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SENSORY INTEGRATION AND CONTACT WITH NATURE: DESIGNING OUTDOOR INCLUSIVE ENVIRONMENTS

by Nilda Cosco and Robin Moore

Nilda Cosco and Robin Moore bring to the layperson the language of designing outdoor environments for a wide variety of special needs. Montessorians will notice correlations between the designers' professional vocabulary and Montessori concepts. Territorial development, for example, is akin to the prepared environment's providing layers of learning for "expanding the 'known' world by pressing against the 'unknown.'" Drawing on a solid research base, Cosco and Moore suggest both guiding principles and specific applications (including illustrative photos) to create environments that promote physical and mental health, attention, cognitive functioning, and motor development for an inclusive community of learners.

INTRODUCTION

This paper is based on the assumption that, regardless of children's abilities or disabilities, nature has a positive impact on well-being and helps children acquire harmonious, healthy lifestyles (Wells; Wells & White). We consider well-being to be a delicate balance between healthy human processes (psychological, physical, spiritual) and healthy environments (composed of landscapes,

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weather, built environments, and the social circumstances of daily life). Carefully designed natural environments can help maintain the balance necessary for the healthy growth of children (Grahm et al.; Kuo & Faber Taylor).

All children need to experience the healthy, harmonizing effects of nature in their everyday lives. Powerful experiences of nature are necessary antidotes to the artificial environments of the new century. Without these experiences, children with and without disabilities will see themselves as apart from nature because it has never been incorporated into their innermost being. If so, as adults they will lack the passion for nature necessary to protect our planet.

Predictable types of behaviors are the consequence of the designed and prepared environment.

So everyday natural places—also referred to as “gardens” or “outdoor prepared environments” in this paper—are places of therapeutic value for all children, where direct contact with nature supports not only health outcomes such as attention functioning (Kuo & Faber Taylor; Faber Taylor et al.) but also the feeling of being alive and in harmony with the world.

Undoubtedly, these environments help individuals feel part of the planet. Creating natural environments in schools not only stimulates the senses of all (children with and without disabilities and their caring adults) but also supports the creation of a new generation of adults (children today) that will more likely understand the processes of nature and will support a healthy Earth. Healthy childhoods and a healthy planet are interwoven.

In school settings, outdoor prepared environments are an extension of the classroom that accommodates most educational activities (at all levels: infants and toddlers, children’s house, lower and upper elementary), after-school programs, and summer camps.

Because it is crucial for children to be in touch with nature as much as possible, indoor environments should not be excluded as resources for fostering such experiences. In cold or extremely hot

climates, indoor prepared environments and gardens can similarly provide rich contact with natural materials (small trees, shrubs, flowers, twigs, rocks, etc.) and foster engagement with nature.

DESIGNING INCLUSIVE ENVIRONMENTS

Although most children with special needs attending regular schools will be able to enjoy almost any type of garden or outdoor environment, it is recognized that there are children with many possible disabilities or special needs that might require extra care or extra stimulation under the guidance of trained professionals. Certainly, the needs of these groups may require additional design features and accommodations, but it does not mean the design of the outdoors needs to be fundamentally different. The basic premise of universal design (another commonly-used term) is that environments should be designed to accommodate the needs of most people (Mace). As stated by the authors in a previous publication (Moore & Cosco “What Makes a Park” 86),

At the young end of the age spectrum, a case can be made for including the general population of children within the purview of universal design because of their vulnerability and developmental needs (Moore, Goltsman, & Iacofano). A small proportion of children live with some type of special need (physical, mental, or sensory impairment) that requires special environmental modifications but children as a whole have special needs defined by levels of maturity and skill limitations. Children are also individuals in the process of learning about the world around them. Richer environments—socially, culturally, and physically—enhance and extend the learning process (Hannaford). Design has an obvious role in helping to create spaces where such richness and diversity of experience can happen—especially for children living in deprived or stressful circumstances.

