WELCOMED DISTRACTIONS

ENHANCING LEARNING IN A SENSORY ENGAGING ENVIRONMENT

ALEKSIA BOGDANOVIC | MASTERS OF ARCHITECTURE | UNIVERSITY OF DETROIT MERCY SOA

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“The woods were my ritalin. Nature calmed me, focused me, yet excited my senses.”

-Richard Louv
Last Child in the Woods (2005)

ABSTRACT
0.00

This thesis is an attempt to extract sensory stimuli from nature, and explore architectonic abstractions that can be implemented in child’s learning environment .The abstractions are designed to help strengthen and improve a child’s cognitive development and learning capabilities.

PART 01

1.00 INTRODUCTION

.01 INTRODUCTION

“

Research has provided support that a child’s health and well-being is connected to nature

INTRODUCTION
1.01

Past generations of children spent much of their free time exploring their neighborhood. Today a child’s precious time is occupied with playing electronics and watching TV. Research has provided support that a child’s health and well-being is connected to nature, and it can help improve their cognitive and academic performances. In nature a child’s senses are activated by intriguing stimuli through self-motivated play.

2.00 CHILDREN AND NATURE

CHILDREN IN THE PAST
2.01

Wouldn't it be ideal if there was a treatment that not only improves attention, cognitive functioning and overall well-being, but also has no side effects and is freely available to everyone? Psychologists, neurologists and educators have known about this therapy for years; it is the interaction with nature. Past generations of children spent much of their free time exploring their neighborhood. My dad remembers playing army in an empty field with his brothers. My mom talks about visiting a tree fort in an abandoned apple orchard. My own recollections include sliding down a hill on a piece of cardboard at a family friends' cottage. There is no doubt that outdoor play used to be the norm.

CHILDREN TODAY
2.02

Today precious time is occupied with social networking, playing with electronics, and watching TV. Parents are overscheduling their kids with organized activities and sports. Educators are lecturing about threats to the earth like global warming; instead of encouraging hands-on contact with nature. Urban development is decreasing the amount of green spaces in communities. 70% of mothers in the US played outdoors every day when they were younger; compared to 31% of their children (Clements, 2013).

NATURE-DEFICIT DISORDER
2.03

Childhood advocate and journalist Richard Louv describes this disconnect with nature as Nature Deficit Disorder. In his well-researched book, *Last Child in the Woods*, Louv speaks of a direct link between a lack of nature and startling childhood trends such as obesity, Attention Deficit Hyperactivity Disorder, and depression. Louv, along with other researchers, has shown that interaction with nature has a positive effect on a child's overall health and well-being.

NATURAL PLAYGROUNDS
2.04

Natural playgrounds have been offered as one solution to nature-deficit disorder. Natural playgrounds provide potential benefits in health, motor function, and environmental identity that are important in childhood growth and development. A natural playground is an area where children can play with natural elements such as sand, water, wood and living plants. Spaces may consist of sloping hills, curving pathways, giant logs, large boulders, and mature trees. In addition to physical and emotional benefits, natural playgrounds promote creativity in children.

Simon Nicholson was an architect who developed the "Theory of Loose Parts" in 1971. Nicholson claimed that in any environment, the potential for creativity rest on the number of "loose parts" it contains (30-35). "Loose parts" are materials or items that children can move, manipulate, control, or change. Loose parts can consist of mud, sand, logs, pine cones, balls, wood or sticks. In addition, Nicholson reported that young children tended to prefer natural loose parts such as sand, mud, and water than traditional loose parts such as balls, ropes, and slides found in traditional playgrounds.

BIOPHILIA
2.05

Besides providing natural play areas, some researchers suggest that educators need to arrange for children to have more direct contact with nature.

Sobel coined the term "echophobia" in young children as the fear of going outside due to stress over ecological problems. Primary school students are learning about threats to the environment such as global warming, destruction of the rainforest, and whale hunting through lectures and videos as opposed to hands-on experiences outside the classroom (Sobel). Louv agrees, "No child can truly know or value the outdoors if the natural world remains under glass, seen only through the lenses, screens, or computer monitors." In Sobel and Louv's opinion, regular contact and play in nature facilitates a love of the natural world.

Biophilia suggets that humans have an instinctive drive to pursue connections with the natural world. Biophila has also been linked to an increase in cognitive functioning. Biophilic design, an extension of biophilia, incorporates experiences of nature into the built environment to reduce stress, enhance creativity and clarity of thought, as well as improve our well-being, and expedite healing. Designers are maximizing natural light, using natural materials, and adding water elements to spaces, to lower our blood pressure and maximize our productivity. Biophilic design attempts to break down the distinction between the building and its natural surroundings.

Both natural playgrounds and biophilic design demonstrate how the disconnection children have with nature is not permanent. We can improve the quality of life and health of our children by providing them with experiences that offer both intimate and hands-on contact with nature.

BENEFITS OF NATURE
2.06

Kuo and Taylor found that 20 minutes of walking in a park setting enhanced attention performance in children with ADHD as compared to the same amount of time walking in an urban downtown setting (402-409).

Bell and Dyment concluded that children who play in school yards that are in natural settings are not only more physically active, but also more aware of nutrition, are more creative, and are friendlier to their peers (952-962).

Likewise, Wells and Evans found that children with more nature near their home rated themselves better on a global measure of self-worth than children with less nature near their home (311-330). Wells and Evans suggested that nature might help in the fight against childhood depression by increasing a child's resistance to stress.

Research citied above and mentioned in figure 1, clearly indicates that nature may prove to be a potent antidote to many conditions affecting children today. North Carolina State University examined research studies involving the benefits of nature when they developed a National Learning Initiative. As highlighted in Figure 1, three important areas of the initiative involved cognitive ability, problem solving, and academic performance.

ENHANCES COGNITIVE ABILITIES
Proximity to, views of, and daily exposure to natural settings increases children's ability to focus and enhances cognitive abilities (Wells, 2000).

IMPROVES ACADEMIC PERFORMANCES
Studies in the US show that schools that use outdoor classrooms and other forms of nature-based experiential education support significant student gains in social studies, science, language arts, and math. Students in outdoor science programs improved their science testing scores by 27% (American Institutes for Research, 2005).

REDUCES ATTENTION DEFICIT DISORDER (ADD) SYMPTOMS
Contact with the natural world can significantly reduce symptoms of attention deficit disorder in children as young as five years old (Kuo and Taylor, 2004).

INCREASES PHYSICAL ACTIVITY
Children who experience school grounds with diverse natural settings are more physically active, more aware of nutrition, more civil to one another and more creative (Bell and Dyment, 2006).

REDUCES STRESS
Green plants and vistas reduce stress among highly stressed children. Locations with greater number of plants, greener views, and access to natural play areas show more significant results (Wells and Evans, 2003).

FIGURE 01: The National Learning Initiative highlighted 3 importnant areas - Cognitive ability, problem solving, and academic performance

> Research has provided increasing support that children's heath & well-being is connected to nature

IMPROVES SELF-DISCIPLINE

Access to green spaces, and even a view of green settings, enhances peace, self- control and self-discipline within inner city youth, and particularly in girls (Taylor, Kuo and Sullivan, 2001).

IMPROVES SOCIAL RELATIONS

Children will be smarter, better able to get along with others, healthier and happier when they have regular opportunities for free and unstructured play in the out-of-doors (Burdette and Whitaker, 2005).

IMPROVES EYESIGHT

More time spent outdoors is related to reduced rates of nearsightedness, also known as myopia, in children and adolescents (American Academy of Ophthalmology, 2011).

IMPROVES NUTRITION

Children who grow their own food are more likely to eat fruits and vegetables (Bell & Dyment, 2008) and to show higher levels of knowledge about nutrition (Waliczek, & Zajicek, 2006). They are also more likely to continue healthy eating habits throughout their lives (Morris & Zidenberg-Cherr, 2002).

FIGURE 02: Play is not restricted to playgrounds and schoolyards

FREE PLAY & QUALITY PLAY
2.07

How does nature help improve a child's cognitive abilities and academic performance? Research indicates it is the way children interact within the natural environment that is important. Children have a naturally deep, urgent need to play. As shown in figure 2, all children will play everywhere and with anything. Play is not restricted to playgrounds and schoolyards as adults seem to think. Children's free play in nature appears to be "quality play" in that it is pleasurable, self-motivated, imaginative, spontaneous, and unburdened by rules imposed by adults.

FINE & GROSS MOTOR SKILLS
2.08

This type of play involves the whole child; gross motor, fine motor and the senses: sight, smell, hearing, taste, touch, vestibular and proprioceptive.

Nature activates a child's gross motor skills with whole body movements such as walking, running, and climbing. Also, the terrain outdoors varies in elevation and has obstacles which challenge a child's gross motor abilities. With objects to climb and jump off of, the outdoors is a more varied environment than a typical child's playroom or gymnasium. In addition to legs and arms, core muscles (stomach and back) and neck muscles are also used when climbing trees, hopping on rocks, or trying to stay balanced on uneven ground. A child with weak gross motor skills can have difficulty sitting upright in class and paying attention.

Nature activates a child's fine motor skills by involving small muscle movements of the hands and fingers with coordination of the eyes. Digging in the dirt, shoveling, raking, pulling weeds in a garden and manipulating clay are all examples of how fine motor skills are engaged in the natural environment. A child with weak fine motor skills can have difficulty cutting with scissors, holding a pencil, and finger feeding.

PHYSICAL INTERACTION
2.09

Through their physical interaction with the environment, children gain information and improve their physical functioning. Physical functioning is closely related to cognitive development as perception is an active experience and children are learning as they move through spaces. It is through perceptual information gained through the senses that an environment reveals information to the child.

It is typical for blind children to develop at a slower pace because they do not gain the same information from the environment as sighted children. In addition, sensory experiences had by children are far more sharp and detailed than that of adults. Yi-Fu Tuan (1974) believes this is because children are more open to the world and free of the stress and time constraints held by adults. Likewise, while adults perceive spaces from a primarily visual perspective, children perceive their surroundings through their bodily interactions with them. These bodily interactions are more meaningful because they engage more than one sense at the same time.

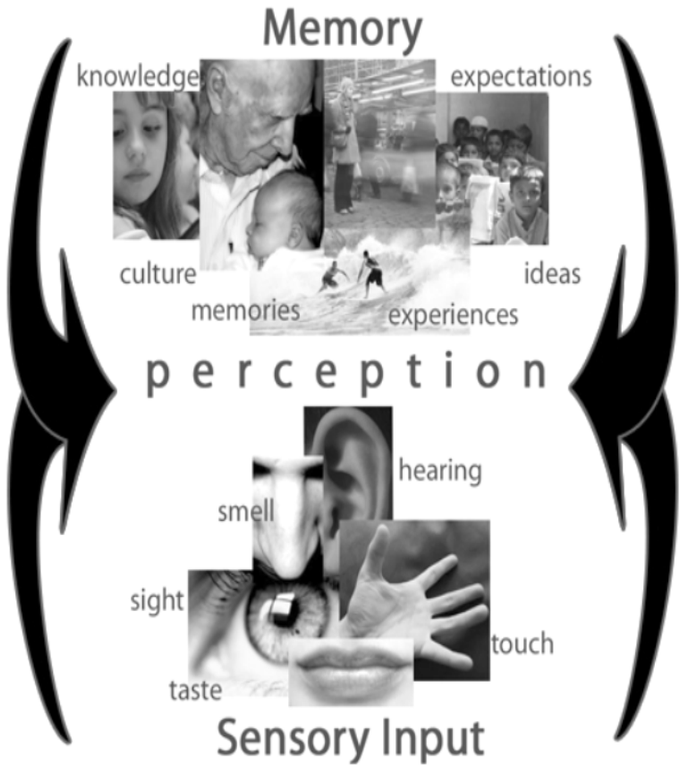
> Sensory Experiences Had By Children Are Far More Acute And Detailed Than That Of Adults: Children Are Free Of Stress And Negligent Of Time & More Open To The World.

3.00 ATTENTION

ATTENTION RESTORATION THEORY (ART)
3.01

ART suggests that different parts of the brain are activated when we expose ourselves to direct and indirect references in nature. These interactions with nature only require "effortless attention" which helps give our brain a break from "directed attention" and therefore helps restore its cognitive functioning.

Another way to explain ART is Top-Down and Bottom-Up Processing. Attention is controlled and modified by cognition, referred to as "top-down processing" which is influenced by knowledge, expectations, and executive processes like working memory and organization. Attention is also modified by sensory stimulation, referred to as "bottom-up processing" which is influenced by fascinating stimuli from the natural environment. In ART, fascinating stimuli from the natural environment dominates attention in an effortless manner which allows the mechanisms necessary for directed attention to recover and replenish.



ATTENTION PROCESSING
3.02

TOP-DOWN PROCESSING

Attention controlled and modified by cognition which is influenced by knowledge, expectations and executive processes.

BOTTOM-UP PROCESSING

Attention controlled by sensory stimulation which is influenced by fascinating stimuli from the natural environment.

INVOLUNTARY & VOLUNTARY ATTENTION
3.03

Nature's effect on cognition has further been explored through the Attention Restoration Theory (ART) by Kaplan. James (1892) originally proposed the separation of our attention into two components: Involuntary attention, which is not under our control and is usually captured by intriguing stimuli, and voluntary attention, which is directed by our cognitive processes.

Kaplan expanded on James' theory by suggesting that the interaction with stimuli in nature invokes our involuntary attention modestly which allows our voluntary attention a chance to replenish. Therefore, after an interaction with nature, one is able to perform better on tasks that would depend on our voluntary attention abilities.

