States, the opposite was happening as women were encouraged to stay home, opening up jobs for returning veterans and becoming full-time housewife-chauffeurs in the sprawling suburbs spawned by low-interest mortgages, freeway construction, and increased car ownership.
11. In an Australian participatory action research project where high school students engaged in redesigning an unused outdoor space, they complained that planners and city officials always think about facilities for toddlers—that is, playgrounds—and rarely for older children and teens (Chawla and Malone 2003, 129–134).

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USEFUL WEBSITES

www.unesco.org/most/growing.htm for updated project reports on Growing Up in Cities

www.unicef-icdc.org for information on the Child Friendly Cities Programme of UNICEF, which focuses on monitoring and implementing the rights of children in urban areas as stipulated in the UN Convention on the Rights of the Child

www.communitygreens.org for information on historic and contemporary examples of shared green space in the interiors of urban blocks

www.plangreen.net for information on compact, mixed-use, green development that integrates native ecosystems

http://www.city.setagaya.tokyo.jp/topics/bunkoku/outline/guide002.html for information on urban landscape and design innovations in Setagaya Ward, Tokyo

www.homezones.org for information on UK examples of shared streets (*woonerven*)

http://www.homezones.org.uk/public/downloads/Tim_Gill_Childstreet_Paper.pdf for a copy of the paper by Tim Gill on Home Zones

http://www.planning.org/cpf/ for information on the City Parks Forum

http://www.naturalearning.org/helpchildrenlearn.html for access to the City Parks Forum publication "Urban Parks Help Children Learn," by Robin Moore

http://www.whatcomwatch.org/php/WW_open.php?id=718 for information about forest kindergartens

http://www.edibleschoolyard.org/about.html for information about the Edible Schoolyard at Martin Luther King Jr. Middle School, Berkeley, California

http://www.urban.nl/childstreet2005/ for diverse information about and from the Childstreet conference held in Delft, the Netherlands, August 2005

http://www.urban.nl/childstreet2005/downloads/delft_manifesto_draft.pdf for a copy of the Delft Manifesto on a Child Friendly Urban Environment–drafted on behalf of the Childstreet conference participants, August 23, 2005

http://www.europoint-bv.com/download/1163606010 for a copy of the Manifesto of the European Child Friendly Cities Network, from the Child in the City conference, Stuttgart, Germany, October 2006

http://www.farmgarden.org.uk/ for information about Urban Farms in the UK and Europe

http://efcf.vgc.be/index.html for information about city farms in Europe

http://www.greenteacher.com/ for information about *Green Teacher*, a magazine by and for educators to enhance environmental and global education across the curriculum at all grades

http://www.ecoliteracy.org/ Center for Ecoliteracy, to access writings of Fritof Capra and others