The creation of such inclusive environments offers children the opportunity to experience beautiful, natural settings, and creates favorable situations for environmental engagement (see Figure 1).

CONCEPTUAL FRAMEWORK

The following conceptual framework helps to explain the potential impact of the environment on children’s behavior, especially



Figure 1. A whimsical planter attracts children's attention and stimulates their imagination. It is a type of semi-permanent object that can add meaning and identity to a setting. After a year or two, when the object looks worn and tired, a new generation of children can work on a replacement stamped with their new personality.

those with special needs. In this paper, environment and behavior are considered as a whole.

Behavior Settings

The space around the school may be considered as a kind of territory that is subdivided in a deliberate way into subspaces called *behavior settings*.

Behavior settings are ecological units where the physical environment and the behavior are indissolubly connected. These eco-behavioral units were first described by Barker. Through direct observation of children, Barker noticed that behavior settings have a clear structure: they are located in time and space, they are com-

posed of entities and events (people, objects, behavior) and other processes (sound, shade, etc.), their spatial and temporal boundaries are identifiable, their components are arranged in a functional way and are part of the whole, and their functions are independent of other adjacent eco-behavioral units. The concept is applied in design research for analyzing human spaces by disaggregating their functional parts (e.g., climbing area, sand pit, water play setting, tricycle path, vegetable garden, etc.).

Therefore, behavior settings have predictable types of behaviors that are the consequence of the designed and prepared environment.

Affordance

Another concept relevant to the topic of designing gardens for all children is *affordance*.

This theoretical approach helps us to understand the impact of the physical environment on children and to identify environmental attributes that are associated with specific behavioral responses. Affordance stresses the relationship between perception and action. According to Gibson and Pick, children learn both about the functional properties of the environment (layout, objects, and events) and about themselves by picking up information through the process of identifying and using the environment in relation to their abilities (e.g. the child is able to climb on an elevated object that is high enough to venture for his/her body scale, ability, and strength). As affordances are learned, they guide children's future behavioral responses to specific environments (Gibson & Pick).

The key to creating inclusive environments is to provide multiple affordances to entice the enjoyment of a wide population (see Figures 2 and 3).

When children are out and about in the environment, they respond to these environmental affordances intuitively. Affordances are expressed in terms of action: The tree is "swingable"; the hill is "rollable"; the puddle—which a landscape architect might consider a drainage problem!—is definitely "splashable." There is nothing more stimulating for children than this type of sensory interaction with the environment.



Figure 2. A low “rollable” hill stimulates the vestibular system and encourages vigorous activity. Observe how each of these children is reading the “affordance” in their own way. Notice the function of the “loose parts” of cardboard and plastic sheet that offer additional experimental / experiential possibilities.

Territorial Development

The third concept is *territorial development*.

As a general notion, the child is dynamically developing hour to hour, week to week, month to month. It is critical, then, to introduce children to the living world in the first year of life—the first spring, the first snow drop, the first snowflake, the first breath of wind! All environments should say to the child: Welcome to the planet!

Territorial range development recognizes that maturing children explore, discover, and make sense of their expanding world through experience, learned skills, and spatial understanding (Moore; Moore & Young; Hart). To maintain this dynamic relationship with



Figure 3. A low stump supports jumping with the intent of touching the low-hanging tree branch. Again, the stump-plus-low-hanging-branch combination “tells” the child, “try to touch me.”

the environment, children repeatedly act at their territorial limits, constantly expanding the “known” world by pressing against the “unknown.” For each child to exercise her or his exploratory skills beyond the known, space must be designed with soft, extendable territorial boundaries. In institutions with a range of ages, levels of ability, and a variety of child-caregiver relationships, environments with higher levels of diversity will more effectively satisfy users’ exploratory needs.

How does a Montessori school environment enable or afford these continuing, expanding contacts as the child develops and matures and extends their territory day to day? Small infant gardens support the venturing of children into the natural world in a confident way. Larger landscapes will provide space for running

and more expansive activities for older children, for enjoying the fresh air or conducting “scientific” explorations.