INVOLUNTARY ATTENTION

Attention is captured by inherently intriguing or important stimuli

VOLUNTARY ATTENTION

Attention is directed by cognitive control processes. Can be restored by interations with nature

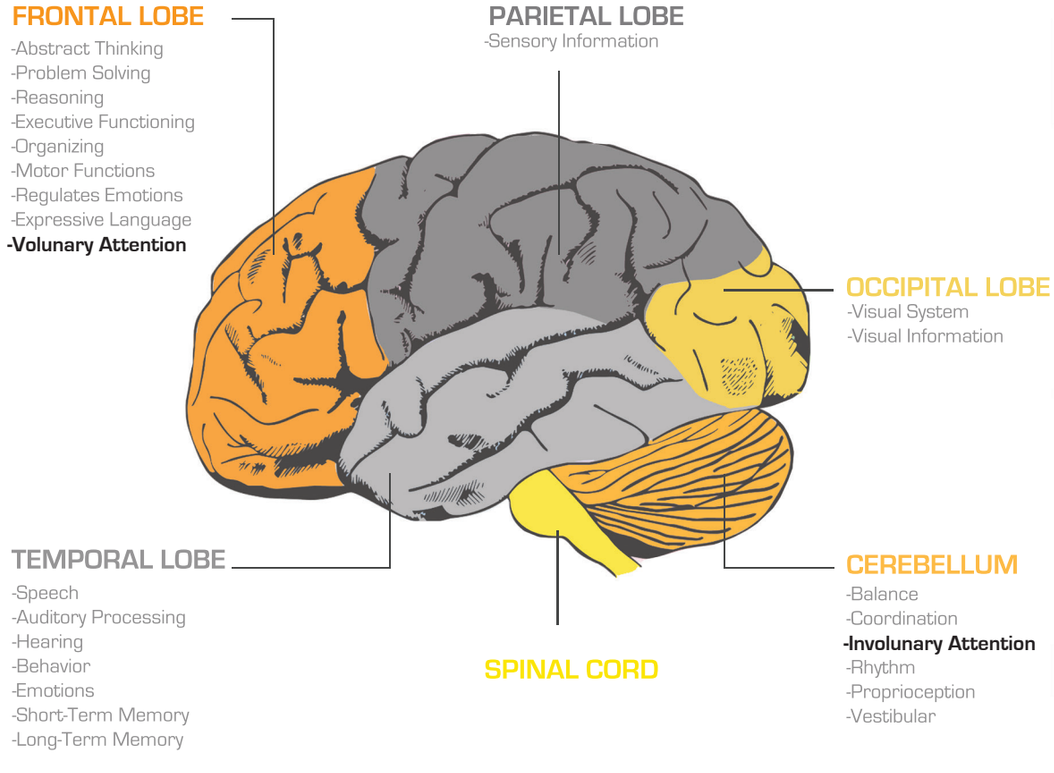
> Interaction with stimuli in nature invokes our involuntary attention modestly which allows our voluntary attention a chance to replenish.

THE BRAIN
3.04

How do restorative mechanisms in nature, like the trickling of light through trees, help us improve our performance? When speaking about cognitive ability and academic performance we need to reference the areas of the brain that are affected. The frontal lobe controls voluntary-directed attention, while the cerebellum controls involuntary attention.

FRONTAL LOBE
Voluntary-directed attention

CEREBELLUM
Involuntary-directed attention



STIMULI IN NATURE 3.05

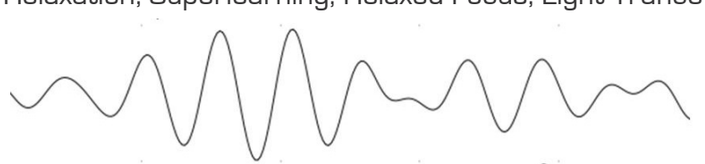
Stimulation in nature and learning also affects the brain physiologically. One example is the frequency of our brain patterns. Most of us live the majority of our lives in a state of beta brain waves. Beta is when we are alert, attentive, and engaged in cognitive functions such as problem solving and decision making. Beta is dominated during focused mental activity. In contrast, when we are relaxed our brain slows down and generally stabilizes in the alpha wave range. This alpha wave range puts us in an ideal condition to learn new information with improved focus and performance. When alpha is dominated, it heightens our imagination, visualization and memory.

BETA WAVES 14-30 HZ

Concentration, Alertness, Cognition, Arousal

ALPHA WAVES 8-13.9 HZ

Relaxation, Superlearning, Relaxed Focus, Light Trance



4.00 THE SENSES

THE SENSES
4.01

As mentioned previously, children's free play in nature is "quality play" because it involves all the senses. The senses are important to a child's learning and contribute to the overall development of a child. Nature provides ample exposure to all seven of these senses.

PROPRIOCEPTION
4.02

Proprioception is the ability to sense what different parts of your body are doing without having to look at them. Children develop proprioception through a series of pushes and pulls that happen when they interact with the natural environment. Sensory receptors in joints, ligaments, muscles, and connective tissue are engaged when picking up sticks or raking leaves. Walking outdoors offers natural messages to a child's feet as they walk on different-sized pebbles and uneven ground. Nature offers resistance and inconsistency that promotes sensory integration from proprioceptive feedback.

VESTIBULAR
4.03

Vestibular input helps children maintain balance and trunk control. When we move our body and head in different directions, the fluid in the inner ear moves back and forth, stimulating the tiny hairs inside. This stimulation provides us with awareness of where our body is in space and helps us move around our environment with ease and control. Vestibular, auditory and visual senses are all interconnected, and if one is not working right, then the other two will be affected. Children with poor vestibular sense may be clumsy, walk in a robot-like fashion, or toe walk. In order to stimulate the hair cells located in the inner ear, children need to move in all different directions. Nature provides these authentic play experiences when they are rolling down hills, swinging, hanging upside down, climbing, crawling, and spinning in circles. Furthermore, children need this vestibular input on a daily basis for a significant amount of time.

SIGHT
4.04

Sight can reinforce what a child learns through the other senses. For example, if a child smells cookies baking, the sight of the cookies confirms that's what it is. Children with decreased vision can have difficulty focusing, analyzing depth, reading, paying attention, concentrating, and copying from the board. Furthermore, "low-level" visual characteristics distinguish natural environments from built environments. These "low-level" visual characteristics include the proportion of straight versus curved edges, the hue and saturation of color, and entropy (statistical randomness of pixel intensity). Berman et. al. found that people prefer images possessing these low-level characteristics. In addition to low-level characteristics, nature is abundant with fractal patterns. The dappling of light under the canopy of a tree and the reflection of clouds in a still lake are examples of fractals in nature. Research has indicated that our brains are attuned to fractals in nature, as they catch and hold our attention. Salingaros found that fractals in nature provide a buffer from stresses induced by external forces (11-28). Hagerhall et. al. proposed that the fractal quality of landscape views is the reason for theconnection between preference and nature (247-255).

There is also evidence that color may impact learning outcomes by improving attention and motor processes. In regards to color preference, children with attention difficulties may find bright colors overwhelming (Clay, 2004). Research may indicate that the subdued, neutral colors found in the natural environment may result in better academic performance.

HEARING
4.05

Hearing sounds in the environment provides us with a sense of the 3 dimensional spaces we occupy. Sounds have many dimensions including intensity (loudness), pitch (high or low), quality (resonance) and localization (where the sound is coming from). A child may have trouble processing all these dimensions together to filter out some sounds while focusing on another. It is also possible for a child to be over-sensitive to sounds, causing anxiety, or be under-sensitive to sounds and not hear their name being called or have difficulty paying attention to what their teacher is saying. According to the Acoustical Society of America (ASA), only 75% of speech is intelligible in many US classrooms due to background noise. While a busy open-concept classroom may expose a child to constant noise pollution, the sounds in nature are calm and relaxing. Listening to birds chattering, crickets chirping, and leaves rustling in the wind, all helps improve children's spatial awareness as they turn to localize the sounds in nature.

TACTILE
4.06

Exposure to tactile events increases a child's tolerance to various haptic interactions. Children who do not receive this feedback may become "tactile-defensive" and exhibit aversive or heightened responses to stimuli that most would find tolerable. When children walk barefoot, their senses are integrated so complications such as toe-walking are avoided. Nature also provides tactile stimulation in the form of thermal sensations such as the feeling of the wind and sun on one's skin.

TASTE & SMELL
4.07

Sense of taste and smell work closely together. Children who have difficulty processing the sense of smell and taste may become overly sensitive to particular smells and tastes. Smells that one might find tolerant may make them gag or vomit. In nature you do not smell just one scent, but rather a multitude of scents of varying intensities. Indoor scents tend to be more constant and man-made such as cleaning chemicals, paint, plastic, and markers. Interestingly, the senses of smell and taste are closely tied to emotions. A certain smell or taste can easily bring up a past memory, whether pleasant or not. Therefore, smelling different scents in nature helps children regulate their emotions to stay calm and relaxed.

SENSORY EXPERIENCES
4.08

In summary, sensory feedback provides us with important information about our surroundings. Sensory feedback makes us feel and act in certain ways. Children need exposure to a variety of sensory experiences regularly in order to integrate their senses. The more exposure a child has to sensory experiences throughout the day, the more integrated and organized the brain, senses and body become. Sensory organization is the process of organizing sensory feedback and making sense of the input coming in. The calmer we are, the better we are able to process and organize our senses. As mentioned previously, sensory disorganization can interfere with the ability to decode information properly and the result is a fight-or-flight response (we either stay and fight or escape and run away). These fight-or-flight responses can cause symptoms such as increased heart rate, dilated pupils, erratic breathing, and heightened muscle tension. These reactions are normal if there is real danger, but not if a child is about to take an exam and there are too many bright colors or loud noises in the classroom. The fact is that children spend much of their waking hours in a learning environment. Many times, this learning environment may be providing sensory experiences that are too great or not enough for a child's system to successfully process. In contrast, nature provides children with experiences that activate all the senses in optimal measures and intensity.

The sensory experiences in nature are subtle, yet not boring or overwhelming. Non-rhythmic stimuli in nature such as birds chirping and the wind blowing are more inviting than deliberate, predictable stimuli such as air conditioners and furnaces in the built environment. Moreover, Beauchamp suggested that natural movement is generally perceived as positive and mechanical movement as neutral or even negative (991-1001). If this is true, than the dappling of light through trees will hold one's attention longer and reap the resulting health benefits, than the repetitive ticking of a clock which will be noticed initially then discounted over time.

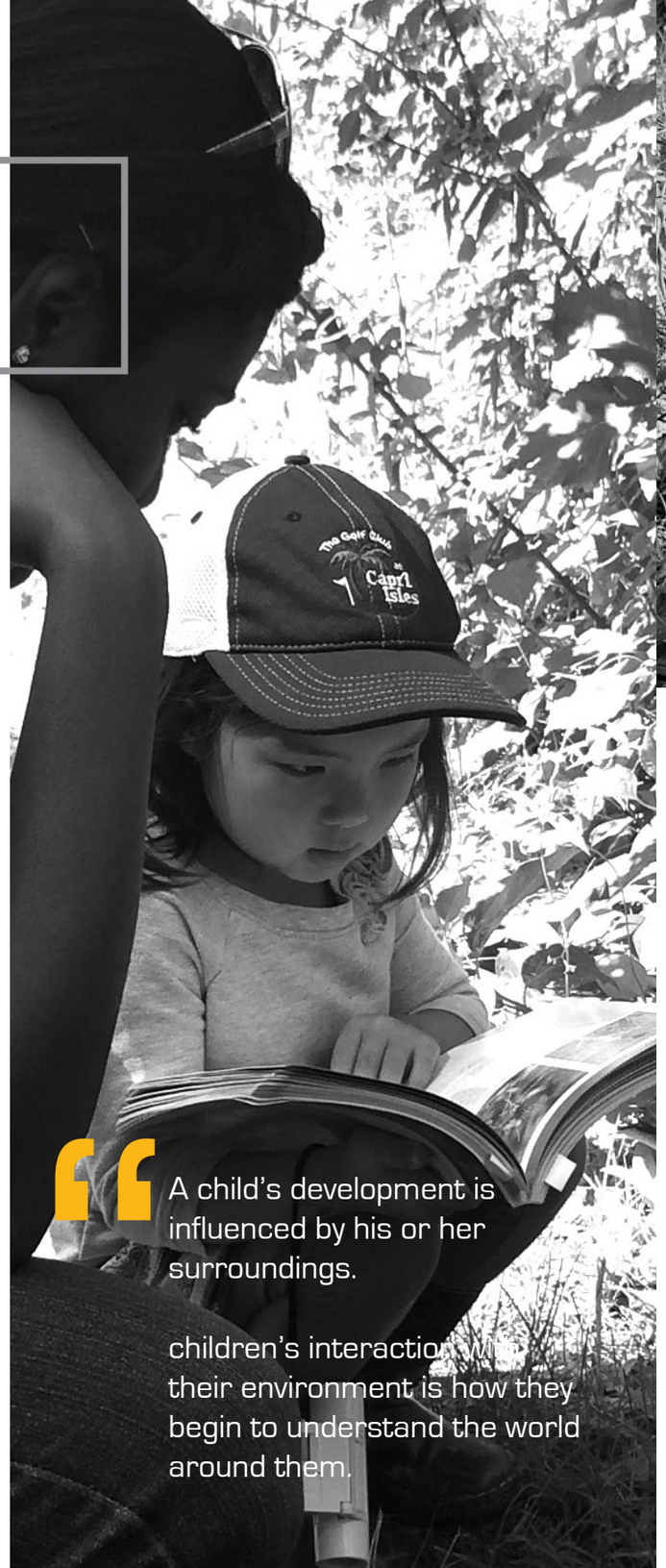
5.00 LEARNING + TEACHING

LEARNING THEORIES
5.01

Several learning theories and teaching methods have embraced the view that a child's development is influenced by his or her surroundings.

Constructivism theories of learning emphasize the importance of the active involvement of learners in constructing knowledge for themselves.

Jean Piaget's Stages of Cognitive Development is a Constructivism theory that begins with the Sensorimotor Stage from birth to 2 years of age. It is during this stage of development that babies and toddlers experience the environment through the sensory modes by tasting things, touching them, handling them, and crawling on them – thus learning more about them.



> A child's development is influenced by his or her surroundings.
>
> children's interaction with their environment is how they begin to understand the world around them.

