ABSTRACT

Title of Thesis:	DESIGNING FOR NEURODIVERSITY: AN AUTISM-INCLUSIVE ELEMENTARY SCHOOL
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Autism Spectrum Disorder (ASD) represents a significant and growing neurodivergent population, with recent U.S. prevalence rates indicating it affects approximately 1 in 36 children. Statistics show that 95% of children with autism rely entirely on the public education system, while less than 3% can access private care. Autistic individuals often experience sensory input such as sight, sound, touch, and smell in an intense, unfiltered, and fragmented manner in the public-school environment, which can readily lead to sensory overload. This thesis aims to use architecture to shift the educational model from forced integration to selective integration. It grants autistic students the spatial agency to dictate their sensory and social exposure. By achieving a delicate balance between an overarching structure and individual flexibility, the design reimagines the elementary school as an active therapeutic tool that truly empowers neurodiverse learners.

DESIGNING FOR NEURODIVERSITY:
AN AUTISM-INCLUSIVE ELEMENTARY SCHOOL

by

Wenjie Zhuang

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Table of Contents

Table of Contents ii
Chapter 1: Introduction 1
1.1 Problem Area 1
The Sensory Reality of Autism 1
The Public-School Reality 1
The Gap in Architectural Practice 1
1.2 Problem Statement: Thesis Question 2
1.3 Possible Built Environment Response 2
Providing Overarching Structure 2
Enabling Individual Flexibility 3
Toward Spatial Agency 3
Chapter 2: Literature Review 4
2.1 Introduction 4
2.2 Predictability and Wayfinding 5
2.3 Sensory Escape Spaces 7
2.4 Outdoor Recovery Space 9
2.5 Summary of Literature Review 10
Chapter 3: Methodologies 12
3.1 Introduction 12
3.2 A Mixed Methods Framework: Bridging Theory and Practice 12
3.3 Primary Methodologies and Their Application 13
Theoretical and Literature Synthesis 13
Case Study Analysis: Autism-Inclusive Schools 13
3.4 General Case Study Analysis and Site Study 16
More general Case Study 16
Site Analysis 18
Chapter 4: Precedent Studies 20
4.1 Introduction: A Curated Journey from Ten to Six Precedents 20
4.2 Analysis of General Precedents 21
Precedent 1: Sant'Elia Nursery School, Como, Italy 21
Precedent 2: Saint Benedict Chapel, Switzerland 23
Precedent 3: Aalto Studio, Helsinki, Finland 24
Precedent 4: Sensory Arts Garden & Pavilion 26
4.3 Analysis of Autism-Inclusive Precedents 27
Predictability: Circulation, Wayfinding, and Visual Coding 27
Sensory Escape Space: Retreat, Regulation, and Recovery 29
Outdoor Green Space: Restorative Environments and Sensory Variety 32
3.4 Conclusion: Emerging Design Principles from Autism-Inclusive Precedents 33
Chapter 5: Zones and the Program 35
5.1 Program Abstract: Architecture as an Active Therapeutic Instrument 35
5.2 Program Zones: A Framework for Balancing Structure and Flexibility 35
5.3 Thesis Program 38

General Education & Shared Core 38
Autism Education Wing 40
Summary of Areas 42
5.4 Program Development: Site Data and Autism-Inclusive Precedent Analysis ...42
Chapter 6: Site Selection and Analysis 44
6.1 Introduction: The Role of Site in Neurodiversity-Inclusive Design 44
6.2 Reston, Virginia: Location and Cultural Context 44
Geographic Location 44
Arts, History, and Cultural Identity 45
6.3 Lake Anne Community: Density, Housing, and Pedestrian Networks 46
Community Design Principles 46
Urban Density and Housing Diversity 46
Pedestrian Network and Walkability 47
School-Community Integration 48
6.4 Lake Anne Elementary School Site: Natural Environment and Existing Conditions 49
Natural Environment and Tree Canopy 49
Existing Building Conditions and Challenges 50
Site Assets: Green Space, Pedestrian Access, and Community Connection 50
6.5 Synthesis: Site as Therapeutic Landscape 51
Chapter 7: Conceptual Testing of the Thesis 52
Introduction: From Research to Design Exploration 52
Core Design Concept: Dual Learning Ecosystems Connected by a Shared Core ...52
Dual Learning Ecosystems 52
The Shared Core 53
Community Bridging 53
7.3 Massing Studies: Testing Scale, Zoning, and Site Fit 53
Contextual Influence: Curved Buildings and Lake Anne Plaza 53
Curved Wings: Shaping Two Main Courtyards 54
Walkable Roofscape: Connecting to the Community Trail 55
7.4 Testing Three Design Principles in the Autism Wing 55
Principle 1: Predictability 56
Principle 2: Sensory Escape Spaces at Multiple Scales 58
Principle 3: Outdoor Green Space 60
7.5 Conclusion: Summary of the Thesis and Future Direction 63
Bibliography 66

Chapter 1: Introduction

1.1Problem Area

The Sensory Reality of Autism

Autism Spectrum Disorder (ASD) represents a significant and growing segment of our population. Current data indicate that 1 in 36 children in the U.S. is diagnosed with autism, a number that has been steadily rising. These individuals experience the world not through a deficit, but through a distinct neurotype characterized by unique sensory and cognitive profiles. For many autistic people, the built environment, with its cacophony of fluorescent lights, echoing sounds, and complex spatial layouts, is not a neutral backdrop but a source of intense, unfiltered, and often overwhelming sensory input. This constant sensory bombardment can lead to sensory overload, a state akin to a cognitive system crash, where the brain can no longer process incoming information. In educational settings, this overload manifests not as misbehavior but as a physiological response to distress, directly impeding learning, social interaction, and well-being.

The Public-School Reality

The challenge is not merely clinical but systemic. Statistics show that 95% of children with autism rely entirely on the public education system, while less than 3% of families can access or afford dedicated private autism schools (NCES, 2024). Public education is therefore a necessity, not a choice, for most autistic students. Today, autistic students make up 13% of all public special education enrollment, making them the fastest-growing demographic in this sector. However, public school environments are overwhelmingly designed around neurotypical standards. They often fail to support neurocognitive accessibility and sensory needs. Common challenges include one-size-fits-all teaching approaches that overlook diverse learning needs, unpredictable spatial layouts that increase cognitive stress, and social challenges and bullying resulting from forced integration without adequate support.

The Gap in Architectural Practice

Despite our growing understanding of autism, much of architectural practice remains rooted in neurotypical standards, creating environments that are, at best, passively accommodating and, at worst, actively harmful. The prevailing one-size-fits-all approach to school design fails to address the profound diversity of autistic sensory experiences, creating a critical gap between the needs of neurodiverse

learners and the spaces provided for their education. This thesis argues that architecture must shift the educational model from forced integration to selective integration, granting autistic students the spatial agency to regulate their sensory and social exposure.

1.2 Problem Statement: Thesis Question

This thesis addresses this gap by investigating the role of architecture not merely as a container but as an active therapeutic agent. Research indicates that 90 to 95 percent of autistic children experience sensory processing differences, yet public school environments remain overwhelmingly designed around neurotypical standards. This disconnect creates a critical need for spaces that move beyond generic accessibility to actively nurture the autonomy, learning, and well-being of neurodiverse learners.

The central problem is achieving a delicate balance between two seemingly competing needs: the need for a clear, overarching structure that provides predictability and reduces cognitive stress, and the equally vital need for individual flexibility to support highly personalized sensory profiles and learning goals. How can architecture grant autistic students the spatial agency to regulate their sensory and social exposure, thereby shifting the educational model from forced to selective integration?

Thesis Question:

How can architectural design, informed by autism-friendly design principles, balance overarching structure with individual flexibility in an autism-inclusive elementary school

1.3 Possible Built Environment Response

One possible response to the problem outlined above is a design framework that synthesizes principles from neurodiversity, pedagogy, and therapeutic practice into a cohesive architectural language. This framework would be built on two foundational pillars: Overarching Structure and Individual Flexibility. Through such a framework, the built environment might shift from being a source of sensory challenge to an active therapeutic tool that supports neurodiverse learners.

Providing Overarching Structure

This would involve creating a legible and predictable environment to reduce cognitive stress and support independent navigation. Potential strategies could include:

Predictable Spatial Sequencing: Using architectural organization to define clear transitions between different activities, creating a coherent spatial narrative throughout the building.

Sensory Calibration: Meticulously controlling acoustic, visual, and tactile stimuli to preempt sensory overload, allowing students to remain in a regulated state conducive to learning.

Visual Legibility: Integrating wayfinding cues directly into the architectural fabric, making the flow of space and the location of key program elements intuitive and easy to navigate.

Enabling Individual Flexibility

Within this clear structure, the design would need to offer a range of choices to accommodate diverse and dynamic sensory needs. This might be achieved through:

A Range of Spatial Typologies: Providing a variety of settings that differ in terms of social intensity, sensory stimulation, and programmatic function, allowing students to select the environment that best matches their current needs.

Adaptable Systems: Incorporating movable elements and adjustable environmental controls to allow users to personalize their immediate surroundings.

Sensory Empowerment: Designing spaces that offer opportunities for sensory exploration and regulation, including dedicated areas for retreat and recovery when sensory overload occurs.

Toward Spatial Agency

If successful, such a framework could grant students spatial agency the ability to regulate their own sensory and social exposure. By creating a setting that is both predictably structured and richly adaptable, architecture might shift the educational model from forced integration toward selective integration, reimagining the elementary school as an active therapeutic tool for learning, growth, and self-regulation. The following chapters will investigate these possibilities through literature review, site analysis, and design exploration.