HEALTHY EFFECTS OF NATURE

Research shows that natural environments influence health in positive ways.

Attention Functioning and Cognitive Development

Exposure to natural settings is associated with improvement in cognitive functioning. In a longitudinal study, Wells explored the effects of nature on cognitive functioning with children between the ages of seven and twelve years who were from low-income, urban families living in housing with different degrees of surrounding “naturalness” (e.g., views from windows, presence of plants and trees near the home). Study findings suggest that an increase in naturalness is related positively to an increase in child attention functioning.

Research by Cornell and colleagues demonstrated how wayfinding, a cognitive task involving planning, memory, spatial cognition, and problem solving, could be also facilitated by landscape attributes. In order to navigate their environment, individuals need to become familiar with contextual sensory cues (spatial cognition). When children ages six and twelve were asked to independently find their way to a place near their home that they selected, the six-year-olds traveled in a linear route and beyond distance limits set by their parents. The twelve-year-olds traveled to more distant locations and experimented with different routes. Richly differentiated landscapes, designed to offer multisensory cues beginning in early childhood, can encourage children to develop independence through continuous exploration and expansion of territorial limits.

Self-Esteem

In the preceding example, Cornell et al. demonstrate how as environments become familiar, development of cognitive skill allows children to continuously take the next step to expand their territory by exploring unfamiliar environments. By building skill, children feel more competent (with themselves and with peers) and self-esteem improves. The forest school project in the United

Kingdom is a current education effort explicitly aimed at providing children with natural settings, with exploration rather than scientific learning as the goal, the aim of which is to increase self-esteem (Swarbrick, et al.).

Academic Performance

Academic tasks require directed attention. Sustained directed attention is mentally fatiguing. Increasing the naturalness of settings (e.g., windows with natural views) or increasing exposures to restorative natural environments, even brief exposures, helps individuals maintain and improve directed attention and therefore score higher in academic performance (Tennessen & Chimprich; Wells; Berto; Berman et al.). Even a few trees or shrubs planted in high-exposure strategic locations may have a measurable impact.

Motor Development

Child motor development may be enhanced when children are offered a more complex environment than is provided by traditional playground settings. A natural landscape or a play space designed to integrate natural elements offers such an environment. A study of children ages five to seven years assessed the impact of a play environment intervention on child motor functioning (Fjørtoft). Children in the experimental group were provided with a natural playscape for nine months and children in a comparison group were provided with traditional playground settings. Motor functioning was assessed twice (pre- and post-intervention). Assessment included balance, coordination, speed of limb movement, flexibility, trunk strength, functional strength, running speed, dynamic balance, and cross-coordination. For nine months both groups played for at least one hour daily within the assigned play settings. Post-intervention assessment of motor fitness revealed that the experimental group showed

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significant improvement for all motor test items except flexibility. Notably, the experimental group showed marked improvement in balance and cross-coordination, skills that improve as a result of diverse movement activity. The author concluded that the natural playscape afforded a more complex environment, and observations of both groups indicated that the children in the natural playscape easily adapted to their environment and exhibited more functional play.

CONCLUSION

A growing research literature (including results of research conducted by the Natural Learning Initiative) suggests that exposure to the natural environment is linked to positive behavioral outcomes. Attributes of outdoor natural environments (gardens) have been associated positively with physical activity, attention functioning, cognitive development, self-esteem, academic performance, and motor development. Scientific evidence supporting the therapeutic effects of contact with nature continues to grow. Most of the research has been conducted with adults—because it is easier to navigate university protocols. As research findings identify restorative effects on cognitive functioning triggered by the perceptual process of interaction with nature, it is reasonable to assume that the effects are at least as relevant to children as to adults.