TEACHING METHODS
5.02

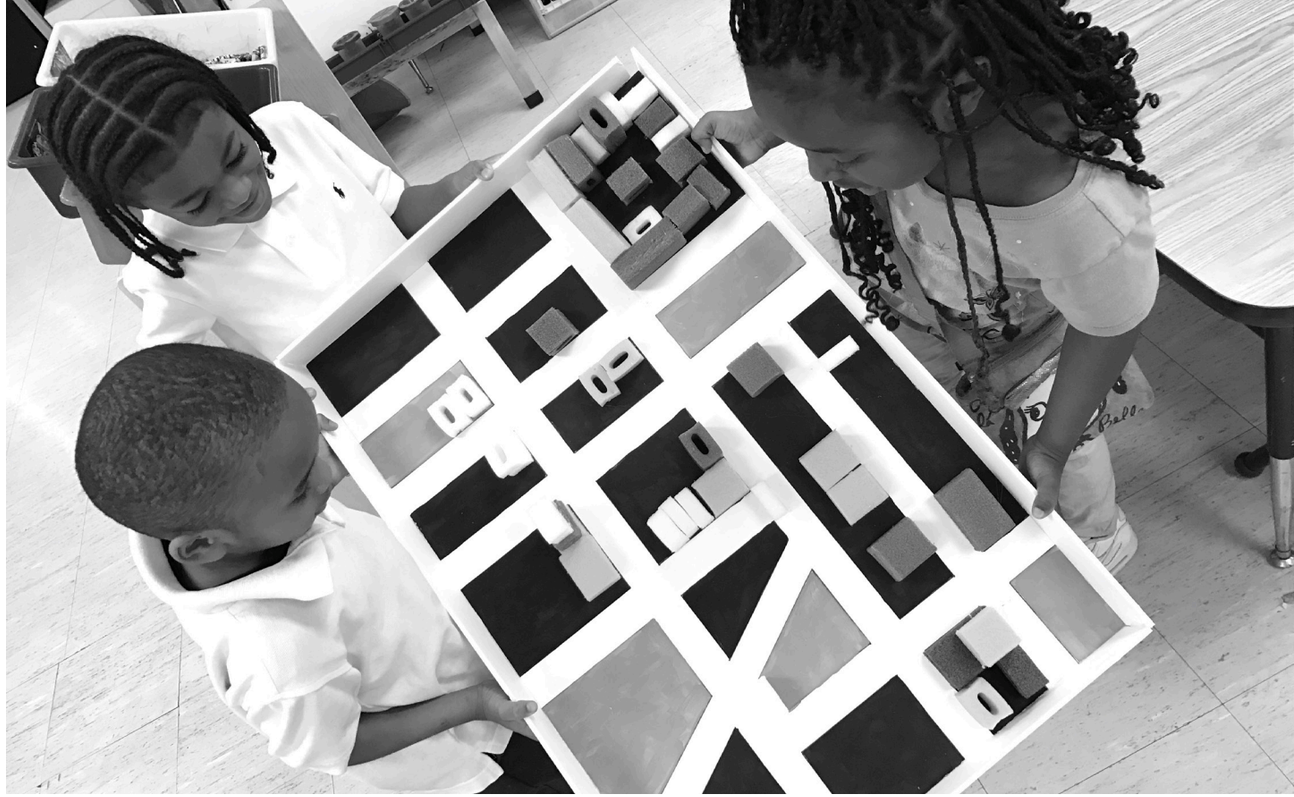
In regards to teaching methods, the Reggio Emilia approach to early education views the environment as another teacher with the potential to inspire children. In this teaching method, "the environment is the third teacher".

The Inquiry-Based Learning approach to teaching opens up students' natural curiosity for the world around them. It encourages children to gather information and formulate questions. According to inquiry-based learning, the "inquiry" begins with information obtained through the senses. The approach also uses nature as a space to spark this inquiry.

TEACHING + LEARNING IN THE CITY: INDEPENDENT STUDY 5.03

Inquiry-based learning was employed during activities to introduce design to young children. Teaching and Learning in the City, a graduate independent study course, integrated how children learn about design and art. Basic design concepts such as scale, color theory, figure-ground relationships, pattern, and rhythm were taught to preschool students in Detroit through hands-on project based activities.

The 14 Kindergarten students were encouraged to seek information and knowledge regarding design notions by gathering information obtained through their senses. The Activities empowered students to become active contributors to their own learning experience.



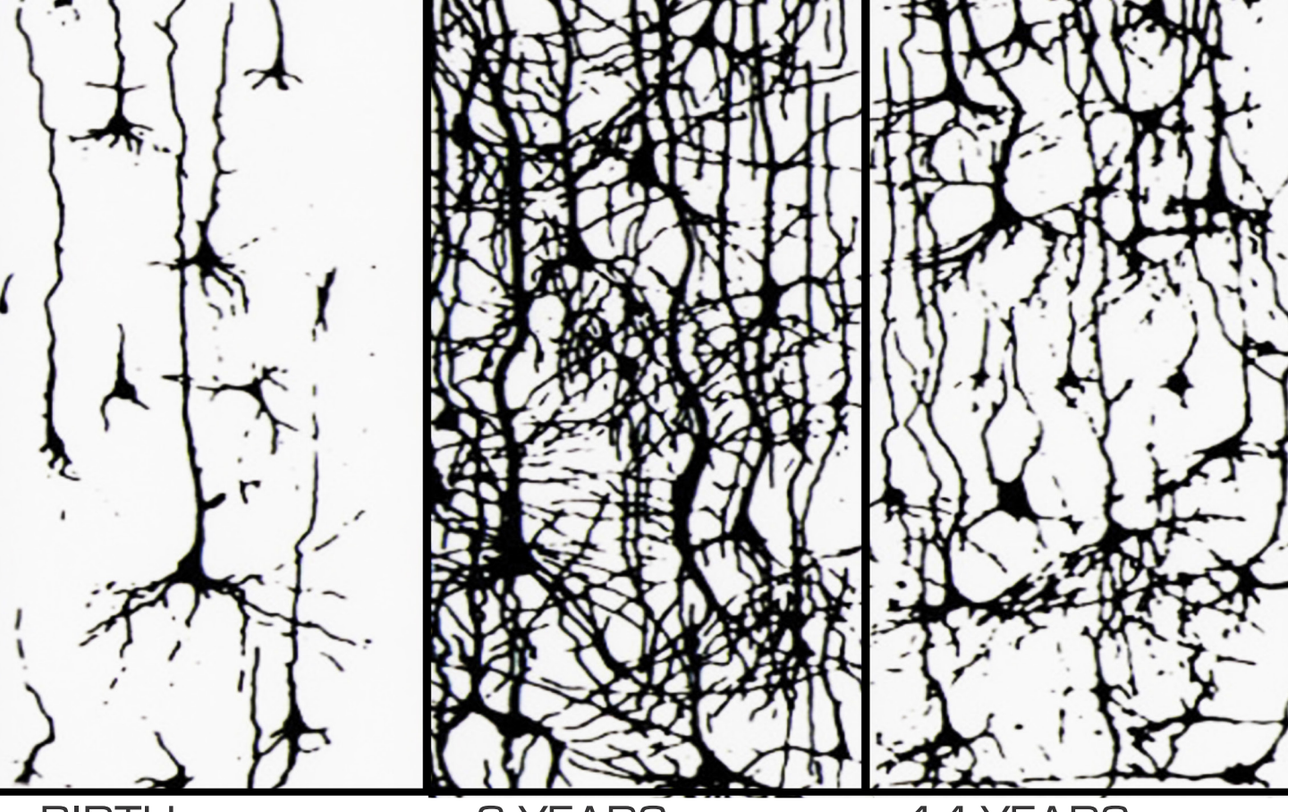


FIGURE 03: Synapse Density over time. Synapses are formed at a faster rate in early childhood than at any other time.

> ...These “windows of learning” are periods when experiences are especially important and skills are more easily learned and connections formed.

TIMING IS EVERYTHING 5.04

Just as important as how children learn is when this learning occurs. The human brain contains over 100 billion neurons which receive, process, and transmit information. In-between neurons are spaces called synapses. When we learn new things, connections are made (in the thinking areas, motor areas, sensory areas, etc.) and synapses are formed. In other words, learning causes structural changes in the brain’s anatomy. Figure 3 shows how in the first decade of life, a child’s brain has twice as many synapses (connections from one neuron to another) than that of an adult. These “windows of learning” are periods when experiences are especially important and skills are more easily learned and connections formed.

HISTORICAL CONSIDERATIONS
5.05

Although teaching methods like Reggio Emilia and Inquiry-Based Learning are implementing change to our philosophy of teaching; the education system in the U.S. has remained nearly the same as it was a century ago. Public schools in the United States are modeled in the 20th century on factories. This "factory model" education system was created in the early 1900's to serve a different time with different needs. Students during the Industrial Revolution were educated to prepare for work in a factory or another sort of industrial type job. Typical school curriculums today continue to have an assembly line aspect in that they are motivated toward producing a relatively uniform product. This is accomplished by grouping students in groups not based on abilities, but rather their chronological age. Everyone in the group is taught the same skills, the same way, at the same time. From the curriculum to testing; everything is standardized.

This "factory model" of education can also be seen in school design. School buildings are constructed with similar floor plans that include long hallways lined with lockers and classrooms located on both sides. Shaw referred to this as the "cells and bells" model; students are sorted by age and dispersed into their "cells", only to move to the next "cell" when they hear the "bell"; just as they did in factories. Inside the classrooms students are seated in rows; a pattern referred to as the "cemetery method" of seating (figure 4). The dynamics of the factory model rests on the fact that the teacher, who is positioned away from the students, controls what information is offered and how it is learned. This factory model philosophy and design provides barriers to providing the personalized, student-centered learning we strive for in education today.

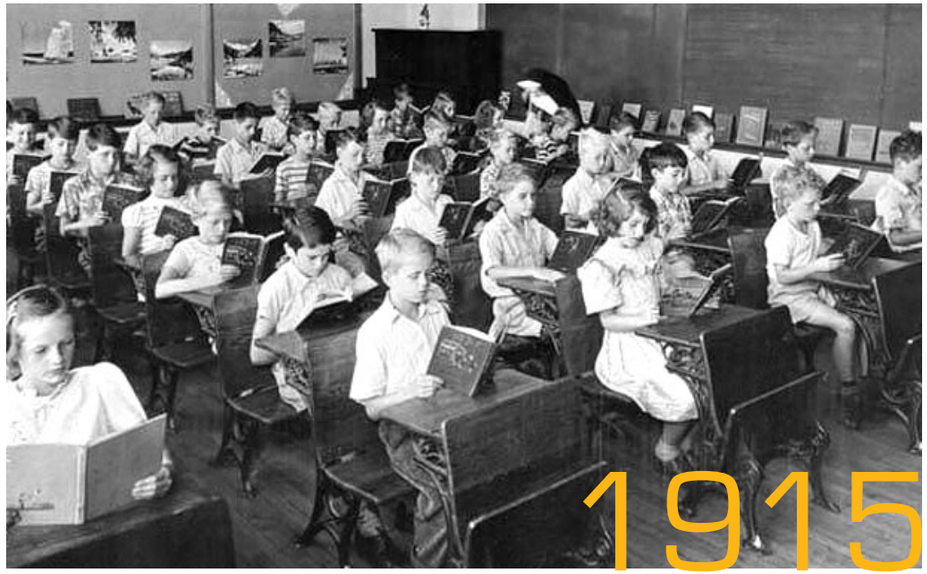


FIGURE 04: "Factory Model" education from the early 1900's persists in today's schools and curriculum

THE NEED FOR PLAY
5.06

Many educators today are reporting that their students are having trouble paying attention in class. Teachers report that kids are falling out of their chairs, cannot sit still, and are experiencing challenges in the areas of basic social skills such as sharing and turn taking. There is also an increase in anxiety, behavior regulation, and sensory issues. Angela Hanscom, an occupational therapist and founder of a nature-based development program in New England, contributes these increasing trends to the decline of play in school. Children as young as kindergarteners are asked to sit for longer periods during "circle time". Unfortunately, the push for academics from parents and educators is recognizing pre-reading, writing, and math skills as more important than the relaxed, playful environment once typical of a preschool. As a result, organized adult-directed learning experiences are replacing active free play in order to meet the academic readiness demands that are expected before children even enter kindergarten. However, meaningful play is needed for children to have whole-body sensory experiences in order to have healthy minds and strong bodies. Furthermore, the outdoors is optimal at engaging all the senses and challenging young bodies. Preschool children are experiencing more sensory and attention issues as a result of schools decreasing opportunities for natural, meaningful play experiences

> GIVE THE PUPILS SOMETHING TO DO, NOT SOMETHING TO LEARN; AND THE DOING IS OF SUCH A NATURE TO DEMAND THINKING; LEARNING NATURALLY RESULTS
>
> -JOHN DEWEY
> Democracy and Education: An introduction to the Philosopy of Education (1916)

6.00 PRECEDENT STUDIES

LOOKOUT
6.01

Rotstein Arkitekter

Stockholm, Sweden

“Many of the units were designed to serve multiple purposes. For example, the storage units are built into the walls as colored niches, serving also as caves and huts for the children. The stairway becomes a place for parallel activities. It also functions as cabin, lookout tower, forest, cave and platform. When descending the stairs it widens, turning into an amphitheater like area. This is the perfect place for play during the day. A quieter and darker room has been created underneath the stairs: a secret hideout.”
- Arch Daily

LEARNING THROUGH THE BODY
6.02

Rosan Bosch Studio

Zaragoza, Spain

"Instead of a classic classroom setup with desks and chairs, a landscape consisting of a cave in a big mountain, a valley and sand dunes where toys and books can be stored and a desert with flexible furnishing now form the setting for many different types of formal and informal learning situations. Learning through the body with hands-on learning and physical challenges."
- Rosan Bosch Studio

ESCAPING
6.03

HIBINOSEKKEI +
Youji no Shiro

Kanagawa Ward, Japan

"As for interior, we designed by imagining "woods". In the woods, there are factors that prompt a variety of discoveries, chances and five senses. The communication space in the center imagines this kind of "woods". Each child has a "nursing room" to which they go back. In the woods, there are small and large space, small step, space where they draw a picture, climbing space and a hut similar to tree house."

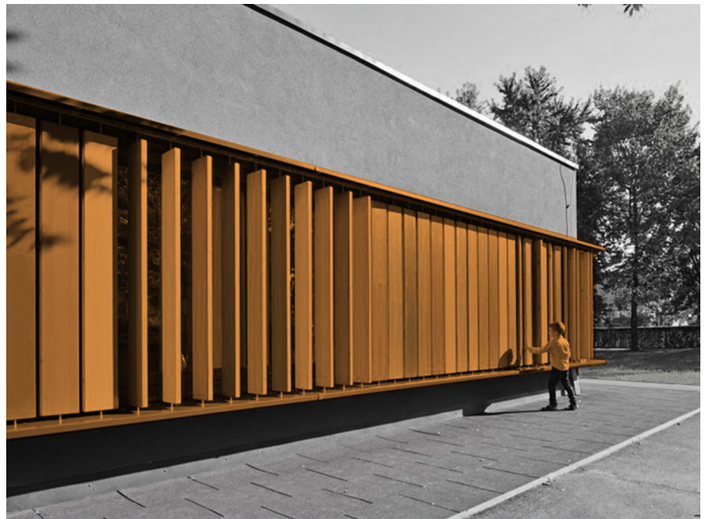
-Arch Daily

MULTIPLE INTELLIGENCES
6.04

Rosan Bosch Studio

Zaragoza, Spain

"The dynamic learning environment is designed in detail with a focus on supporting the educational institution's applied pedagogy 'Multiple Intelligences', based on a unique concept design that accommodates children's need to learn and develop based on a combination of different learning styles."
- Rosan Bosch Studio



ENCOURAGE PLAY
6.05

Jure Kotnik Architecture

Ljubljana, Slovenia

The colorful, interactive Kindergarten facade allows children to determine how much natural light can enter the interior of the classroom. Through manipulating the wooden slats children can change the daily look of their learning environment. Giving children a sense of ownership in where they play is important.