Chapter 2: Literature Review

2.1 Introduction

Autism Spectrum Disorder (ASD) is a neurological and developmental condition that affects how individuals interact with others, communicate, learn, and behave. Contemporary scholarship increasingly reframes autism not as a deficit or disorder but as a distinct neurotype characterized by unique cognitive and sensory profiles. Harvey argues for a paradigm shift from deficit-based models toward understanding autism as a neurological difference, a position echoed by Yergeau, who introduces the concept of "neuroqueerness" to challenge stereotypes of autistic passivity and advocate for autistic agency and identity. [1]

Central to understanding autism in the context of architectural design is the recognition of pervasive sensory processing differences. For many autistic individuals, the built environment is not a neutral backdrop but a source of intense, unfiltered, and often overwhelming sensory input. Abraira and Ginty provide the neurobiological foundation for understanding tactile sensitivity, detailing how low-threshold mechanoreceptors (LTMRs) process touch from the skin to the brain.[2]Møller offers a comprehensive overview of all five sensory systems, explaining how raw sensory data is transformed into perception.[3] Together, these sources establish that sensory processing differences are not behavioral choices but physiological realities rooted in neural architecture.

The consequences of sensory overload in educational settings are profound. When the brain can no longer process incoming sensory information, a state of distress occurs that directly impedes learning, social interaction, and well-being. Orhan Korhan establishes the broader principle that indoor environmental quality, including thermal, visual, and acoustic comfort, directly impacts occupant health, safety, and quality of life.[4] For autistic students, who may already experience

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[1] Catherine Harvey, Difference Not Disorder: Understanding Autism Theory in Practice (London: Jessica Kingsley Publishers, 2018); Melanie Yergeau, Authoring Autism: On Rhetoric and Neurological Queerness (Durham: Duke University Press, 2018).
[2] Victoria E. Abraira and David D. Ginty, "The Sensory Neurons of Touch," Neuron 79, no. 4 (2013): 618–639.
[3] Aage R. Møller, Sensory Systems: Anatomy and Physiology (Amsterdam: Academic Press, 2003).

[4] Orhan Korhan, ed., Indoor Environment and Health (London: IntechOpen, 2019).

heightened sensory and social stress, the design of the learning environment becomes not an ancillary concern but a primary determinant of educational outcomes.

Despite this understanding, public school environments remain overwhelmingly designed around neurotypical standards. Common challenges include one-size-fits-all teaching approaches, unpredictable spatial layouts that increase cognitive stress, and social challenges resulting from inadequate support.[5] What remains unclear is how architectural design might respond to these challenges in a way that moves beyond generic accessibility toward genuine spatial agency for autistic learners. This literature review, therefore, examines existing research across environmental psychology, neuroscience, sensory integration therapy, and educational practice to identify recurring themes and evidence-based strategies that could inform the design of autism-inclusive learning environments. Gaines et al. provide a critical theoretical framework for understanding environmental fit in ASD design, while Steg and De Groot establish foundational principles for how spatial design impacts psychological states such as anxiety, focus, and well-being.[6] Building on these foundations, the review explores what the literature reveals about the relationship between spatial design and the needs of neurodiverse learners in educational settings.

2.2 Predictability and Wayfinding

Autistic individuals often experience the built environment as fragmented, unpredictable, and overwhelming. Research in environmental psychology and neuroscience suggests that spatial predictability is not a matter of preference but a cognitive necessity for reducing sensory overload and supporting independent navigation.

Groh demonstrates that the brain's spatial processing systems are foundational to all thought, integrating visual, auditory, and vestibular input to construct a coherent understanding of surroundings.[7] For autistic individuals, who may experience differences in sensory working memory, predictable spatial layouts can serve as an external support system, reducing cognitive load and freeing mental resources for learning.[8]Mooney et al. provide specific neurological evidence for this need: their study found that children with ASD show impaired memory for item-space associations while retaining intact memory for item-color associations.[9] This finding

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[5] Martin Hanbury, Educating Students on the Autistic Spectrum: A Practical Guide, 2nd ed. (Los Angeles: SAGE, 2012); Claire E. Hughes-Lynch, Teaching Children with High-Functioning Autism: Strategies for the Inclusive Classroom (Waco, TX: Prufrock Press, 2012).

[6] Kristi Gaines et al., "Foundational Theories for ASD," in Designing for Autism Spectrum Disorders (New York: Taylor & Francis Group, 2016), 11–18; Linda Steg and Judith I. M. De Groot, Environmental Psychology: An Introduction, 2nd ed. (Chichester, UK: John Wiley & Sons, 2019).

[7] Jennifer M. Groh, Making Space: How the Brain Knows Where Things Are (Cambridge, MA: Harvard University Press, 2014).

[8] Pierre Jolicœur et al., Mechanisms of Sensory Working Memory: Attention and Performance XXV (Amsterdam: Academic Press, 2015).

[9] Lindsey N. Mooney et al., "Children with ASD Show Impaired Item-Space Recollection, But Preserved Item-Color Recollection," Autism Research 13, no. 11 (2020): 1985–1997.

has direct architectural implications. Color, rather than spatial location, may be a more reliable cue for navigation and wayfinding in schools for autistic students.

Buether et al. offer a practical framework for using color as a systematic architectural tool to reduce spatial ambiguity, define zones, and aid navigation.[10]When combined with predictable circulation patterns, color-coded wayfinding can transform a potentially confusing environment into a legible, empowering space. The foundational work of Birren on color psychology further supports this approach, establishing that color choices influence mood and arousal, making them not merely aesthetic but therapeutic design decisions.[11] Kusuma Wardani and Mustikasari provide empirical evidence that children with ASD show clear preferences for warm color combinations, which correlate with higher levels of attention and motivation during learning activities.[12]

Noise control is equally critical for predictability. Kanakri et al. provide empirical evidence that noise is a paramount concern in ASD educational settings, with teachers identifying soundproof walls and carpeting as highly effective mitigators.[13] Bies et al. offer the engineering foundation for achieving such acoustic control, specifying how to technically design for noise reduction.[14]Together, these sources argue that predictable environments require not only visual legibility but also acoustic predictability. Kohfeld adds that stimulus intensity directly affects reaction time, suggesting that carefully calibrated auditory and visual stimuli can support more predictable cognitive processing for autistic learners.[15]

Gaines et al. synthesize these insights into actionable architectural strategies, emphasizing intentional floor plans to create predictability and the importance of acoustical and visual privacy.[16] Hanbury reinforces this from a pedagogical perspective, noting that structured, predictable environments are essential for autistic students to thrive academically and socially.[17] Ainscow and UNESCO advocate for environmental adjustments that foster participation and engagement, supporting the

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[10] Axel Buether et al., Colour: Design Principles, Planning Strategies, Visual Communication (Munich: Edition Detail, 2014).

[11] Faber Birren, Color Psychology and Color Therapy: A Factual Study of the Influence of Color in Human Life (New Hyde Park, NY: University Books, 1961).

[12] Nuril Kusuma Wardani and Bunga Fefiana Mustikasari, "Colour Preference on Picture Therapy Cards in Children With ASD," KnE Social Sciences (2023).

[13] Shireen M. Kanakri et al., "Noise and Autism Spectrum Disorder in Children: An Exploratory Survey," Research in Developmental Disabilities 63 (2017): 85–94.

[14] David A. Bies et al., Engineering Noise Control, 6th ed. (Boca Raton: CRC Press, 2024).

[15] David L. Kohfeld, "Simple Reaction Time as a Function of Stimulus Intensity in Decibels of Light and Sound," Journal of Experimental Psychology 88, no. 2 (1971): 251–257.

[16] Gaines et al., "Foundational Theories for ASD."

[17] Hanbury, Educating Students on the Autistic Spectrum.

argument that physical design is integral to inclusive education.[18] engagement, supporting the argument that physical design is integral to inclusive education.

In summary, the literature establishes that predictability in school design must operate through multiple sensory channels: visual (color-coded wayfinding, legible spatial sequencing), auditory (controlled noise levels, sound-absorbing materials), and cognitive (consistent layouts that reduce the need for item-space memory). These strategies collectively reduce cognitive stress and support independent navigation.

2.3 Sensory Escape Spaces

Despite best efforts to calibrate sensory input, overload remains an inevitable reality for many autistic individuals in educational settings. The provision of dedicated spaces for retreat and recovery is therefore not an amenity but a necessity.

Caldwell and Horwood provide the therapeutic rationale for such spaces, explaining how sensory integration approaches can help individuals process and respond to sensory information.[19] Their work emphasizes that environments designed for sensory regulation must offer controlled, predictable sensory experiences that allow individuals to de-escalate from overload and regain emotional control. Fowler offers a practical framework for designing multisensory environments (MSEs), covering the planning, setup, and equipping of therapeutic sensory spaces.[20] This source directly informs the architectural specification of escape spaces, detailing how controlled sensory experiences can promote relaxation and self-regulation.