When Maria Montessori stressed the importance of working outdoors with nature, in nature, she demonstrated a remarkable understanding that this was not frivolous instruction but a profound insight, no doubt informed by her close observation of “nature-effects” on the children around her. In working with nature within the Montessori philosophy, not only can we underscore the importance of children’s being outdoors in rich, natural settings, but we can also *prepare* those settings by adding extra details, prompts, potential discoveries, and pedagogical links to strengthen the impact on children, with all manner of needs.

DESIGN RECOMMENDATIONS

The following recommendations are adapted from Moore and Cosco, “Well-Being by Nature.”

Orient the garden site to receive year-round sun and shelter from winter winds.

Plants are the essence of “healing” in gardens for well-being. They need sun to grow. Children need outdoor spaces warmed by the sun, depending on latitude and season. Locate gardens so adjacent buildings will not overshadow them.

Site the garden on level terrain.

Anything but a very modest degree of topographical change across the site will most likely give difficult access problems from building and garden entrances, especially for children or teachers using wheelchairs or mobility devices. Here we are referring to overall site topography, not hills and slopes created as design features for children’s enjoyment.

Conserve natural features of the site.

Natural features such as mature trees, rock outcroppings, hills, oaks, and watercourses should be conserved as they provide natural identity to the site and potentially useful amenities (e.g., shade trees). Conserve as much topsoil as possible, to give new plantings the best possible start in life.

Locate the garden so it is overlooked by children’s indoor spaces.

For children who cannot go outdoors, a garden view is critical. Staff can make the connection between inside and outside by physically importing natural elements from the garden as well as by visibly transplanting outdoor plants prepared by the children indoors.

Locate the garden adjacent to children’s spaces.

Locating gardens next to children’s spaces, such as playrooms, classrooms, and multipurpose rooms, will save time and energy on the part of staff such as play leaders and horticultural therapists, who must move items of equipment and play materials back and forth.

Locate the garden so that it is visible from public use facilities such as entrances and waiting areas.

When the garden is visible from the facility entrance, it reinforces a friendly, welcoming message to children, family members, and visitors. It also ensures supervision from staff.

Infants' and toddlers' gardens.

Provide direct access from the building to infants' and toddlers' gardens (see Figure 4). Random paving provides access to mini-lawns and planting beds. The central lawn is crowned as a low "hill." Plants were selected for varied texture, color, and year-round interest. Adirondack chairs offer a relaxing place for staff to take time out with children. A large, manufactured shade structure partly covers the garden but allows sufficient light for healthy plant growth. Staff added a colorful banner to respond to air movement.

Make garden entrances welcoming and child friendly.

Children, especially as first-time users, should feel welcomed into the garden. This can be achieved through colorful plantings and by placing playful artifacts such as sculptures, benches, archways, etc., at strategic locations. Child-made artifacts and gardens created by young people can be displayed. To avoid glare when exiting buildings (especially for children with sight impairments),



Figure 4. An infant garden offers comfort for teachers and children. The varied textures, colors, and fragrances of the plants offer sensory, hands-on experiences in a safe environment. The lawn, which has slight undulations to challenge children learning to walk, is a wonderfully adaptable space. The raised planter in the background is full of aromatic plants at child height. Notice how the covered porch of the classroom offers a seamless transition between indoors and outdoors.

translucent awnings, pergolas, shade trees, or other shading devices should be located at exit thresholds.

Accessibility/Usability

Provide accessibility for children using wheelchairs, transporters, walkers, cots, etc.

Children with physical impairments use a variety of mobility devices. Gardens should be universally designed to provide stimulating experiences regardless of abilities or disabilities. For example, make sure that hands-on landscapes are at appropriate heights for users of these devices, including children in prone positions. We recommend working directly with the staff, children, and parents to assess the particular physical requirements and appropriate design dimensions for the user group rather than relying solely on basic ADA (Americans with Disabilities Act) requirements. Plants are such flexible and diverse materials that settings can be designed to accommodate a broad variety of needs.