7.00 SENSORY ABSTRACTIONS (PRELIMINARY IDEAS)

.01 ADVANCING / PAUSING

.02 PLAYING

.03 WALKING

.04 SITTING

.05 ESCAPING

ADVANCING / PAUSING
7.01

How can we extract these sensory stimuli mechanisms from nature and implement them into the design of children's spaces during these critical periods?

Textures and tactile qualities can invent, arrange, or change movement as children move through a space. The abstraction shown in figure 5 makes noise and engages the auditory and visual senses and can help advance children down a hallway. This would be similar to dragging a stick along a picket fence when walking in nature. Variations in texture can also be used to hurry or slow down the pace of travel within a particular area like a hallway.
A foam wall abstraction can create a space where children would linger and explore.
The foam wall is similar to an experience one would have in nature with sand, mud, mosses, or other absorbent substances. A child can manipulate it and engage the visual and tactile senses. Research indicates a strong connection between our visual and auditory sensory systems and psychological well-being (Hunter et al, 2010).

In addition to choreographing movement, abstractions can also create a sense of extent (a perceptive of the environment that suggests exploration is possible) like a bend or curve in a hallway.

FIGURE 05: An abstraction which engages the auditory and visual senses can help advance children down a hallway.

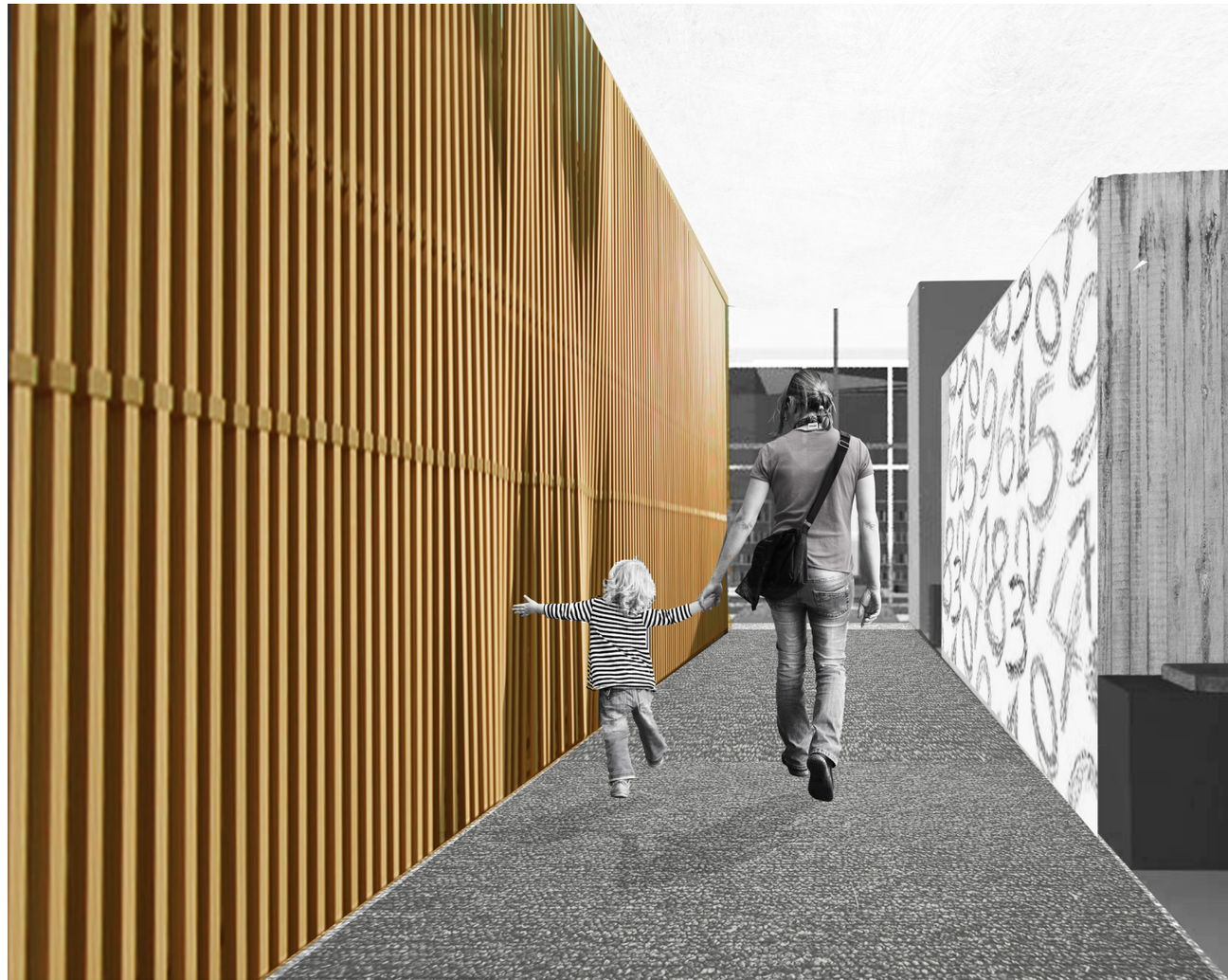


FIGURE 06: The slow changing patterns mimic seasonal changes experienced in nature.

PLAYING
7.02

Children are fascinated by momentary exposure to unpredictable movements. The non-rhythmic sensory stimuli feel special and interesting to children; it is a brief but welcomed distraction. An environment lacking in variation can lead to boredom and passivity (Heerwagen, 2006).

This abstraction can be at a height above the children's head where they are not able to touch it but are visually interested in the slow changing patterns while they play. The abstraction provides momentary exposure to unpredictable movement (figure 6). The abstraction can mimic the seasonal changes experienced in nature.

This implication integrates design ideas from the sky, sand, and trees that are manipulated by the wind. The design can use natural air flow for change or an irregular HVAC system.

FIGURE 07: Proprioceptive sensations are engaged as children walk over surfaces of variable textures and levels.

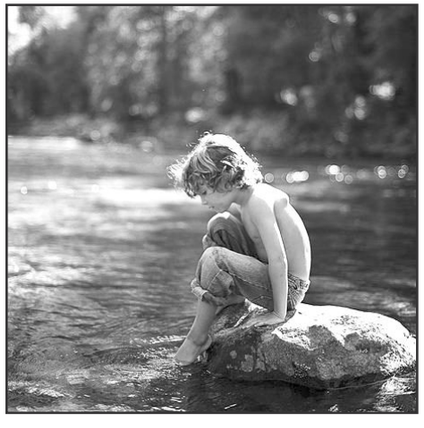
WALKING
7.03

Walking outdoors offers natural messages to a child's feet as they walk on different sized pebbles and uneven ground. Nature offers resistance and inconsistency that promotes sensory integration from proprioceptive feedback.

The abstraction can be a pathway that is variable in texture and levelness of the ground, therefore offering both tactile and proprioceptive sensations as children walk over and through them (figure 7).

Because of their size, children's eyes are closer to the floor and to objects at low levels. Therefore, they notice things like changes in floor level, which are often overlooked by adults. In addition, the eyes engage at a distance while the hands and feet are engaged at the point of contact, resulting in an increased and more intimate sensory experience.

FIGURE 08: Slow and irregular thermal changes engages a child's senses.



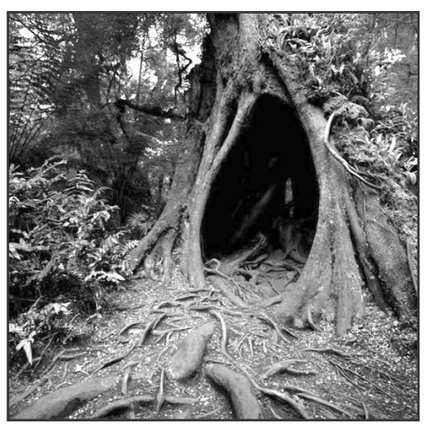
SITTING
7.04

Arens et. al. found that temporary over-cooling of a small portion of the body when hot, or over-heating when cold, without impacting the body's core temperature, is perceived as highly comfortable (60-66). This is similar to feeling a cool breeze on a warm day or leaning against a warm rock on a cool day.

Research suggests that a variety of thermal conditions within a classroom can lead to better student performance (Elzeyadi, 2012). Similarly, changes in ventilation velocity can have a positive impact on comfort with no negative impact on cognitive function, while also offering some increase in the ability to access short term memory (Wigo, 2005). In spite of these findings, traditional approaches to thermal design have focused on minimizing variation in temperature, humidity, and airflow.

A permanent floor condition that slowly and irregularly changes thermal temperature can engage a child's senses. The sensory experience is subtle and unpredictable, similar to that experienced in nature, as not to be a distraction (figure 8). Again, the abstraction can mimic the seasonal changes experienced in nature.

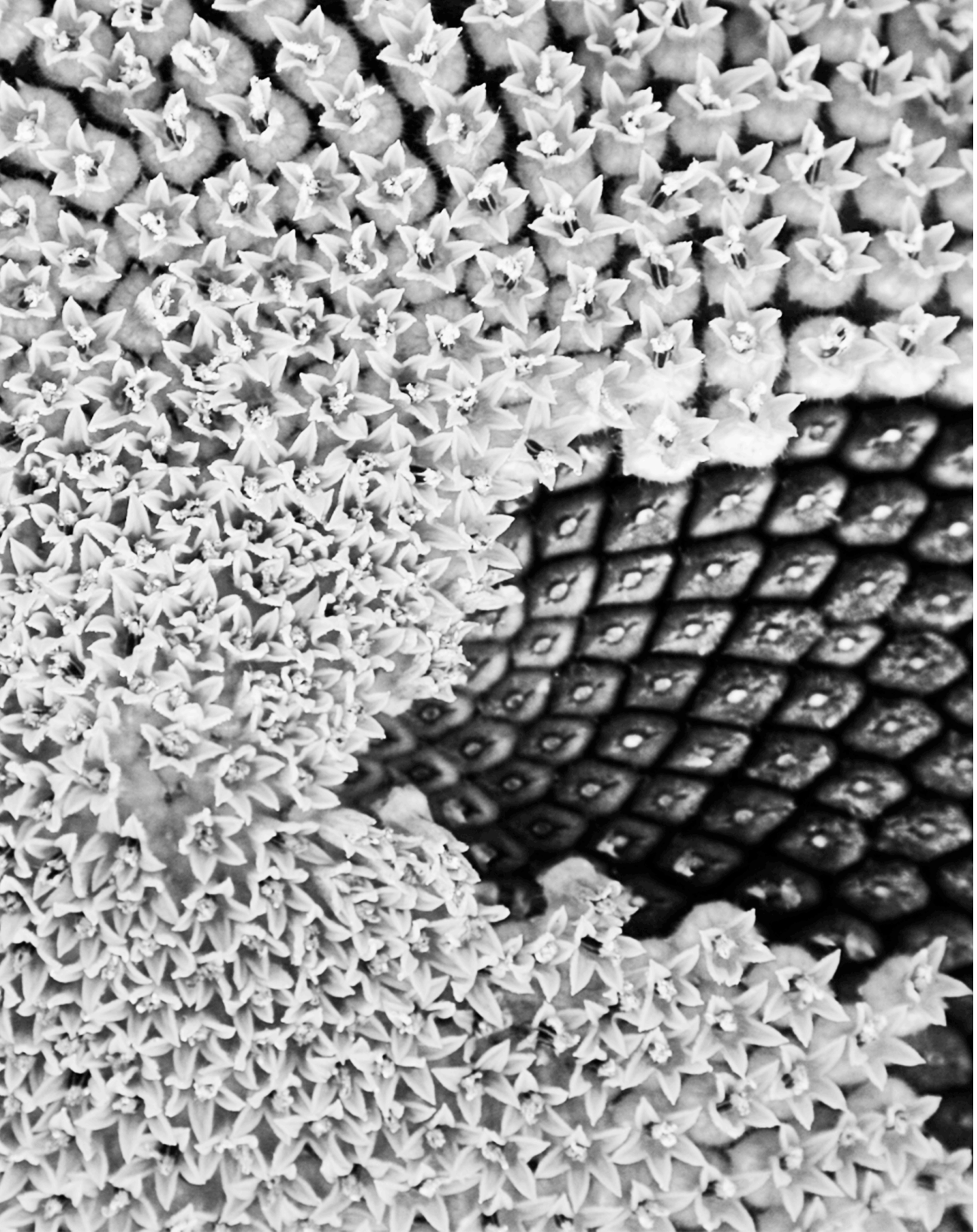
FIGURE 09: Refuge spaces feel safe and are important for restoration experience and stress reduction.



ESCAPING
7.05

Refuge is a space for removal from the key areas of activity in which an individual feels protected from behind and overhead. A space with good refuge feels safe and can be used by an individual or small group to work, rest, or play (figure 9). Common refuge spaces in nature include sitting with your back against a large shade tree or sitting in a treehouse. Refuge spaces are important for restoration experiences and stress reduction. Benefits of refuge spaces include improved concentration and attention (Grahn and Stigsdolter, 2010).

The benefits of refuge are even stronger when paired with Prospect. Similar to the "edge of the woods" in the natural environment; it provides protection from weather and predators but allows for outward observation.



8.00 CONCLUSION

.01 CONCLUSION

> Is there an approach to architectural design that understands the significance of sensory experience to learning?