Lehman introduces a more dynamic concept: adaptive sensory environments that can respond to occupant needs in real time.[21] While her framework incorporates emerging interactive technologies, the core principle that environments can actively "tune" themselves to support user regulation aligns with the therapeutic goals of escape spaces. For autistic learners who may experience sensory processing differences as a form of sensory distress, the ability to retreat to a space that offers predictable, low-stimulus conditions is essential.[22]

The neurobiological basis for tactile design in escape spaces is provided by Abraira and Ginty, who detail the mechanisms of low-threshold mechanoreceptors

[18] Mel Ainscow and UNESCO, Special Needs in the Classroom: A Teacher Education Guide, 2nd rev. ed. (Paris: UNESCO Pub., 2004).
[19] Phoebe Caldwell and Jane Horwood, Using Intensive Interaction and Sensory Integration: A Handbook for Those Who Support People with Severe Autistic Spectrum Disorder (London: Jessica Kingsley Publishers, 2008).
[20] Susan Fowler, Multisensory Rooms and Environments: Controlled Sensory Experiences for People with Profound and Multiple Disabilities, 1st American paperback ed. (London: Jessica Kingsley Publishers, 2008).
[21] Maria Lorena Lehman, Adaptive Sensory Environments: An Introduction (Abingdon, UK: Routledge, 2017).
[22] Caldwell and Horwood, Using Intensive Interaction and Sensory Integration.

(LTMRs) and how the nervous system processes complex tactile information.[23] This research explains why materiality, texture, and physical surfaces are not aesthetic choices but fundamental to sensory experience. Hatwell, Streri, and Gentaz extend this argument, presenting touch as a sophisticated cognitive system capable of object recognition and spatial understanding.[24] For escape spaces, this means that tactile materials such as soft fabrics, calming textures, and natural wood are not decorative but therapeutic, providing grounding sensory input that supports self-regulation.

Grace and Dalgliesh offer complementary perspectives from educational and home settings, emphasizing that controlled sensory experiences and organizational systems reduce anxiety for children with sensory processing differences.[25] Their work reinforces that escape spaces must be integrated into the daily rhythm of the school day, not positioned as punitive or isolated areas. Gaines et al. specifically identify the critical importance of acoustical and visual privacy in reducing sensory overload, a finding that directly informs the design of escape spaces.[26] Similarly, Orhan Korhan establishes the broader principle that indoor environmental quality directly impacts occupant health and well-being, legitimizing the rigorous design of escape spaces as therapeutic interventions.[27]

Volkmar and Wiesner provide clinical validation for these design choices, noting that behavioral and sensory challenges in ASD can be mitigated through predictable layouts and sensory-sensitive environments.[28] Burns and Venn emphasize that Individualized Education Programs (IEPs) require environments that can support specific, documented student needs, reinforcing that escape spaces must be responsive to individual sensory profiles.[29]

The literature thus supports escape spaces as intentional, therapeutic environments that provide acoustical and visual privacy, controlled tactile stimulation, and the opportunity for sensory retreat. These spaces must be integrated within the larger school ecosystem, accessible from learning areas, and designed to support active self-regulation rather than passive isolation.

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[23] Abraira and Ginty, "The Sensory Neurons of Touch."
[24] Yvette Hatwell, Arlette Streri, and Edouard Gentaz, Touching for Knowing: Cognitive Psychology of Haptic Manual Perception, 1st ed. (Amsterdam: J. Benjamins, 2003).
[25] Joanna Grace, Sensory Stories to Support Additional Needs: Making Narratives Accessible through the Senses (London: Jessica Kingsley Publishers, 2022); Carolyn Dalgliesh, The Sensory Child Gets Organized: Proven Systems for Rigid, Anxious or Distracted Kids, 1st Touchstone trade paperback ed. (New York: Touchstone, 2013).
[26] Gaines et al., "Foundational Theories for ASD."
[27] Orhan Korhan, Indoor Environment and Health.
[28] Fred R. Volkmar and Lisa A. Wiesner, Essential Clinical Guide to Understanding and Treating Autism, 1st ed. (Hoboken, NJ: Wiley, 2017).
[29] Edward Burns, *IEP-2005: Writing and Implementing Individualized Education Programs (IEPs)* (Springfield, IL: Charles C Thomas, 2006); John Venn, Assessing Students with Special Needs, 2nd ed. (Upper Saddle River, NJ: Merrill, 2000).

2.4 Outdoor Recovery Space

Green spaces and outdoor environments offer unique restorative potential for autistic learners. The literature on environmental psychology establishes that natural settings can reduce stress, restore attention, and support well-being, findings that have particular relevance for sensory-sensitive populations.

Steg and De Groot provide a comprehensive overview of environmental psychology, including the effects of environmental stress and the emotional impacts of natural environments.[30] Their work establishes that exposure to nature can serve as a restorative environment, reducing anxiety and improving cognitive function. For autistic students who experience heightened sensory and social stress throughout the school day, outdoor spaces offer a necessary respite.

The sensory benefits of outdoor environments extend beyond visual rest. Whitaker, Simões-Franklin, and Newell examine the independent yet complementary roles of vision and touch in texture perception, concluding that each modality provides unique, non-redundant data about a surface.[31] Outdoor environments naturally engage both systems: visual engagement with greenery and sky, tactile engagement with grass, bark, stone, and water. Hrach argues that physical movement, spatial environments, and sensory engagement are not distractions but essential components for deepening learning, a finding that supports the integration of outdoor movement and exploration into the school day.[32]

Brogaard and Gatzia challenge the traditional visual bias in philosophy and cognitive science, arguing that non-visual sensory experiences (touch, proprioception, interoception) are fundamental to forming justified beliefs and knowledge.[33]Their work provides epistemological justification for designing outdoor spaces that engage the full sensorium, not merely the visual system. For autistic learners, who may process sensory information differently, outdoor spaces can offer a more forgiving and diverse sensory palette than highly controlled indoor environments.[34]

The therapeutic potential of outdoor spaces is further supported by research on sensory integration. Caldwell and Horwood note that sensory integration activities often involve physical movement and outdoor engagement.[35] Chiang and Bauminger-Zviely both emphasize that functional life skills and social-emotional development

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[30] Steg and De Groot, Environmental Psychology.

[31] T. Aisling Whitaker, Cristina Simões-Franklin, and Fiona N. Newell, "Vision and Touch: Independent or Integrated Systems for the Perception of Texture?," Brain Research 1242 (2008): 59–72.

[32] Susan Hrach, Minding Bodies: How Physical Space, Sensation, and Movement Affect Learning, 1st ed. (Morgantown: West Virginia University Press, 2021).

[33] Berit Brogaard and Dimitria Electra Gatzia, eds., The Epistemology of Non-Visual Perception (New York: Oxford University Press, 2020).

[34] Møller, Sensory Systems.

[35] Caldwell and Horwood, Using Intensive Interaction and Sensory Integration.

are enhanced when learning occurs in varied, real-world settings.[36] Outdoor recovery spaces, when designed with varied degrees of enclosure and privacy, can support both individual retreat and controlled social interaction.

Ring, Daly, and Wall introduce the concept of the environment as a "third teacher," a principle that applies powerfully to outdoor spaces.[37] When outdoor areas are designed as intentional learning and recovery environments rather than anonymous playgrounds, they become active participants in the educational process. Klein, Cook, and Richardson-Gibbs demonstrate how environmental modifications serve as foundational inclusion strategies in educational settings, particularly during formative developmental years.[38] Harvey reinforces this by rejecting deficit-based models and advocating for environments that honor neurodiversity, a principle that extends to outdoor spaces where sensory differences can be accommodated rather than pathologized.[39]

Palko and Deáková provide technical guidance on material selection for outdoor environments, including noise protection and thermal performance, ensuring that outdoor recovery spaces can be designed to meet the sensory needs of autistic learners while remaining functional and durable.[40]

In conclusion, outdoor recovery spaces serve multiple functions: they provide restorative environmental contact that reduces stress, they offer diverse sensory engagement that supports self-regulation, and they create opportunities for flexible social interaction that can be calibrated to individual needs.[41] For an autism-inclusive elementary school, outdoor spaces are not supplementary but essential components of the therapeutic environment.

2.5 Summary of Literature Review

The literature examined in this chapter reveals several recurring themes that together point toward a coherent architectural response to the needs of autistic

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[36] Hsu-Min Chiang, ed., Curricula for Teaching Students with Autism Spectrum Disorder, 1st ed. (Cham: Springer International Publishing, 2017); Nirit Bauminger-Zviely, Social and Academic Abilities in Children with High-Functioning Autism Spectrum Disorders (New York: Guilford Press, 2013).

[37] Elmer Ring, Patricia Daly, and Eugene Wall, eds., Autism from the Inside Out: A Handbook for Parents, Early Childhood, Primary, Post-Primary and Special School Settings (Oxford: Peter Lang, 2018).

[38] M. Diane Klein, Ruth E. Cook, and Anne Marie Richardson-Gibbs, Strategies for Including Children with Special Needs in Early Childhood Settings (Albany, NY: Delmar/Thomson Learning, 2001).

[39] Harvey, Difference Not Disorder.

[40] Milan Palko and Karin Deáková, eds., Advanced Building Construction and Materials 2013: Selected, Peer Reviewed Papers from the 2013 International Conference on Advanced Building Construction and Materials 2013 (ABCM 2013) (Zurich: Trans Tech Publications, 2014).

[41] Steg and De Groot, Environmental Psychology; Whitaker, Simões-Franklin, and Newell, "Vision and Touch"; Hrach, Minding Bodies; Bauminger-Zviely, Social and Academic Abilities.

learners. Across neuroscience, environmental psychology, and educational practice, consistent findings emerge regarding the importance of spatial predictability, the necessity of dedicated spaces for sensory retreat and self-regulation, and the restorative potential of outdoor environments. These themes appear repeatedly across diverse research contexts, suggesting they are not arbitrary categories but fundamental concerns that any autism-inclusive school design must address.

In summary, the literature does not prescribe a single formula for design. However, it does reveal three principles that consistently emerge from the evidence: predictability and wayfinding, sensory escape spaces, and outdoor recovery spaces. These principles form an evidence-based foundation for the design exploration that follows in subsequent chapters.