Provide usability for children with sensory impairments.

The needs of sight- and hearing-impaired children should be met in ways that are nonintrusive for other children. Sight-impaired children need acoustic, tactile, and fragrance cues for orientation and wayfinding. Hearing-impaired children need visual cues. For children with sight impairments, check the design of the garden for protruding objects; pathways should be designed with strongly delineated edges to facilitate easy, safe movement. Plantings should offer fragrances that coincide with the visual wayfinding structure of the garden. Wind chimes are useful cue devices.

Design gardens to include children with a wide range of special needs.

Discussions with staff should be facilitated to identify the functional needs of users: children with emotional, learning, physical, sensory, and developmental impairments—temporary or permanent.

Accommodate needs for both challenge and rest.

Provide a range of physical/social settings so that each individual can explore and discover his or her own level of challenge. In order to grow, children need to be challenged. One child may be challenged by the idea of simply going outside. Another will need to overcome shyness in playing with other children. Yet another will

find planting a flower in a pot a new and exciting experience. Other children might seek rest rather than challenge. They need quiet, peaceful corners to restore their attention functioning or stamina.

Provide a broad range of group settings to accommodate children's being together as well as being alone.

Children have a wide range of social and psychological needs that are constantly changing. It is fundamental to the role of the outdoor environment that each child have freedom to find her or his own most comfortable and enjoyable setting. A choice of settings that range in degrees of privacy should be provided (see Figure 5). They should be of different sizes to accommodate a variety of groups. Also, consider the variety of mobility devices the children may be using.

Facilitate child-nature interaction.

Provide as many options as possible for children to experience nature through their senses and/or through hands-on activities. The essence of an outdoor environment for well-being is to support children's experience of the sensory richness and living quality of



Figure 5. Tables and moveable chairs provide a shady space for individual children or small groups in this sensory garden. This "bounded setting" offers an abundance of affordances for children and adults alike.

nature. Natural settings should contain the greatest diversity of plants possible, selected for their collective year-round performance from early spring to late fall. At any time of year there should be a new natural event happening in the garden. Select species that produce flowers, fruit, and other parts that can be harvested and used by the children as play objects or in arts and crafts projects, especially during winter months.

Provide activities for releasing stress.

One of the most meaningful activities for a child in a stressful situation is to be able to intervene in the cycle of life—to start a new life within another species. The feasibility of such activities depends on the institutional commitment to facilitate and support planting activities.

Provide attractive movable items that will engage children in their use of the outdoor environment.

One of the fundamentals of children's play is the desire to manipulate the environment. Small wagons that can be moved around or a sandbox with toys will be sources of delight and provide



Figure 6. A scalloped sensory table provides a lovely example of a prepared environment used to explore textures, water, or other sensory materials. The lip keeps objects from sliding off and holds sufficient water for splashing.

excellent opportunities for children and teachers to interact. Sand should stay covered with a light, fine-mesh net when not in use to protect it from animals. The sand should be replaced or topped up periodically. Watering cans left casually in the garden will encourage children to water the plants.

The group activity space in Figure 6 is focused around a multi-purpose, sensory activity table. The deeply scalloped table allows children using wheelchairs and standing frames to reach the variety of loose, natural objects prepared for sensory exploration. The shape allows children to interact easily with each other and the staff. The table has a low lip to stop objects from sliding off (as well as to hold water when used as a water table). Low-hanging tree branches provide a natural enclosure.



Figure 7. A flowering tree offers seasonal interest. Reflections in the mirror tiles at its base entice children's curiosity and give them the sensation of "floating" in the blossoms.

Integrate the arts (in children's eyes).

Therapeutic gardens offer innumerable opportunities for integration of the arts. The reflective tile surface at the base of the tree shown in Figure 7 stimulates children to enjoy the multiplied movement of the branches and flowers during the blooming season. The effect is mesmerizing, as children feel suspended between the tree crown and the reflected image.

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