CONCLUSION
8.01

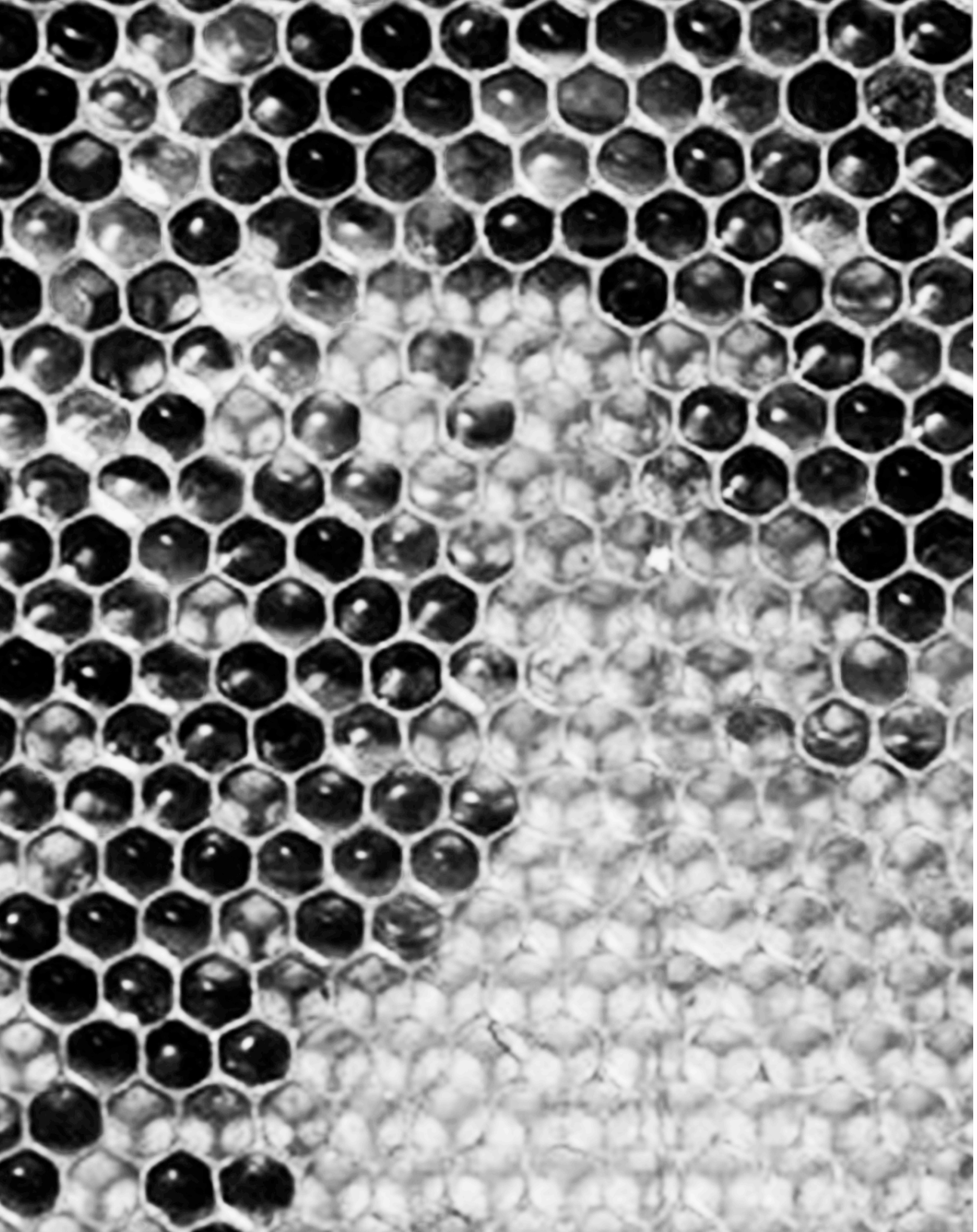
Spaces for children usually only differ in colors chosen, interior design components, and furniture, from spaces designed for adults. Sometimes they are places simply "recycled" after being used by the adult population. In order to design spaces for children, it is important to first understand how children develop, interact and learn from their environments. Research recognizes the importance of the environment on children's development; however, this knowledge is seldom applied to the design of children's spaces.

Biophilic design reconnects us with nature to reduce stress and improve our efficiency. Designers are using patterns and fractals, maximizing natural light, and incorporating "green walls" to improve our personal well-being, productivity, and relationships with others.

Educators are using nature as a space to encourage collaboration, communication and exploration in learning new ideas. Teachers are ordering butterfly kits, constructing nature tables, and growing garden herbs inside their classrooms. However, as we have recently discussed, children's understanding of the world takes place primarily through physical experience and is shaped by the environment they exist in. It is through the physical experiences of children that the senses are engaged and learning takes place.

Is there an approach to architectural design that understands the significance of sensory experience to learning?

PART 02



1.00 | INTRODUCTION

.01 | INTRODUCTION

> These sensory stimuli mechanisms from nature can be implemented into the design of children's spaces.

INTRODUCTION
1.01

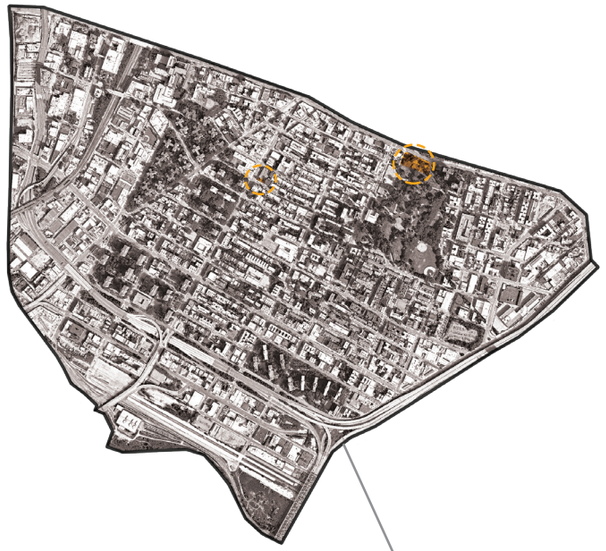
The positive effects of the sensory experiences in nature will be implemented into the built environment to provide similar outcomes on the cognitive performance of children in a preschool environment. These applications are not obvious, or anticipated but are assumed to engage involuntary attention while allowing the ability for focused tasks to replenish. Therefore, one would be able to perform better on tasks that require voluntary attention abilities. Applications can be single or multi-sensory and will serve as a framework that is actualized in the early learning domain depending upon spaces and activities.

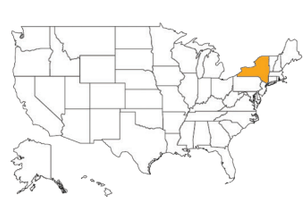
2.00 SITE INVESTIGATION

MOTT HAVEN, SOUTH BRONX

2.01

The Bronx in New York City presented itself as an ideal location to implement these abstractions. Mott Haven is an existing neighborhood located in the southern end of the Bronx, along the Harlem River and is surrounded by the neighborhoods Harlem, Upper Manhattan, Brooklyn and Queens. Mott Haven appeared to be a typical urbanized setting where children could be sensory deprived due to many contributing factors.

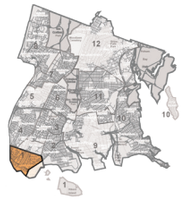




UNITED STATES OF AMERICA

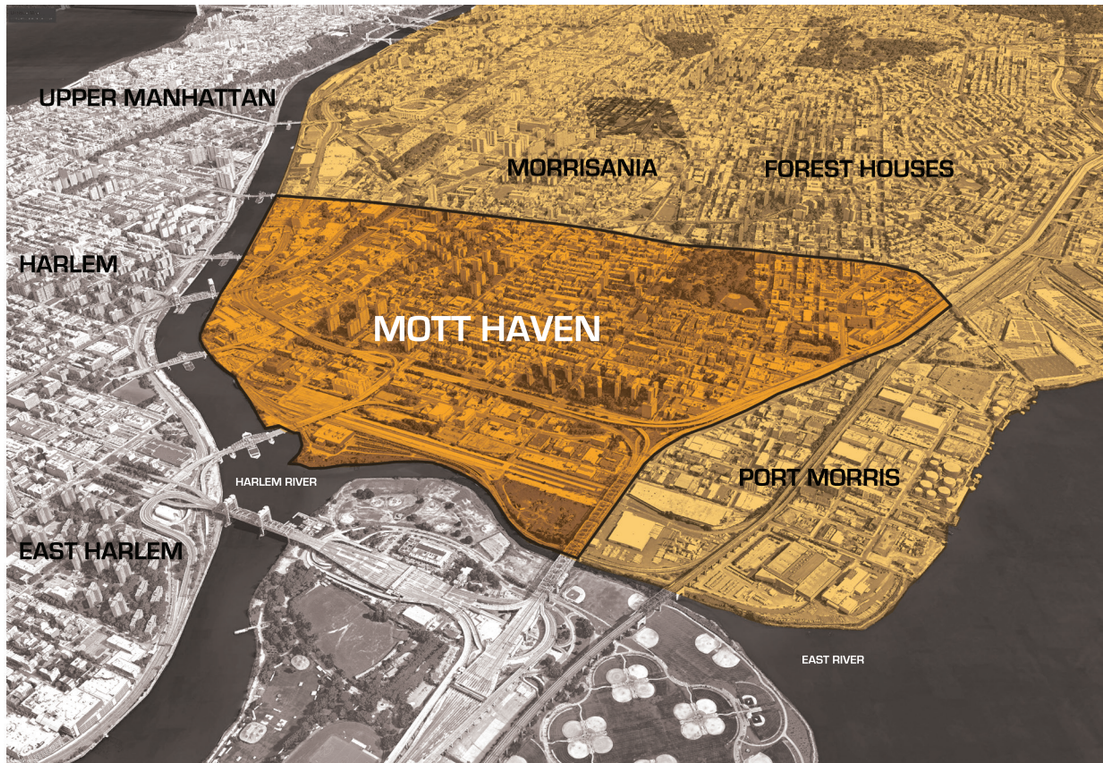
NEW YORK

NEW YORK CITY

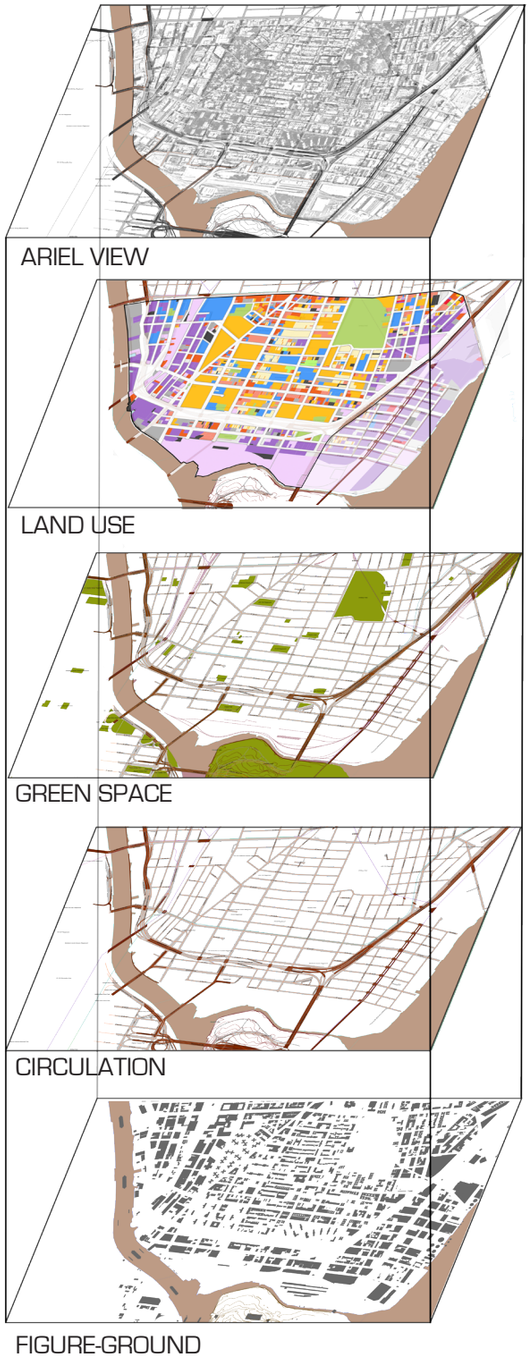


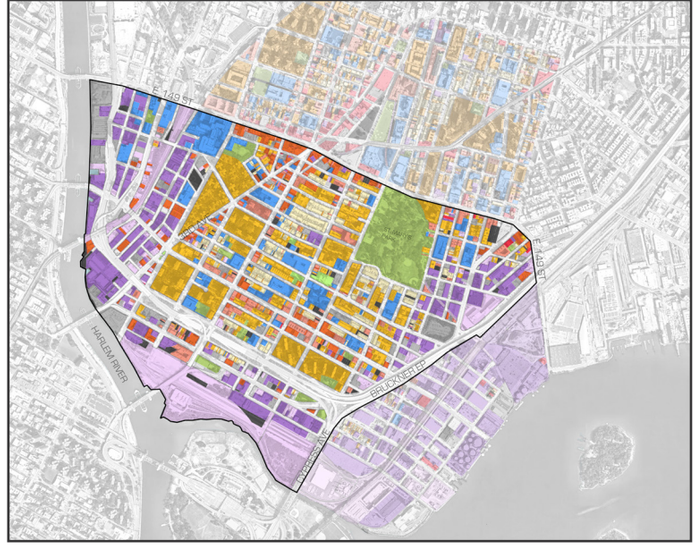
THE BRONX

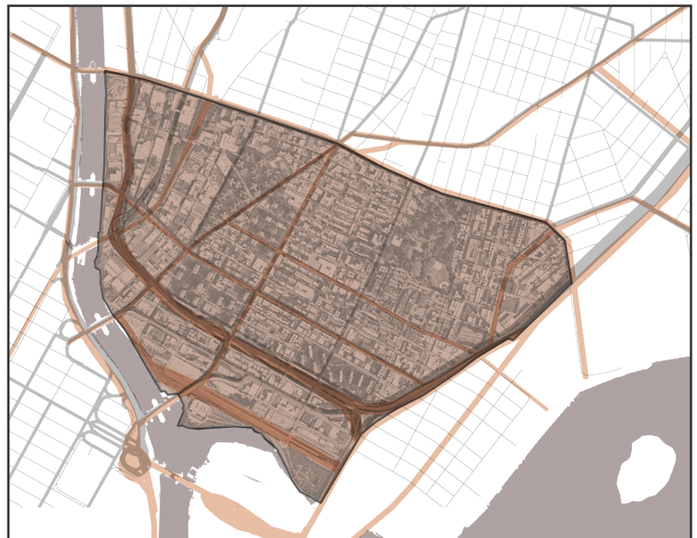
MOTT HAVEN



NEIGHBORHOOD ANALYSIS







> Mott Haven appeared to be a typical urbanized setting where children could be sensory deprived due to many contributing factors.