Chapter 3: Methodologies

3.1 Introduction

The central inquiry of this thesis is how to balance overarching structure with individual flexibility in an autism-inclusive elementary school that engages with the complex, dynamic, and deeply personal realm of human sensory experience. Architectural solutions cannot be derived from a priori assumptions or universal standards; they must be grounded in a rigorous understanding of how autistic individuals perceive, interpret, and interact with their surroundings. Therefore, research methodology is not an ancillary exercise but the very foundation of the design proposal. It provides the critical link between the theoretical frameworks of neurodiversity, pedagogy, and therapy outlined in the literature review and the tangible, material reality of the built environment. This chapter details a multifaceted methodological framework designed to navigate this complexity. It integrates qualitative and quantitative, analytical and synthetic approaches to ensure that the resulting architectural design is not merely speculative but is evidence-based, responsive, and empathetically attuned to its neurodiverse users.

3.2 A Mixed Methods Framework: Bridging Theory and Practice

The methodological approach for this thesis is fundamentally mixed methods, recognizing that a single mode of inquiry is insufficient to address the multifaceted nature of the research question. This framework operates on a spectrum from subjective, qualitative interpretations of experience to objective, quantitative measurements of environmental performance, and from interdisciplinary theory synthesis to pragmatic design translation.

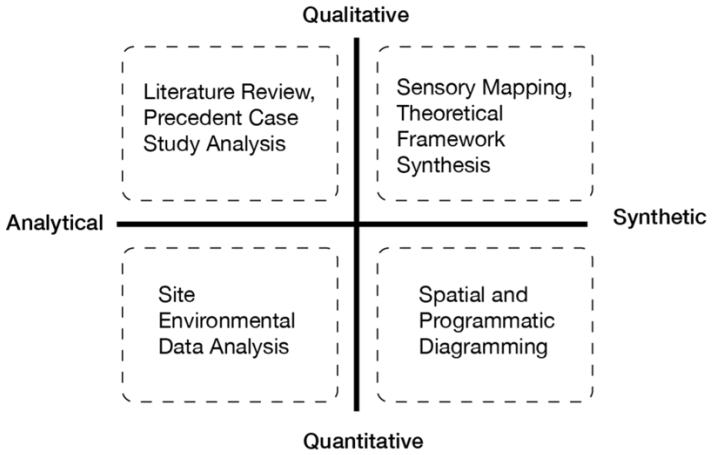


Figure 1： Research Methods Diagram illustrated by Wenjie Zhuang

3.3 Primary Methodologies and Their Application

Theoretical and Literature Synthesis

This study employs theoretical and literature synthesis as its foundational research methodology, which entails the critical review and integration of existing knowledge and theories across multiple disciplines, including environmental psychology, neuroscience, special education, and architecture.

The methodological perspective presented by Ray Lucas in Chapter 9 of his work is particularly significant. His advocacy of James Gibson's "ecological perception theory," which emphasizes that environmental perception must be studied within real-world contexts, strongly supports the core position of this thesis: that design should be based on authentic, dynamic sensory experiences rather than relying on abstract, laboratory models detached from actual environments.

Through the synthesis of this interdisciplinary literature, we can construct a solid and reliable theoretical framework in Chapter 2. This framework establishes the core principles guiding all subsequent design decisions: spatial legibility, sensory calibration, individual agency, and ensuring that every step of the design process is well-grounded in theoretical evidence.

Case Study Analysis: Autism-Inclusive Schools

To derive design intelligence from built environments specifically designed for autistic learners, this thesis employs comparative case study analysis as a core methodological approach. This method is particularly suited to the research question because it allows for the systematic examination of multiple precedents to identify recurring patterns, successful strategies, and potential design principles that emerge from built evidence rather than from theory alone.

Six existing autism-inclusive or autism-dedicated school facilities were selected for this comparative analysis. The selection criteria included geographical diversity, programmatic scale, and documented design intentionality toward autistic users. The cases are Utah Valley University Autism Center (USA), Northern School for Autism (Australia), Niddrie Autistic School designed by Guymer Bailey

Architects (Australia), Sai Kirupa Special School (India), Aspect Treetop School (Australia), and the Els Sensory Art Garden (USA).



Figure 2. Utah Valley University Autism Center (USA)



Figure 2. Northern School for Autism (Australia)



Figure 3. Niddrie Autistic School (Australia)



Figure 4. Sai Kirupa Special School (India)



Figure 5. Aspect Treetop School (Australia)

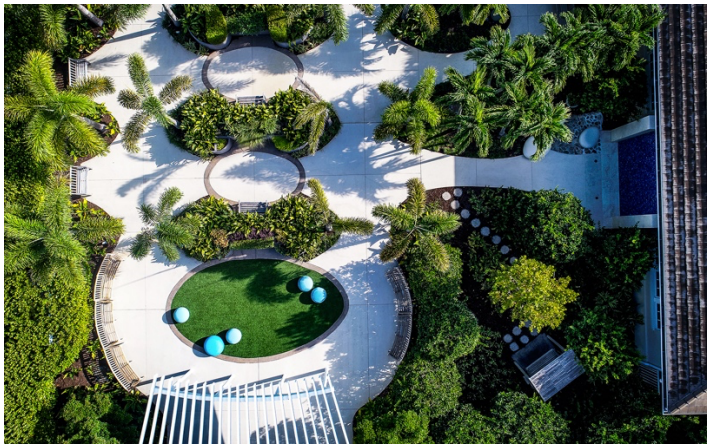


Figure 6. Els Sensory Art Garden (USA)

For each case, the analysis examines spatial organization, circulation patterns, sensory zoning strategies, material palettes, and the integration of dedicated therapeutic spaces. The cases are analyzed using a consistent framework drawn from the theoretical literature established in Chapter 2, including criteria related to predictability, sensory regulation, and spatial agency.

The purpose of this comparative analysis is not merely to document individual projects but to identify cross-cutting themes and design strategies that recur across different contexts. By systematically comparing how each case addresses challenges such as sensory overload, independent navigation, and individual flexibility, the analysis aims to synthesize transferable design principles that can inform the proposal developed later in this thesis. The detailed findings of this case study analysis, including the three emergent design principles, are presented in Chapter 4

3.4 General Case Study Analysis and Site Study

More general Case Study

This research employs comparative case study analysis to derive design intelligence from built projects that successfully address both universal educational needs and neurodiverse sensory requirements. Four seminal projects are analyzed through a structured lens. Sant'Elia Nursery School informs the spatial organization and circulation flow of universal school design. Aalto Studio demonstrates topographical integration and courtyard design. The Sensory Arts Garden provides specialized knowledge in sensory calibration zones. Saint Benedict Chapel contributes to an understanding of materiality and dynamic light modulation. Through systematic comparison, this analysis identifies how universal architectural principles can be adapted to support neurodiverse sensory experiences.



Figure 7. Sant'Elia Nursery School precedent by Giuseppe Terragni



Figure 8. Aalto Studio



Figure 9. Saint Benedict Chapel

The cross-case examination reveals transferable strategies for balancing structured environments with flexible spatial experiences. By studying these diverse precedents, the research develops a nuanced understanding of how spatial sequencing, sensory zoning, and material selection can collectively create learning environments that support both individual sensory needs and collective educational functions. This comparative approach ensures the resulting design framework is both theoretically grounded and validated through successfully built examples, bridging the gap between general educational design and specialized sensory requirements.

Site Analysis

Site selection and analysis serve not merely as preliminary design steps but as a methodological approach to deeply understand the interaction between users and their environment. This study moves beyond conventional cartographic analysis by integrating behavioral observation with human activity trajectory surveys, providing a comprehensive understanding of the site's behavioral and accessibility context.



Figure 10. Reston, Virginia

The selected site is in Reston, Virginia, where Lake Anne Elementary School currently operates. Reston is a planned community founded on principles of radical inclusion, social equity, diversity, affordable housing, and the integration of live and work within the same community. These community design principles align closely with the thesis's goal of creating an autism-inclusive school that bridges the school and the broader community.

Human Activity Trajectory and Accessibility Analysis:

Given the unique nature of educational facilities for autistic children, it is crucial to study the demographic distribution and transportation patterns of the target population. This research defines a thirty-minute reasonable driving distance as the primary service radius, using this parameter to analyze the spatial distribution of actual educational needs. The analysis specifically considers traffic variations during peak hours to more accurately reflect commuting accessibility and time costs, providing quantitative support for site selection and transportation planning.

Field Investigation and Behavioral Documentation:

Through multiple visits to the Reston site, systematic on-site data collection is conducted. Behavioral pathway observation tracks natural movement patterns and lingering behavior around the site to inform circulation design and social node placement. Environmental data collection records solar paths, wind patterns, and topographic features to assess their potential for sensory regulation and biophilic design. The existing Lake Anne Elementary School building is also documented for its structural conditions, spatial fragmentation, and relationship to surrounding green spaces.

Expected Outcomes:

By integrating human activity trajectories with environmental and behavioral data, this study elevates site analysis from static spatial description to dynamic, user-centered, comprehensive assessment. This process ensures that the design not only responds to the physical characteristics of the Reston site but also becomes genuinely grounded in the lived experiences and commuting realities of autistic students and their families, establishing a solid foundation for creating learning environments that truly support neurodiversity.

Chapter 4: Precedent Studies

4.1 Introduction: A Curated Journey from Ten to Six Precedents

Precedent study in architecture serves as a fundamental methodology for testing, refining, and translating abstract theories into built reality. For a thesis focused on designing for the nuanced experiences of neurodiversity, this process is indispensable. It allows the research to build upon proven design intelligence, learning from both historical wisdom and contemporary innovation.

The initial research phase involved a broad survey of ten architectural works across various scales, typologies, and cultural contexts. This wide-ranging investigation was crucial for identifying recurring themes and critical design challenges relevant to creating autism-friendly environments. The selection criteria were intentionally diverse, encompassing two distinct categories of precedents.

The first category comprises four general precedents selected for their mastery in spatial organization, materiality, light modulation, and sensory calibration. These are Sant'Elia Nursery School, Aalto Studio, Sensory Arts Garden, and Saint Benedict Chapel. Sant'Elia Nursery School informs spatial organization and circulation flow in universal school design. Aalto Studio demonstrates topographical integration and courtyard design. The Sensory Arts Garden provides specialized knowledge in sensory calibration zones and tactile exploration. Saint Benedict Chapel contributes to an understanding of materiality and dynamic light modulation. Together, these four general precedents offer transferable strategies for balancing structured environments with flexible spatial experiences.

The second category comprises six autism-inclusive or autism-dedicated school facilities: Utah Valley University Autism Center (USA), Northern School for Autism (Australia), Niddrie Autistic School designed by Guymer Bailey Architects (Australia), Sai Kirupa Special School (India), Aspect Treetop School (Australia), and the Els Sensory Art Garden (USA). These cases were selected for their direct application of autism-friendly design principles in educational settings.

From this initial pool of ten, the research strategically narrows its focus to the six autism-specific precedents for detailed comparative analysis. The four general precedents serve as a broader theoretical and methodological foundation, while the six autism-inclusive schools provide the most direct and actionable insights for the design of an autism-inclusive elementary school. This refinement marks a critical shift from broad reconnaissance to focused, in-depth comparison.

The goal of this chapter is not to describe each case in isolation but to compare them across key design dimensions. The analysis examines how each case addresses spatial organization, circulation patterns, sensory zoning strategies, material palettes, and the integration of dedicated therapeutic spaces. By systematically comparing the six cases, the chapter identifies cross-cutting themes and design strategies that recur across different geographical and cultural contexts.

The findings of this comparative analysis reveal three design principles that consistently emerge from built evidence: predictability and wayfinding, sensory escape spaces, and outdoor recovery spaces. These principles, presented at the conclusion of this chapter, directly inform the design proposal developed in subsequent chapters.

4.2 Analysis of General Precedents

Precedent 1: Sant'Elia Nursery School, Como, Italy



Figure 11. Sant'Elia Nursery School, Como, Italy

Rationale for Selection:

Sant'Elia Nursery School represents a pioneering example of modernist architecture specifically designed for children's educational needs. As an early 20th-century rationalist project, it demonstrates how clear spatial organization and thoughtful program layout can create environments that support both structured learning and free exploration. Its design principles remain highly relevant for creating autism-friendly educational spaces that balance predictability with sensory richness.

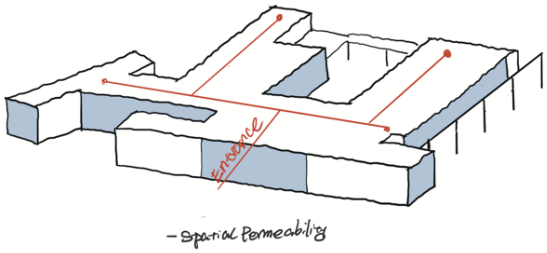


Figure 12. Sant'Elia Nursery School Circulation Analysis Diagram by Wenjie Zhuang

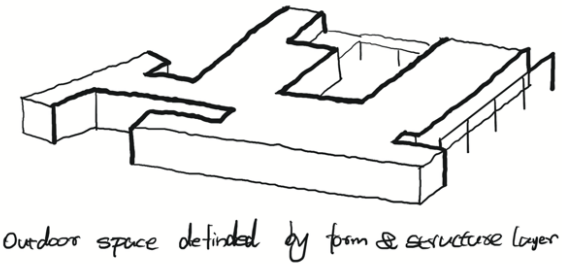


Figure 13. Sant'Elia Nursery School Space Analysis Diagram by Wenjie Zhuang

Analysis and Findings:

- The precedent analysis reveals several key design strategies:
- The building's organization around a central courtyard creates a protected outdoor heart while maintaining visual connections between indoor and outdoor spaces
- Clever use of structural columns and building boundaries defines both interior spaces and exterior zones at a child-appropriate scale
- The clear distinction between primary and auxiliary spaces creates a legible spatial hierarchy that supports wayfinding and activity organization
- Strategic placement of glazed partitions and openings allows for controlled visual access while maintaining acoustic separation where needed
- The integration of landscape design with circulation paths creates natural movement patterns and sensory experiences

Intended Outcome:

Sant'Elia Nursery School demonstrates how rationalist principles can be applied to create environments that are both highly organized and richly experiential. Its approach to spatial zoning, scale-appropriate design, and indoor-outdoor relationships provides valuable lessons for creating educational environments that support neurodiverse learners through clear spatial structure while offering varied sensory experiences.

Precedent 2: Saint Benedict Chapel, Switzerland



Figure 14Saint Benedict Chapel, Switzerland by Peter Zumthor

Rationale for Selection:

Saint Benedict Chapel by Peter Zumthor represents the powerful potential of architectural minimalism in creating deeply sensory environments. Selected for its masterful manipulation of materiality, light, and acoustic qualities, this small-scale project demonstrates how limited means can achieve profound emotional and sensory impacts. Its approach to spatial sequencing and material honesty offers crucial insights for creating calming, focused environments suitable for neurodiverse users.

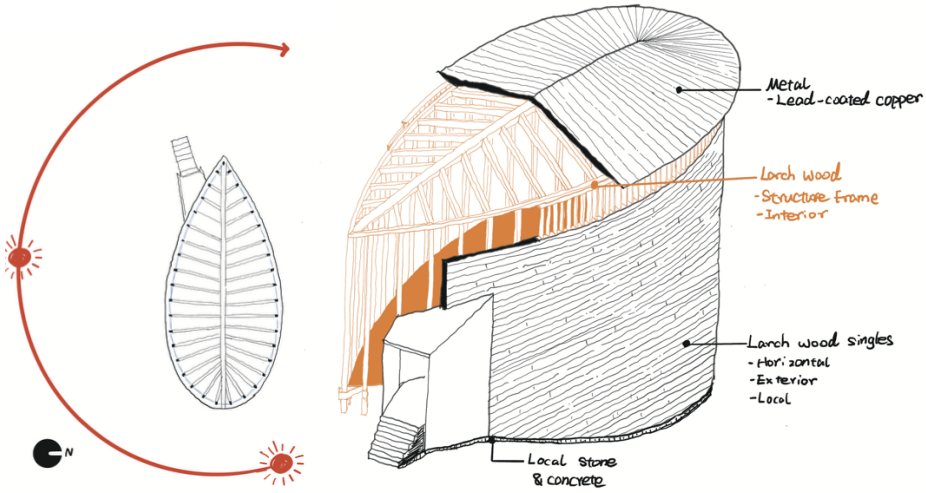


Figure 15. Saint Benedict Chapel Analysis Diagram by Wenjie Zhuang

Analysis and Findings:

- The examination uncovers several essential design qualities:
- The carefully choreographed approach path creates a gradual transition from secular to sacred space, mentally preparing visitors
- Local larch wood shingles and stone foundations create strong connections to the site while providing tactile warmth
- Strategically placed apertures control light penetration, creating dynamic patterns that change throughout the day

- The unified material palette creates sensory consistency and reduces visual complexity
- The compact scale and wooden interior generate specific acoustic properties that enhance a contemplative atmosphere
- Seasonal material changes create dialogue with natural cycles while maintaining interior environmental stability

Intended Outcome:

Saint Benedict Chapel demonstrates how intentional material selection and light manipulation can create environments that support emotional regulation and sensory comfort. Its principles of spatial sequencing, material authenticity, and atmospheric creation provide valuable guidance for designing learning spaces that reduce sensory overload while maintaining spiritual and emotional resonance. The chapel shows how highly structured spatial journeys can incorporate moments for personal reflection and sensory recovery.

Precedent 3: Aalto Studio, Helsinki, Finland



Figure 16. Aalto Studio by Alvar Aalto,Aino Aalto

Rationale for Selection:

The Aalto Studio represents Alvar and Aino Aalto's human-centered approach to modernism, characterized by organic forms, natural materials, and sensitive site integration. Selected for its demonstration of how architectural spaces can harmonize human activity with natural environments through sensory intelligence, this precedent offers valuable insights into creating non-institutional, comforting environments that support wellbeing through material and spatial choices.