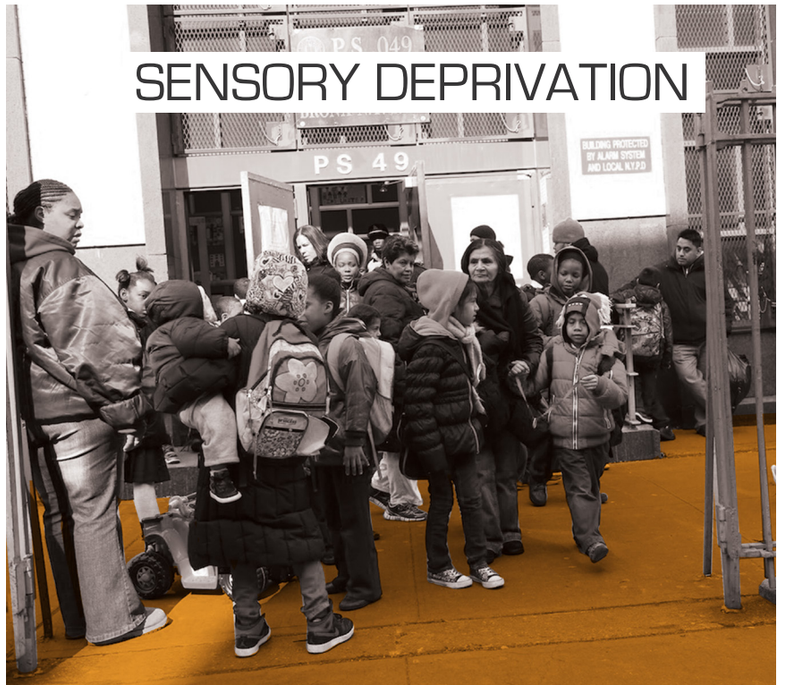
EXISTING NEIGHBORHOOD CONDITIONS

2.02

Elementary schools in the South Bronx district lack green spaces to provide students with sensory experiences. The majority of the green spaces that are available are vacant, over-grown, or abandoned. Schools have few or no windows and those that do lend themselves to views of densely urbanized areas. Outdoor play areas are the opposite of natural playgrounds as they consist of concrete or gravel with commercial play structures. The South Bronx is a high-density area dominated by tenement-style apartment buildings and large public housing complexes. These types of dwellings lack front and backyards. All of these factors contribute to a deficiency in sensory experiences and therefore the abstractions can provide the benefits that nature fails to offer.

NO WINDOWS

HIGH DENSITY



SENSORY DEPRIVATION

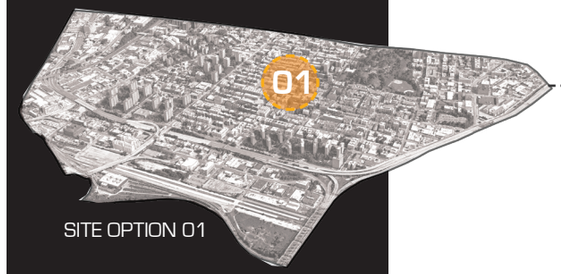
LACK OF GREEN SPACE

CONCRETE PLAYGROUNDS

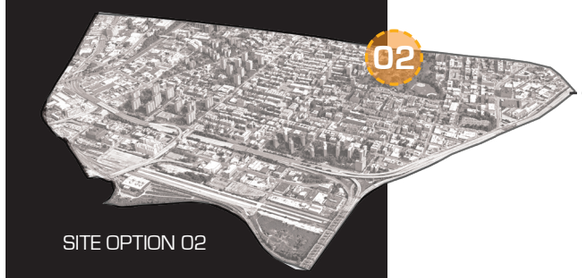
POTENTIAL SITE OPTIONS

2.03

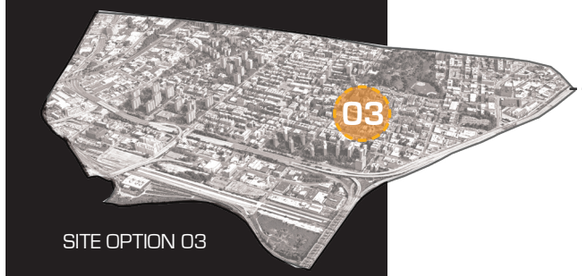
There were 5 potential sites located in the Mott Haven neighborhood of the South Bronx. All of the site options were ideal locations where a stand alone kindergarten could be implemented. Each site provided interesting opportunities but I have chosen to move forward with 2 sites. The abstractions could be implemented into any of the given site options. This is because the predicted outcome of this thesis will be a stand alone kindergarten school that can be designed and built in any typical urban setting.



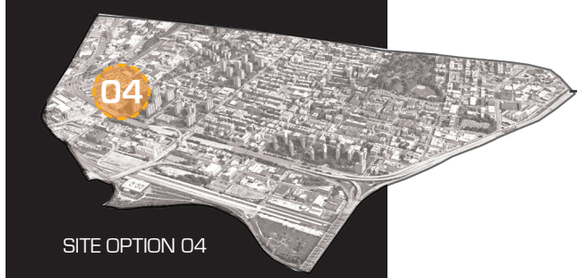
SITE OPTION 01



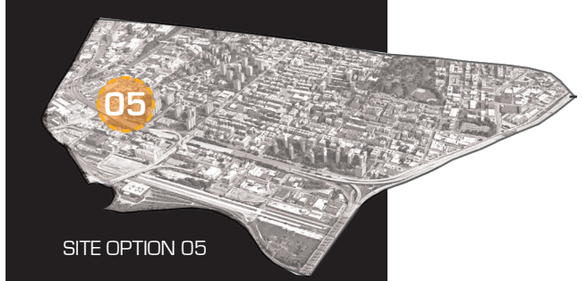
SITE OPTION 02



SITE OPTION 03



SITE OPTION 04

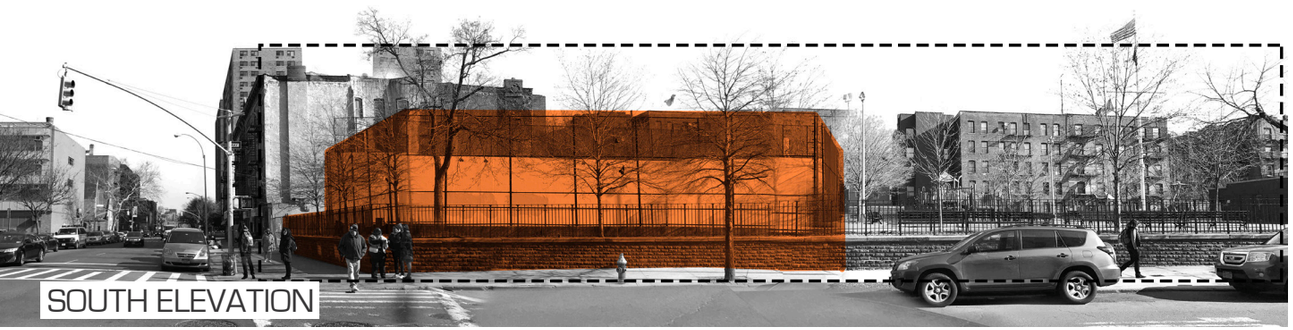


SITE OPTION 05

SITE OPTION 01
2.04

Site Option 1 is a vacant basketball court located in the People's Park. The site is in a major intersection adjacent to 2 schools. The location is one example of how the abstractions can be implemented in an educational site that would be found in a traditional urban setting.

WEST ELEVATION



SOUTH ELEVATION

EAST ELEVATION

“

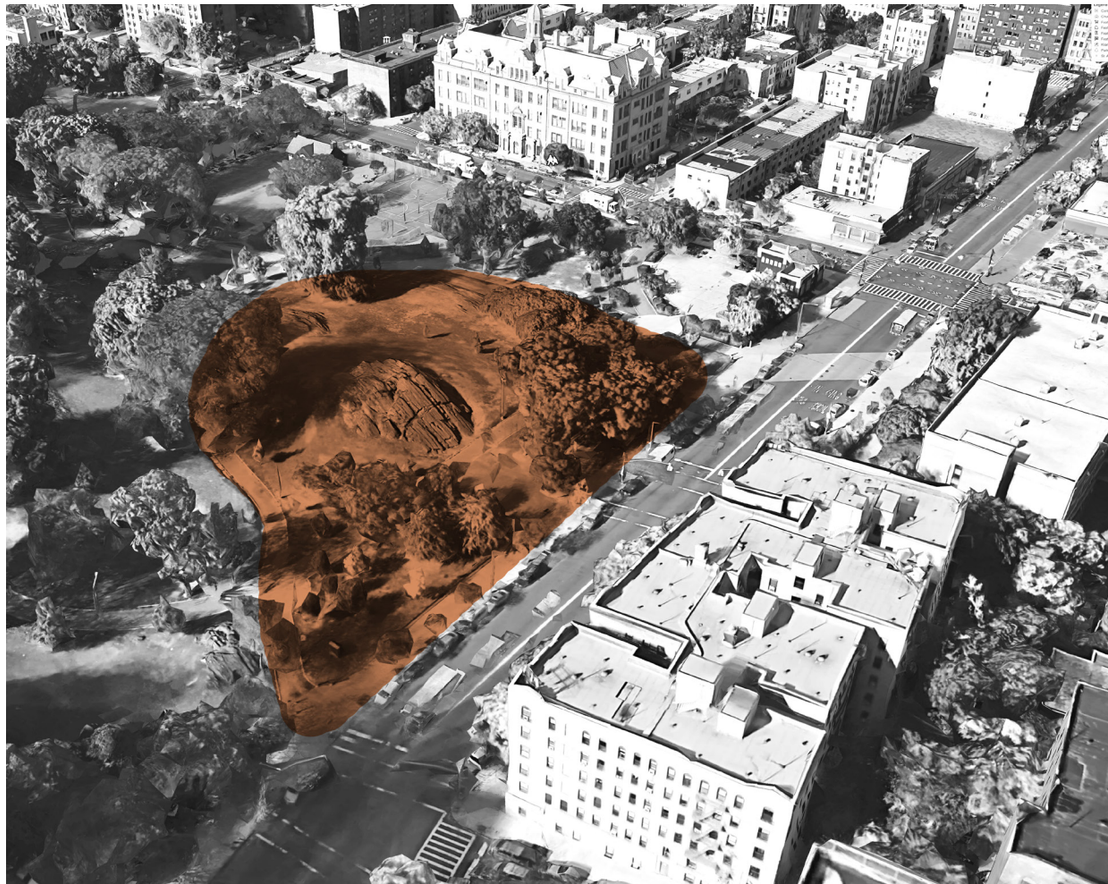
... An educational site that would be found in a traditional urban setting.

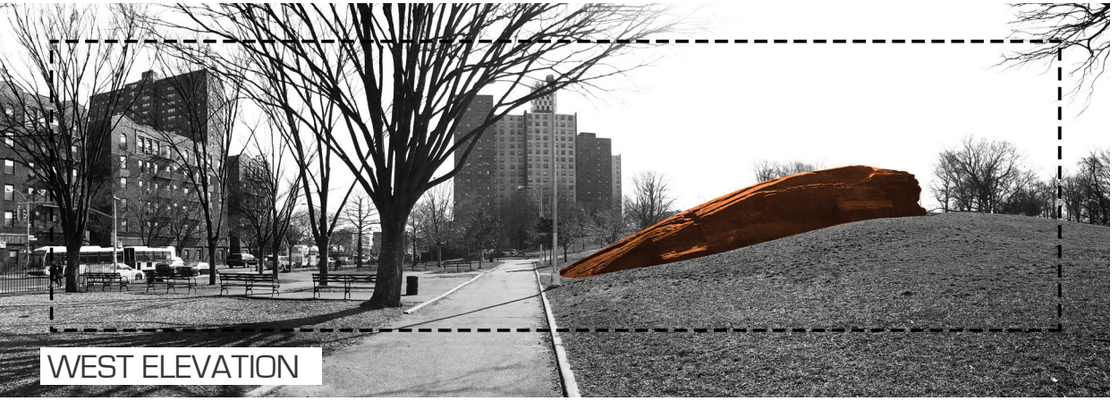
SOUTH ELEVATION

NORTH ELEVATION

SITE OPTION 02
2.05

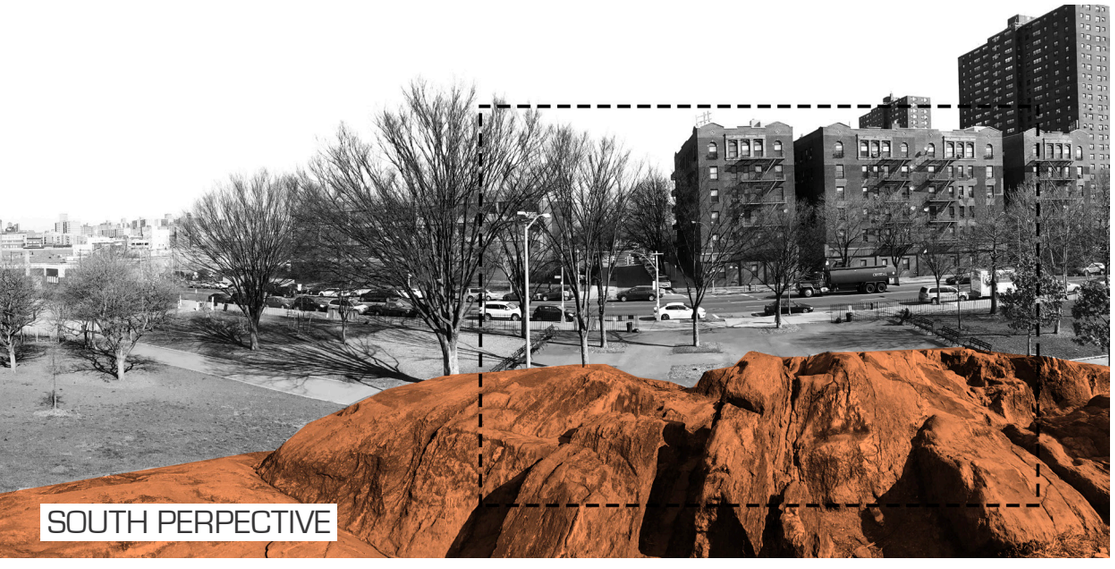
Site Option 2 is a located in St. Mary's public park which has unique rock formations. The site is located at the front of the park along a major street. This location is an example of how the abstractions can be implemented in a unique, non-traditional setting.