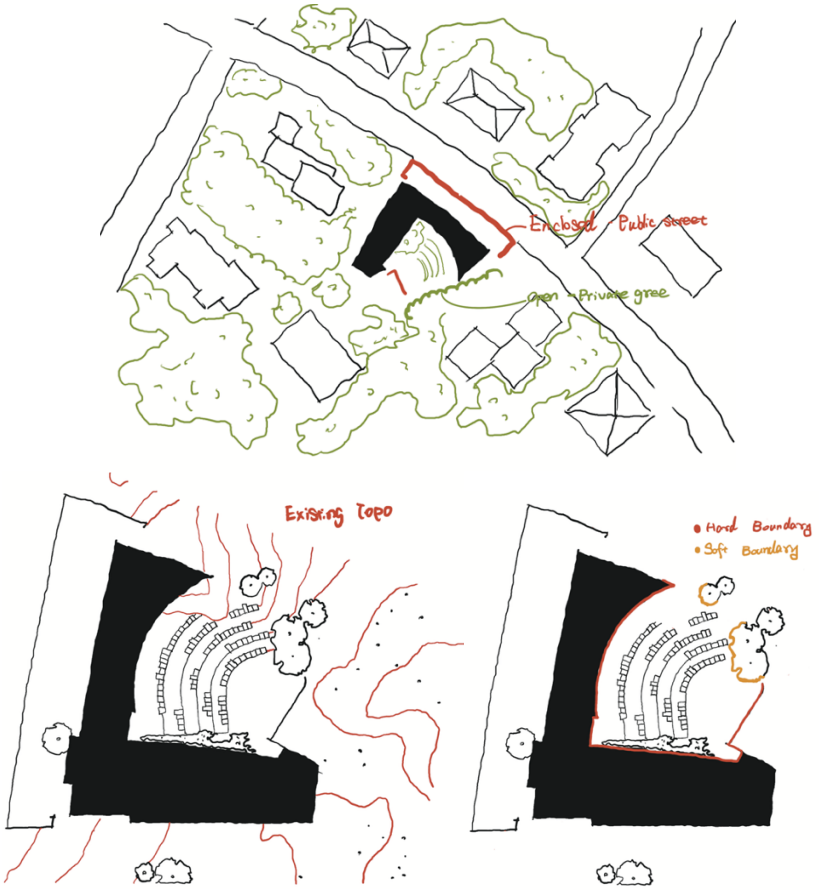


Figure 17. Aalto Studio Analysis Diagram by Wenjie Zhuang

Analysis and Findings:

- The analysis identifies several key design approaches:
- The building responds differentially to its context more closed to public streets, more open to private gardens
- Outdoor spaces follow natural topography, integrating human activities with landscape features
- Strategic spatial organization creates clear hierarchies from private to collective spaces
- Variation in ceiling heights and spatial volumes defines different functional zones while maintaining visual connections
- Natural wood surfaces and organic forms create tactile warmth and visual softness
- Structural modules provide organizational clarity while allowing functional flexibility
- Carefully designed sightlines maintain privacy where needed while preserving connections to nature

Intended Outcome:

Aalto Studio provides a model for integrating architectural design with natural environments in ways that support sensory wellbeing. Its principles of contextual

response, material warmth, and spatial hierarchy demonstrate how built environments can feel both organized and organic. The studio's approach shows how clear architectural structure can coexist with sensory richness and individual comfort, making it particularly relevant for creating educational environments that support neurodiverse learners.

Precedent 4: Sensory Arts Garden & Pavilion



Figure 18. Sensory Arts Garden & Pavilion

Rationale for Selection:

The Sensory Arts Garden & Pavilion represents a contemporary, evidence-based approach to designing for neurodiversity. Selected for its intentional application of sensory design principles developed through interdisciplinary collaboration, this facility demonstrates how purpose-built environments can support sensory processing needs across multiple user groups. Its comprehensive sensory zoning and user-controlled features make it particularly relevant for creating inclusive educational environments.

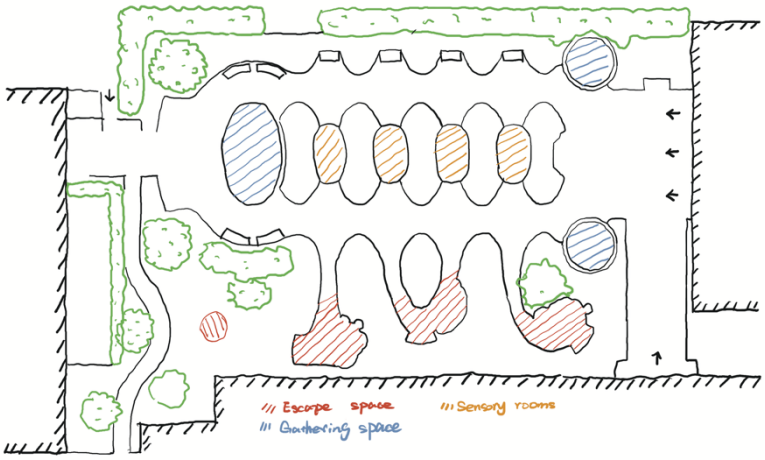


Figure 19. Sensory Arts Garden & Pavilion Analysis Diagram by Wenjie Zhuang

Analysis and Findings:

- The study reveals several innovative design strategies:
- Eight distinct sensory zones provide calibrated experiences for different sensory needs and preferences

- User-controlled interactive elements allow visitors to modulate their sensory input
- A clear circulation hierarchy from public to private spaces supports predictable navigation
- Rounded corners and smooth transitions throughout the design enhance psychological safety
- Buffer zones between activity areas help define spaces while providing sensory transitions
- Non-stigmatizing design integrates therapeutic features as natural environmental elements
- Graduated challenge principles allow users to engage at their comfort level

Intended Outcome:

The Sensory Arts Garden provides a contemporary model for translating sensory integration theory into built form. Its evidence-based approach to sensory zoning, user control, and graduated challenges demonstrates how environments can actively support sensory regulation and integration. The garden's success in serving diverse user groups validates architectural strategies that prioritize sensory needs as a primary design consideration, offering valuable lessons for creating educational spaces that support neurodiverse learners through environmental design.

4.3 Analysis of Autism-Inclusive Precedents

While the four general precedents examined above offer valuable insights into spatial organization, materiality, and sensory calibration, the six autism-inclusive or autism-dedicated facilities provide the most direct evidence for designing specifically for neurodiverse learners. These six cases, Utah Valley University Autism Center (USA), Northern School for Autism (Australia), Niddrie Autistic School (Australia), Sai Kirupa Special School (India), Aspect Treetop School (Australia), and Els Sensory Art Garden (USA), are analyzed here through a comparative, cross-case lens rather than in isolation. The analysis examines around three design principles that consistently emerge from the literature and the built evidence: predictability, sensory escape space, and outdoor green space. For each principle, the six cases are compared to identify recurring strategies, successful applications, and potential limitations.

Predictability: Circulation, Wayfinding, and Visual Coding

Predictability in the built environment reduces cognitive stress and supports independent navigation for autistic users. Across the six cases, several strategies recur to achieve spatial predictability.

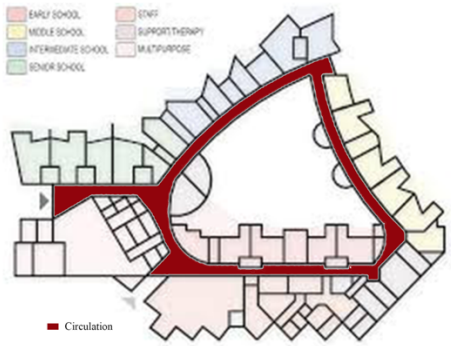


Figure 20. Northern School for Autism Analysis Diagram illustrated by Wenjie Zhuang



Figure 21. Niddrie Autistic School Analysis Diagram illustrated by Wenjie Zhuang

Clear circulation is consistently prioritized. The Northern School for Autism and Niddrie Autistic School both employ straightforward, legible circulation paths that minimize ambiguous junctions and dead ends. Circulation is treated not as residual space but as an active organizational device that structures the entire facility.

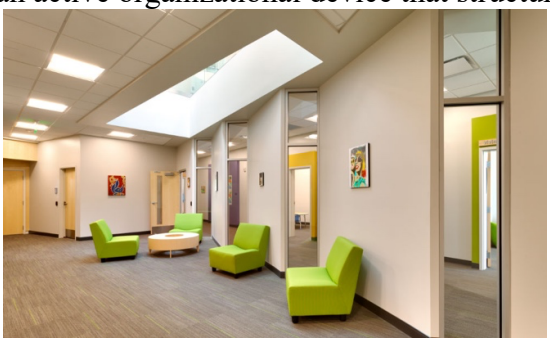


Figure 22. Classroom view of Utah Valley University Autism Center



Figure 23.Hallway of the Sai Kirupa Special School

Wayfinding is reinforced through visual coding. Utah Valley University Autism Center and Sai Kirupa Special School both utilize color-coded systems to distinguish different zones or classroom clusters. Sai Kirupa specifically employs low-saturation grays and natural wood tones as a calming backdrop, with color used selectively as a navigation cue rather than as pervasive stimulation.

Graphic identity strategies supplement architectural wayfinding. Sai Kirupa Special School integrates graphic cues directly into the corridor environment, making the flow of space and activity predictable. The Els Sensory Art Garden extends wayfinding into the landscape, using changes in paving, planting, and enclosure to signal transitions between sensory zones.

Across all six cases, predictability is achieved not through a single device but through the integration of clear circulation, redundant visual cues, and consistent graphic language. These strategies collectively reduce the cognitive load of navigation, allowing students to direct attention toward learning rather than wayfinding.

Sensory Escape Space: Retreat, Regulation, and Recovery

Despite careful sensory calibration, overload remains inevitable for many autistic individuals. The provision of dedicated escape spaces where students can retreat to regulate and recover emerges as a consistent feature across the six cases.



Figure 24. The Sensory Escape Space of the Northern School for Autism



Figure 25. The Sensory Escape Space of the Niddrie Autistic School

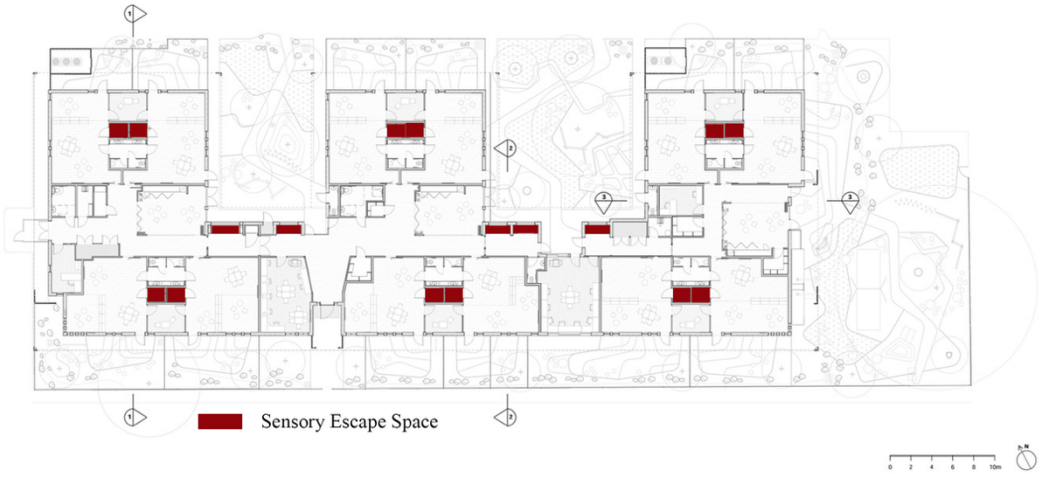


Figure 26. The Sensory Escape Spaces of the Niddrie Autistic School

The Northern School for Autism integrates escape spaces directly adjacent to learning areas, allowing students to withdraw without leaving their familiar classroom zone. These spaces are characterized by strict acoustical control, visual privacy, and calming material palettes. Similarly, Niddrie Autistic School incorporates sensory

calming rooms that are accessible from multiple classrooms, providing a shared resource without requiring long circulation paths.



Figure 27. The Sensory Escape Spaces of the Aspect Treetop School

Aspect Treetop School places particular emphasis on acoustical privacy. Escape spaces are designed with sound-absorbing materials and isolated from high-stimulus corridors. The Els Sensory Art Garden, while not a full school facility, demonstrates how sensory retreat can extend into outdoor environments, with enclosed seating niches and tactile surfaces that offer controlled sensory input.



Figure 28. The Sensory Escape Spaces of the Sai Kirupa Special School

Utah Valley University Autism Center and Sai Kirupa Special School both provide a range of escape spaces with varying degrees of enclosure and privacy. Some spaces are designed for individual retreat, others accommodate small groups with a supervising adult. This variety allows students to select the level of social and sensory exposure that matches their current needs.

Across all six cases, escape spaces are never positioned as punitive or isolated. They are integrated into the daily rhythm of the facility, accessible from learning areas, and designed to support active self-regulation rather than passive withdrawal.

Outdoor environments offer unique restorative potential for autistic learners, providing respite from the controlled intensity of indoor spaces. Across the six cases, outdoor spaces are treated not as anonymous playgrounds but as intentional therapeutic environments.



Figure 29. Outdoor Green Space of The Northern School for Autism

The Northern School for Autism incorporates green spaces with a clear visual connection to interior learning areas, enabling passive supervision as students engage with nature. These outdoor areas feature varied degrees of enclosure from open lawns to sheltered alcoves, giving students choices about their level of exposure.

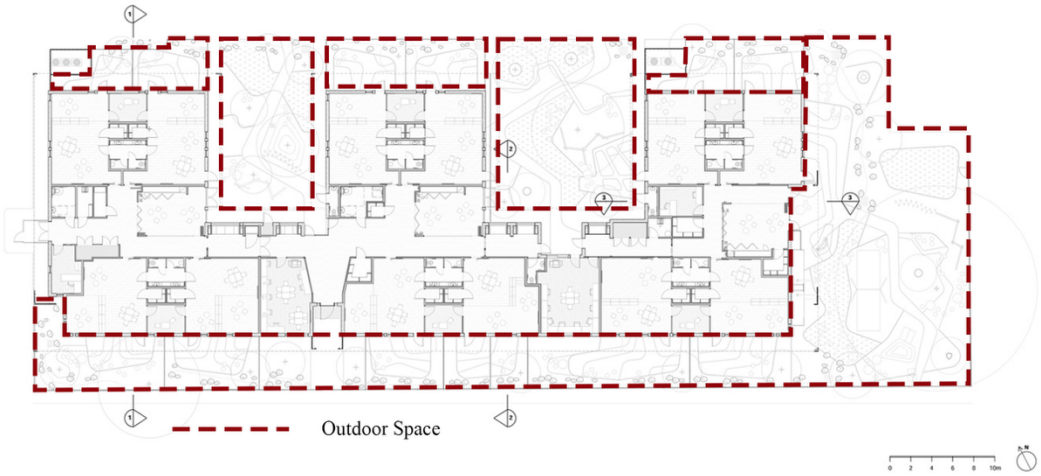


Figure 30. Outdoor Green Space of The Niddrie Autistic School

Niddrie Autistic School integrates outdoor learning areas directly into the classroom cluster, making the transition between inside and outside seamless and predictable. The Els Sensory Art Garden specializes in sensory zoning extended into the landscape, with distinct zones for tactile exploration, visual engagement, olfactory stimulation, and quiet retreat. Paving changes, planting density, and seating niches define these zones without rigid boundaries.

Utah Valley University Autism Center and Aspect Treetop School both recognize that not all outdoor spaces need be active. Quiet gardens, shaded seating areas, and planted buffers provide opportunities for passive recovery. These spaces are positioned away from high-noise zones such as playfields or drop-off areas.

Sai Kirupa Special School demonstrates how even limited outdoor space can be used therapeutically. Compact courtyards with natural materials, water features, and seating niches offer sensory grounding and visual respite from the interior environment.

Across all six cases, outdoor green space is not supplementary but essential. It serves multiple functions: restorative environmental contact, diverse sensory engagement, flexible social interaction, and a bridge between structured indoor learning and unstructured recovery.

3.4 Conclusion: Emerging Design Principles from Autism-Inclusive Precedents

The comparative analysis of the six autism-inclusive facilities reveals three design principles that consistently emerge across geographical and cultural contexts. These principles are not imposed from theory but are observed repeatedly in built evidence.

First, predictability is achieved through the integration of clear circulation, redundant wayfinding cues, and consistent visual coding. Across all six cases, legible spatial organization reduces cognitive stress and supports independent navigation. Color is used selectively as a navigation tool rather than as pervasive stimulation, and graphic strategies supplement architectural cues.

Second, sensory escape spaces are provided as integrated, accessible retreats for self-regulation. These spaces are never positioned as punitive or isolated. They offer acoustical and visual privacy, calming material palettes, and varying degrees of enclosure to accommodate individual preferences. Their integration into the daily rhythm of the facility, adjacent to learning areas rather than removed, validates self-regulation as a normal and necessary activity.

Third, outdoor green space functions as an essential therapeutic environment, not a supplementary amenity. These spaces offer restorative contact with nature,

diverse sensory engagement, and flexible opportunities for social interaction or quiet retreat. Varied degrees of enclosure, clear visual connection to interior spaces, and intentional sensory zoning characterize successful outdoor environments across the six cases.

Together, these three principles form an evidence-based foundation for autism-inclusive school design. They demonstrate that architecture can shift from being a source of sensory challenge to an active therapeutic tool. The following chapter translates these principles into a design proposal for the Lake Anne Elementary School site in Reston, Virginia.

Chapter 5: Zones and the Program

5.1 Program Abstract: Architecture as an Active Therapeutic Instrument

The design of learning environments for autistic children requires a fundamental reconsideration of architecture's purpose, transforming it from a passive container into an active therapeutic instrument. This thesis addresses the critical disconnect between evidence-based autism pedagogy and the physical environments meant to support it. Rooted in evidence-based autism pedagogy and sensory design frameworks, the proposed architectural prototype translates therapeutic and educational principles into a built environment that systematically balances comprehensive structure with individual flexibility. Moving beyond conventional school design, this program creates a spatial ecosystem where every architectural element, from acoustic buffers to transitional thresholds, serves the dual purpose of supporting learning while promoting sensory regulation. By integrating specialized spaces like sensory pods and recharge nooks within a logical spatial sequence, the design empowers neurodiverse learners through environmental predictability while providing opportunities for self-directed sensory modulation.

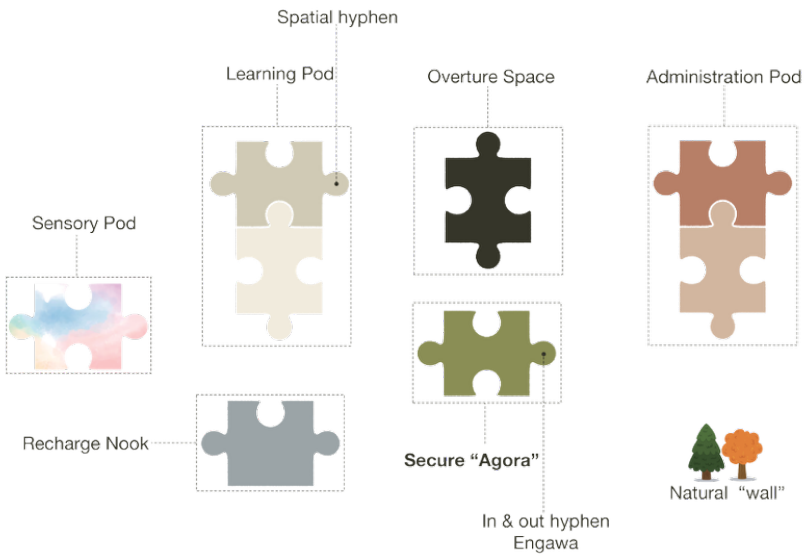


Figure 31. Program zones diagram by Wenjie Zhuang

5.2 Program Zones: A Framework for Balancing Structure and Flexibility

The architectural program organizes space through two complementary layers that collectively create a responsive environment for neurodiverse learners.