WEST ELEVATION

NORTH ELEVATION



SOUTH PERPECTIVE

“

... An educational site
that would be found in a unique,
non- traditional setting.

3.00 DESIGNING AN EARLY LEARNING ENVIRONMENT | **KINDERGARTEN**

SITE PLAN | KINDERGARTEN
3.01

The selected site is located between a public elementary school, people's park, and a high school. This corner condition was an example of a traditional urban setting, where a stand-alone kindergarten could be implemented. The designed kindergarten was able to work with the existing park on the east end, and create an interesting outdoor space for locals and the children.

PERSPECTIVE | KINDERGARTEN
3.02

The objective of this thesis was not to only create a kindergarten, but to show designers and architects that the interior spaces of schools are very important and need to be designed with great understanding and care. The overall building acts as a classroom where children learn through their interaction and play in different spaces, while engaging with the abstractions. It is critical for designers and architects to see this thesis as a framework of ideas and research that can be implemented into any school.

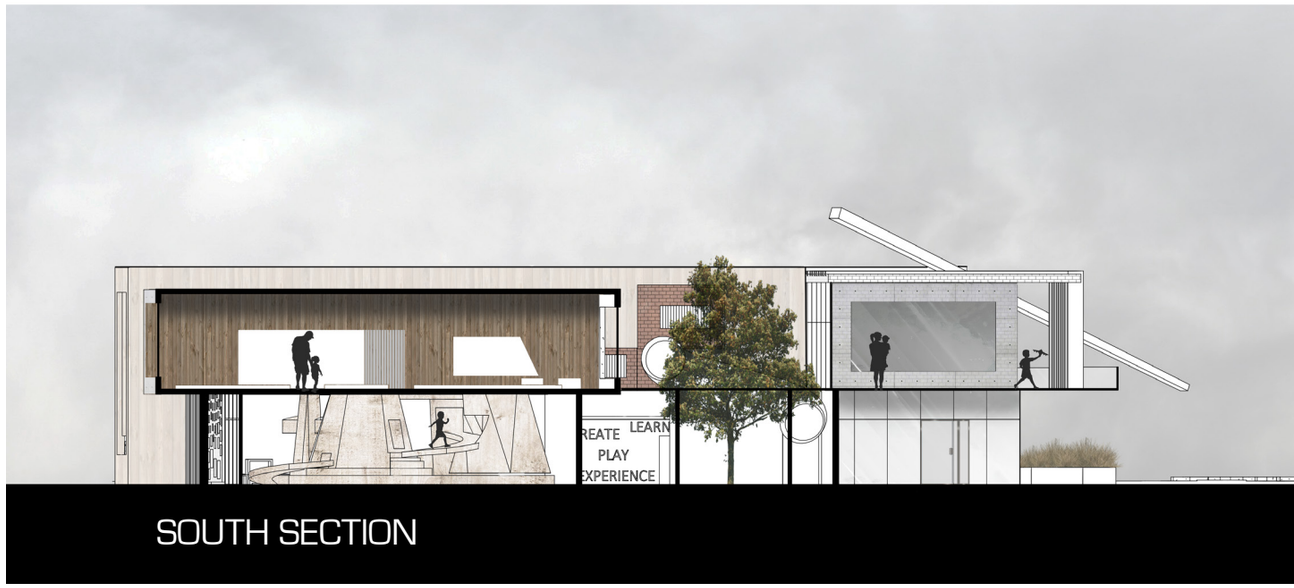
PERSPECTIVE | KINDERGARTEN
3.03

ELEVATIONS | KINDERGARTEN
3.04

WEST ELEVATION

SOUTH ELEVATION

SOUTH SECTION | KINDERGARTEN
3.05

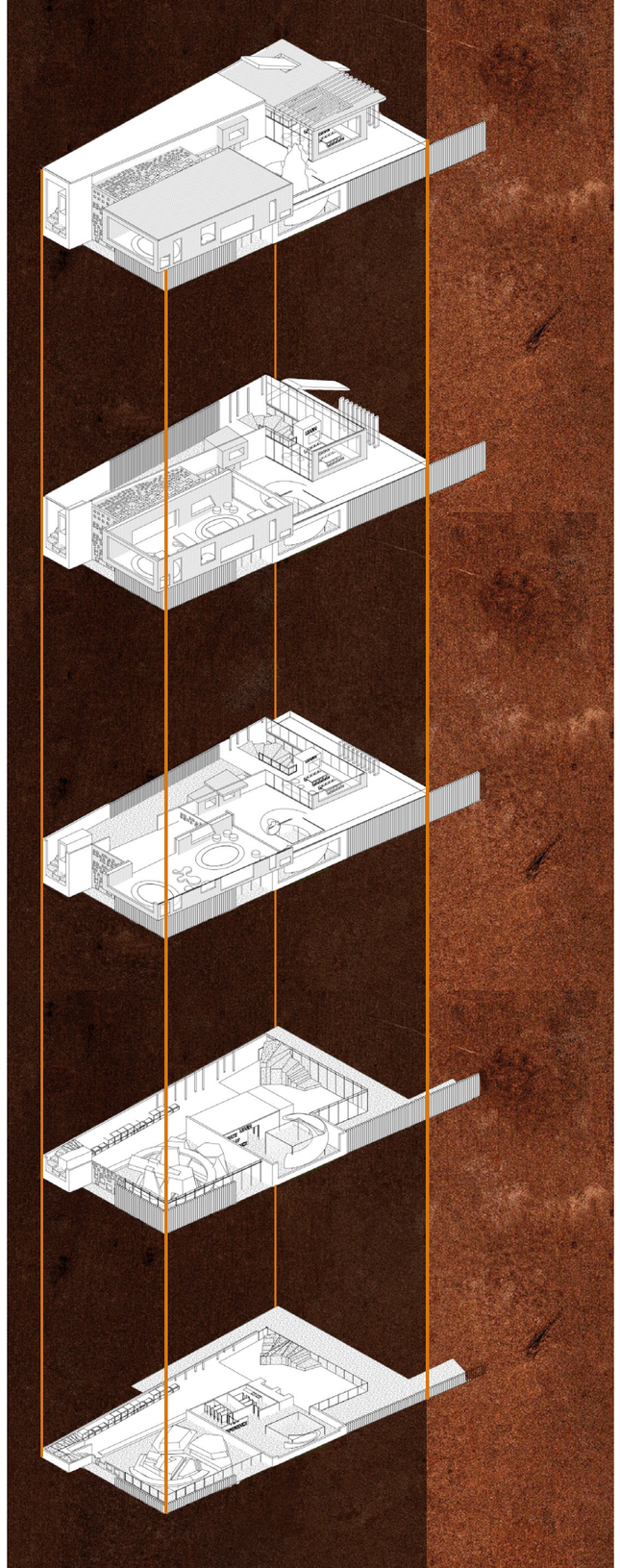


SOUTH SECTION

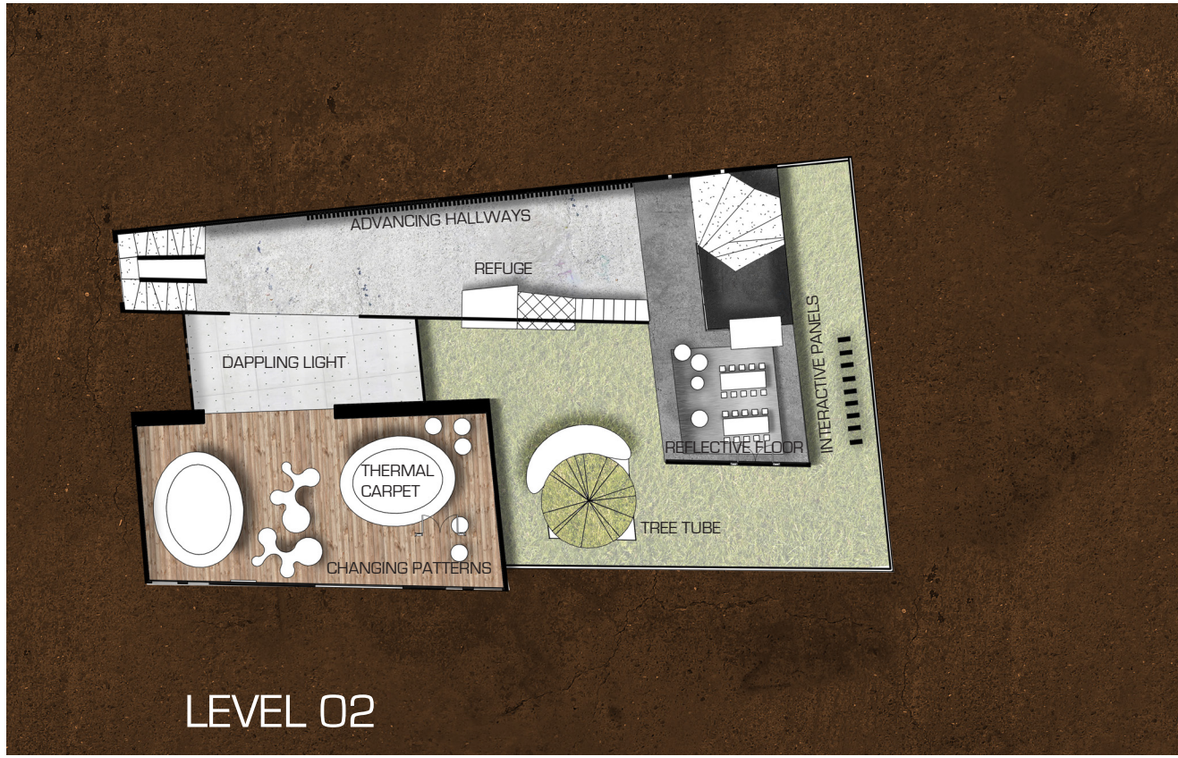

SOUTH SECTION

FLOOR PLANS
| KINDERGARTEN

3.06



LEVEL 01



LEVEL 02

EAST PERSPECTIVE | KINDERGARTEN
3.07

WEST ELEVATION | KINDERGARTEN
3.08

SOUTH PERSPECTIVE | KINDERGARTEN

3.09

4.00 SENSORY ABSTRACTIONS

ABSTRACTIONS
4.01

These abstractions are not obvious or anticipated but are assumed to engage involuntary attention while allowing the ability for focused tasks to replenish. Therefore, students would be able to perform better on tasks that require voluntary attention. Applications can serve as a framework that can be actualized in traditional settings such as Site 01. These specific sets of guidelines (and others not yet mentioned) can be implemented in a stand-alone kindergarten school to stimulate the restorative effects on cognitive functioning.

SURFACES
Walls, ceilings, floors, windows, and façade

TRANSITIONAL
Stairs, ramps, hallways/corridors, and door/entrances

HVAC
Artificial air handling and circulation

LIGHT
Artificial light and natural light through skylights, windows and openings in walls

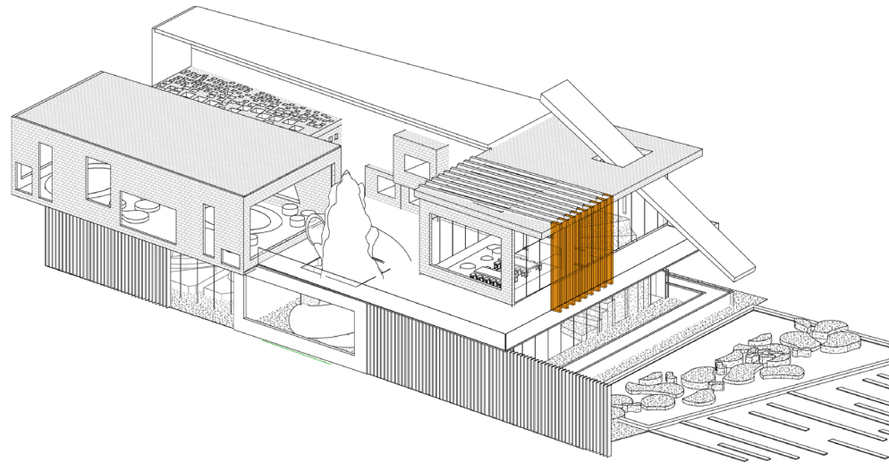
SPACES
Refuge, Prospect, Mystery, and Risk

INTERACTIVE PANELS

SURFACES

4.02

Manipulating the wooden panels allows children to adjust the natural light that can enter the interior of the classroom. Similar visual feedback is obtained when sunbeams shine through the trees.

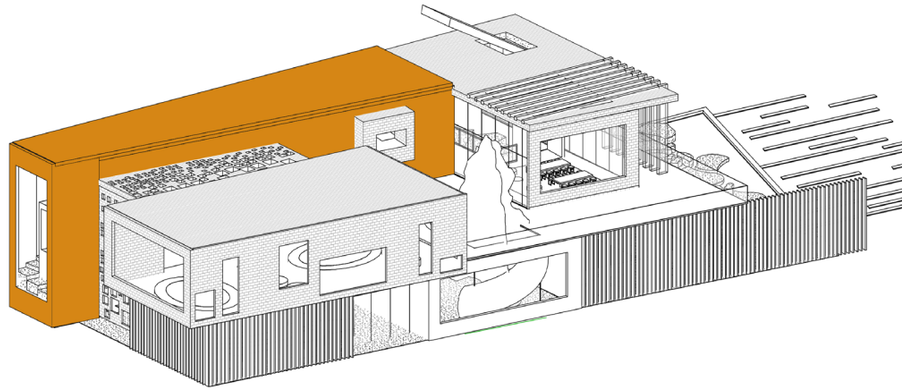


DYNAMIC PATHS

SURFACES

4.03

As children navigate down a pathway of variable texture and level that offers resistance and sensations of crunchy vs soft and noisy vs. quiet.

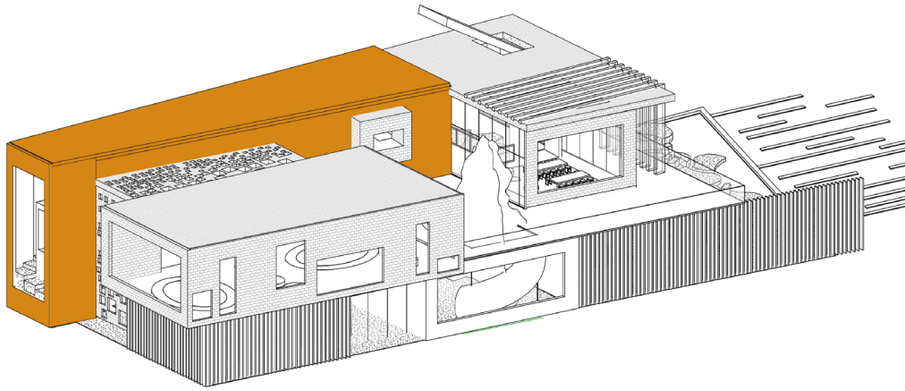


HALLWAYS

TRANSITIONAL

4.04

Textures and tactile qualities can invent, arrange, or change movement as children move through a space. The abstraction engages the auditory and visual senses and can help advance children down a hallway. This would be similar to dragging a stick along a picket fence as you walk outdoors. Foam could be used to slow children down as they engage with the absorbant material.

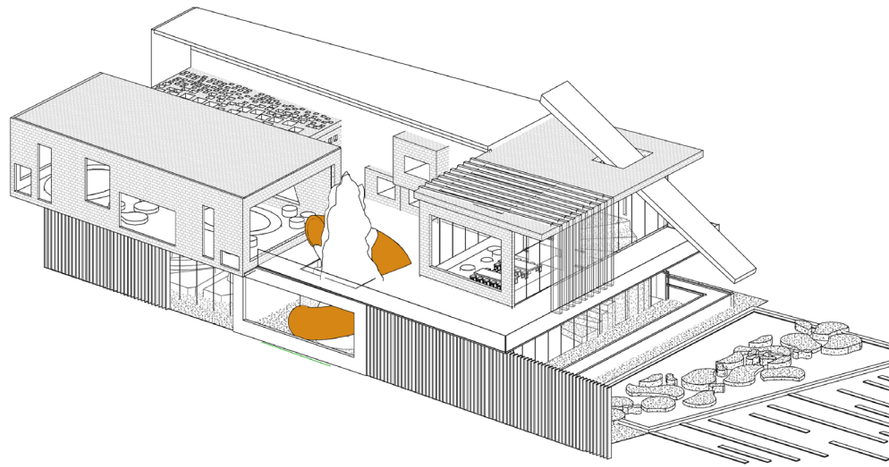


TREE TUBE

TRANSITIONAL

4.05

The climbing structure engages fine and motor movements to seamless transitions from indoors to outdoors. This blurs the wall or boundary between nature and the built environment.

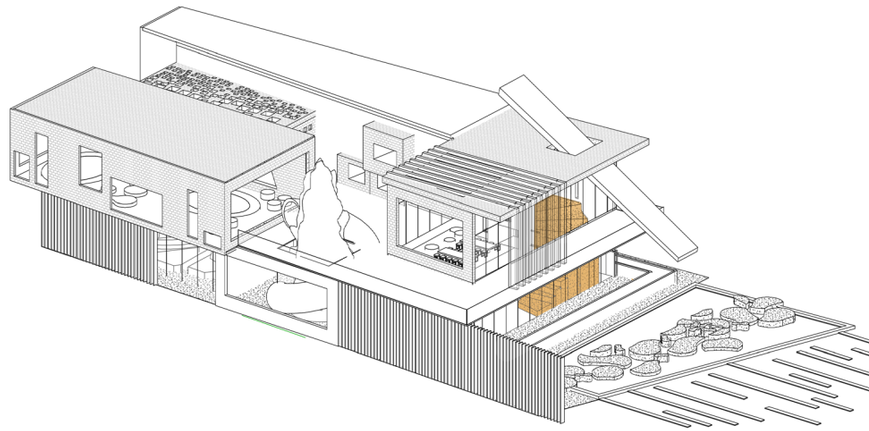


STAIRS

TRANSITIONAL

4.06

Similar to walking on uneven terrain in nature, this abstraction involves stairs with risers and landings of different widths and heights. This offers the same vestibular feedback that nature would provide.

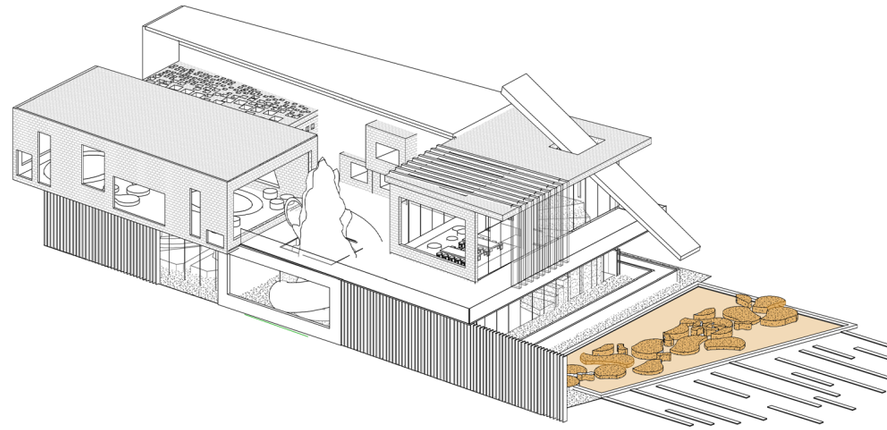


STEPPING STONES

TRANSITIONAL

4.07

The stepping stones are of random sizes and configurations. Children recieve vestibular and proprioceptive input as they use the stones to cross the water.

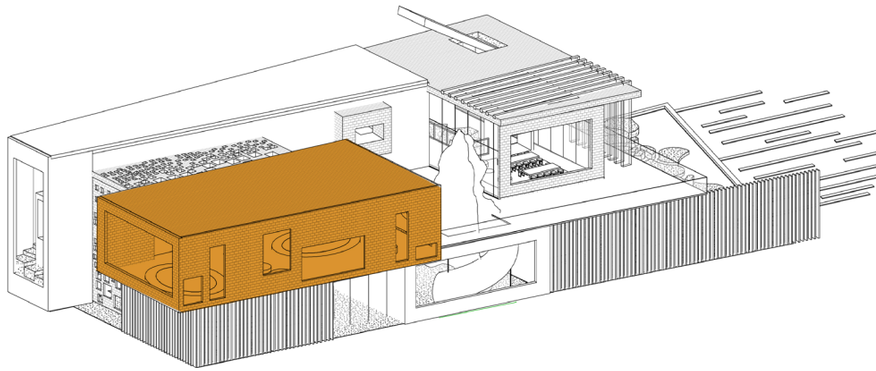


CHANGING PATTERNS

HVAC

4.08

This abstraction will be at the height above the child's head where they are not able to touch it but are visually interested in the slow changing patterns while they play. The abstraction can mimic seasonal changes experienced in nature. This implication integrates design ideas from the sky, sand, and trees that are manipulated by the wind. The design can use natural air flow for change or an irregualr HVAC system.

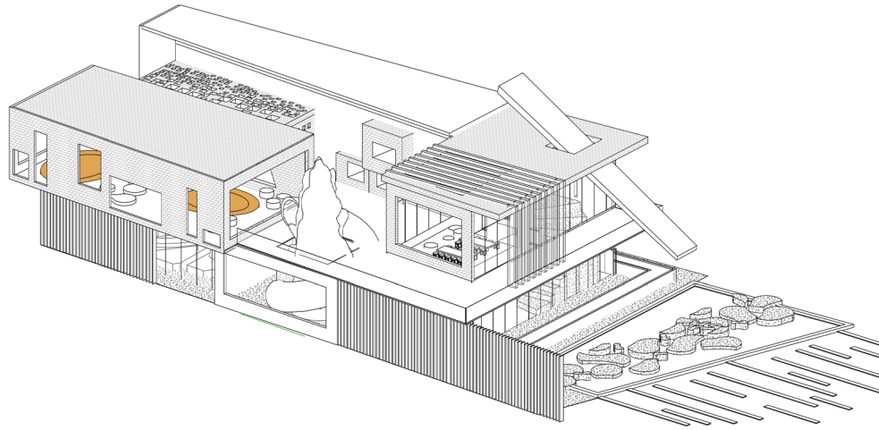


THERMAL CARPET

HVAC

4.09

Children are fascinated by momentary exposure to unpredictable movements. The non-rythmic sensory stimuli feel special and interesting to children; it is a brief but welcomed distraction. An environment lacking in variation can lead to boredom and passivity (Heerwagen, 2006). This abstraction will be at the height above the child's head where they are not able to touch it but are visually interested in the slow changing patterns while they play. The abstraction can mimic seasonal changes experienced in nature.

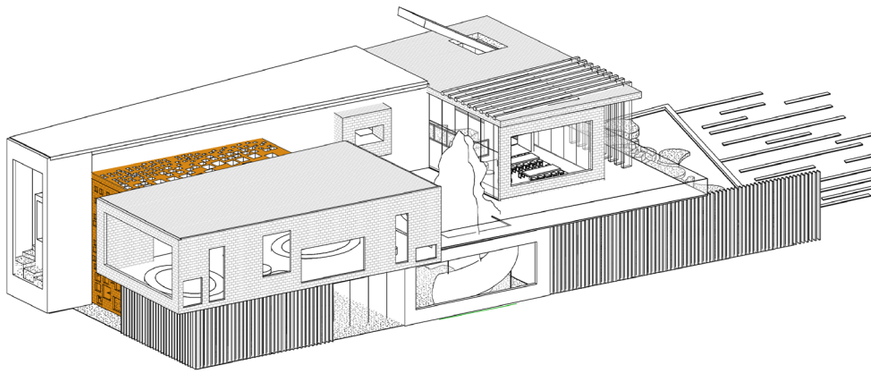


DAPPLING LIGHT

LIGHT

4.10

Similar to light filtering through the trees in nature, this abstraction uses a screen wall/skylight to allow natural light to create interesting patterns on the interior space.

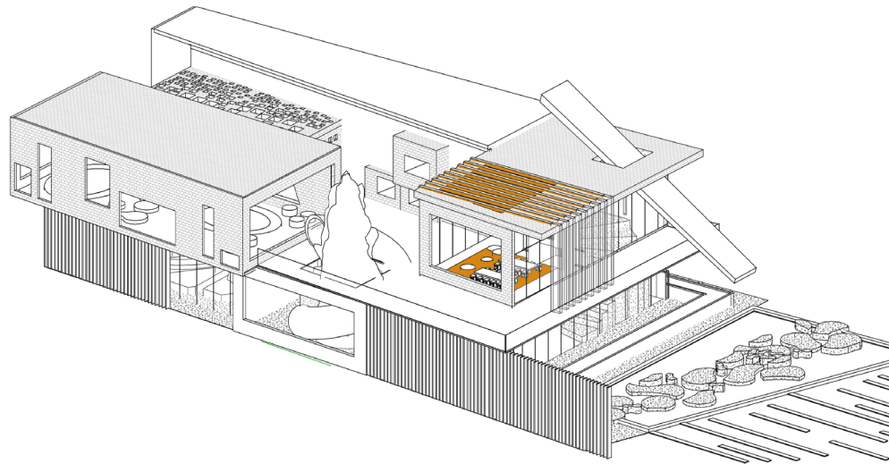


REFLECTIVE FLOOR

LIGHT

4.11

The subtle visual effects are as random as the changing sky and moving water. The floor will include a reflective material that will create interesting patterns and movements from the sky.

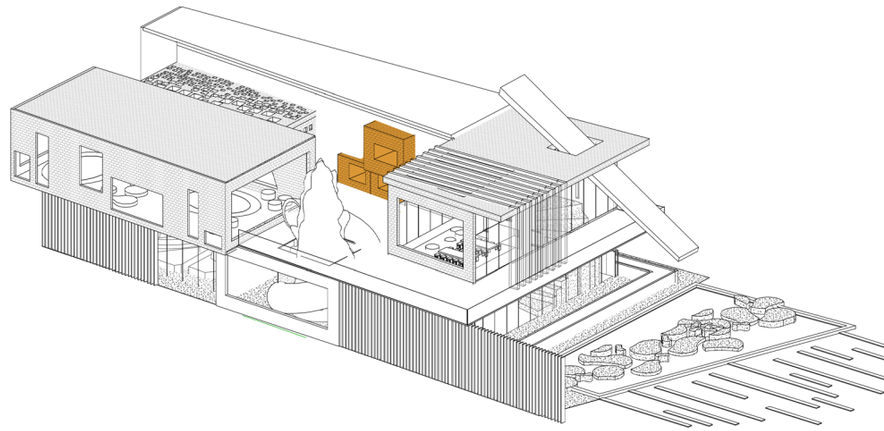


REFUGE

SPACES

4.12

Similar to sitting with your back against a large tree, a refuge space can remove a child from key areas of activity leading to a feeling of protection from behind and above. Refuge spaces are important for restoration experiences and stress reduction.

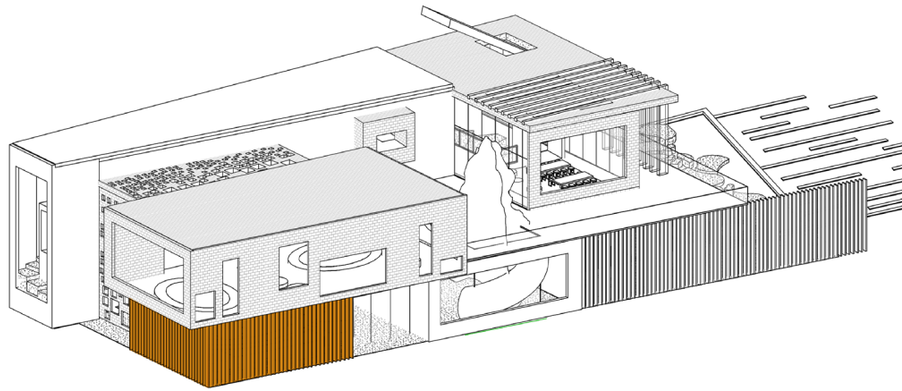


CLIMBER

SPACES

4.13

Similar to exploring in nature, the climber facilitates gross motor movements including rolling, reaching, crawling, walking, balancing, climbing, and jumping. This climber extracts similar spaces and landscapes experienced in nature that a child would interact with.



5.00 | CONCLUSION

.01 | CONCLUSION

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Sensory stimuli mechanisms from nature can be implemented into the design of children’s spaces to enhance cognitive functioning.

CONCLUSION
5.01

This thesis attempts to understand the restorative effects on cognitive functioning in nature and implement them into an early learning environment/ kindergarten through these specific set of guidelines.

6.00 BIBLIOGRAPHY

BIBLIOGRAPHY
6.01

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