Structural Framework: Establishing Order and Predictability

This layer provides a comprehensive framework that reduces anxiety through spatial clarity, directly aligning with the emphasis on structure and predictability established in the literature review and previous studies.

Overture/Entrance Space: The entry sequence begins with a carefully calibrated decompression zone, providing immediate orientation and panoramic visibility into the school's core. Preceded by a Spatial Hyphen, this space enables gradual sensory and cognitive adjustment before entering learning environments.

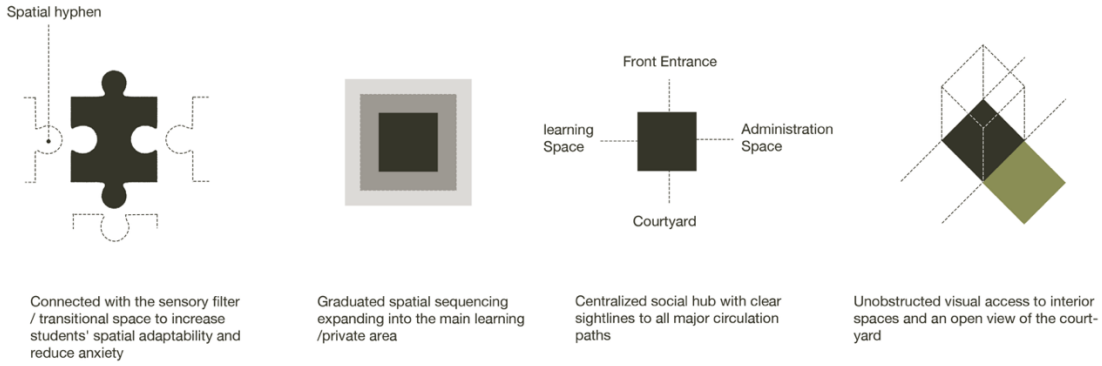


Figure 32. Program Vignettes 1 by Wenjie Zhuang

Spatial Hyphen (Transition Zone): These transitional spaces employ materiality and light to create sensory decompression zones between areas of varying stimulation levels, supporting cognitive reorientation.

Secure Agora/Courtyard: Serving as the central social and circulation hub, this intelligible green heart maintains clear sightlines to all major circulation paths while functioning as a biophilic anchor for the entire complex.

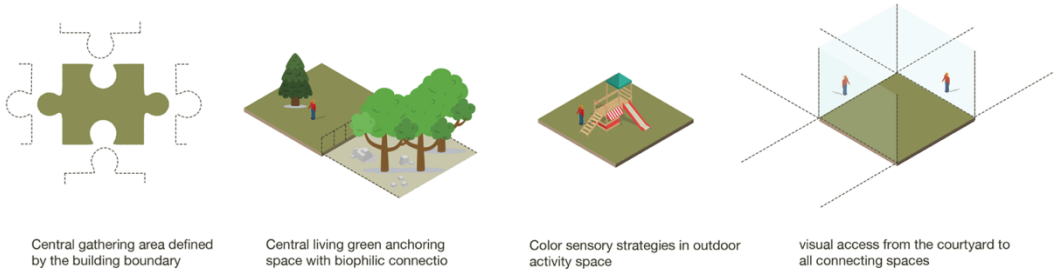


Figure 33. Program Vignettes 2 by Wenjie Zhuang

In and Out Hyphen (Engawa): Semi-outdoor thresholds enable users to autonomously choose their level of outdoor engagement, from active participation to quiet observation.

Individual Flexibility Layer: Providing Choice and Autonomy

Nested within the macro-structure, this layer offers diverse opportunities for sensory regulation, aligning with the principle of capitalizing on individual strengths and flexibility identified in the research.

Learning Pods: Intimately scaled, acoustically controlled environments provide predictable settings for concentration, featuring adjustable lighting systems and mobile furniture for reconfiguration

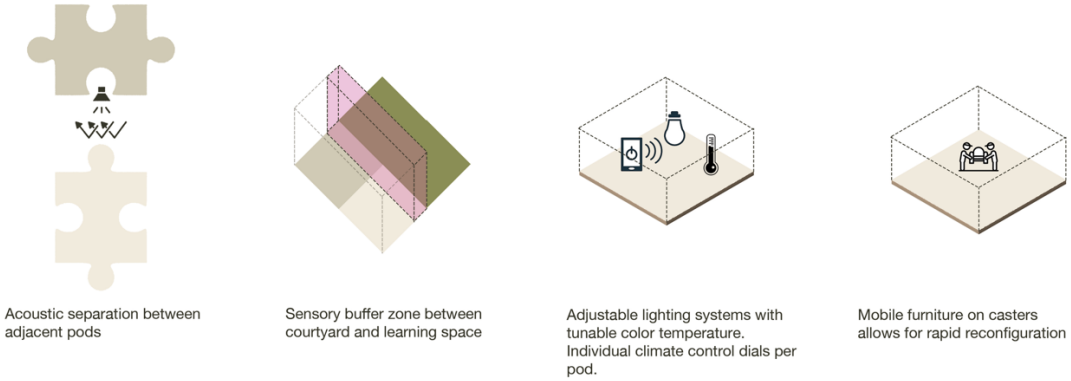


Figure 34.Program Vignettes 3 by Wenjie Zhuang

Sensory Pods: Active areas for sensory seeking or stimulation support diverse self-regulation needs through calibrated visual, tactile, and proprioceptive experiences.

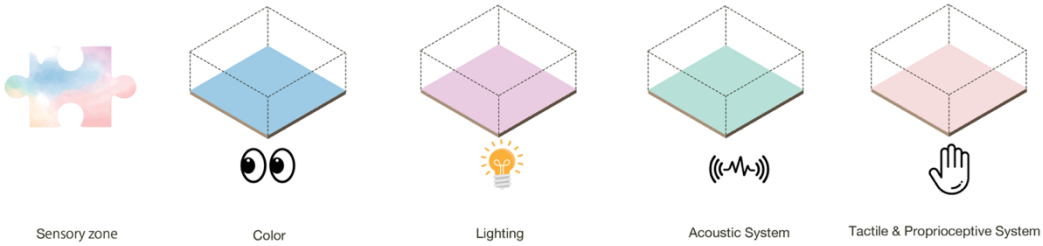


Figure 35.Program Vignettes 4 by Wenjie Zhuang

Recharge Nook: Deeply recessed alcoves with 80 percent visual separation offer immediate sanctuary from sensory overload, equipped with weighted blankets and white noise generators.

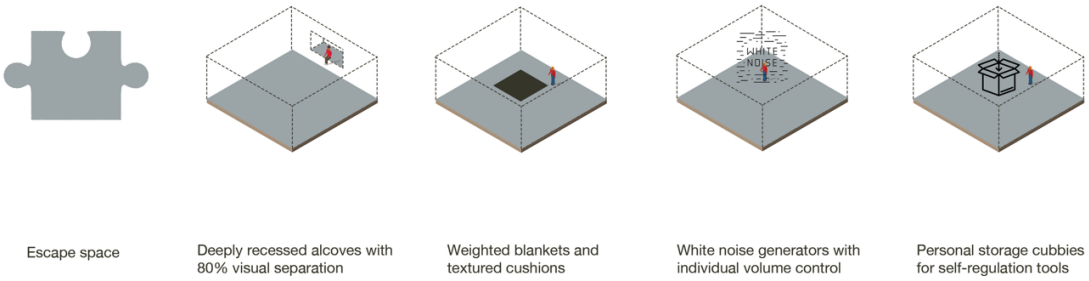


Figure 36. Program Vignettes 5 by Wenjie Zhuang

5.3 Thesis Program

General Education & Shared Core

Category	Space Name	Qty	Area (NSF)	Rec. Dimensions	Design Notes
1.0 ADMINISTRATION & GUIDANCE					
Secure Vestibule	1	200	10' x 20'	Two-stage entry, blast-resistant glazing	
Welcome / Waiting Area	1	600	-	Visual connection to parking	
General Office / Reception	1	400	-	Workstations for admin assistants	
Principal's Office	2	200	12' x 16'	Private, meeting table space	
Assistant Principal Office	1	150	10' x 15'	-	
Conference Room	1	350	18' x 20'	General staff meetings	
Health Clinic	1	500	-	Includes accessible toilet, 2 cots, fridge	
Workroom / Mailroom		400	-	Copiers, teacher mailboxes	

2.0 ACADEMIC CLASSROOMS (K-5)	4				
Pre-K / Kindergarten Class	4	1,000	30' x 34'	Includes en-suite toilet. Direct outdoor access required	
Grade 1 Classroom	16	975	30' x 33'	Includes en-suite toilet	
Grade 2-5 Classroom	4	800	28' x 29'	Standard academic studio	
Extended Learning Area	4	400	-	Open plan breakout space shared by every 4 classrooms	
Teacher Team Office	4	150	10' x 15'	Shared planning space per grade level	
Small Group / Resource Room		400	20' x 20'	For ESL, Reading Recovery, or Gifted (AAP)	
3.0 INSTRUCTIONAL MEDIA & TECHNOLOGY					
Media Center (Library)	1	3,000			Open plan includes stacks, reading nooks, circulation desk
MakerSpace / STEAM Lab	1	1,000	30' x 34'	Heavy duty flooring, sinks, power drops	
Computer Lab / Tech Hub	1	900	30' x 30'	Can be integrated into Media Center	
AV / Server Storage		250	-	Climate controlled	

4.0 VISUAL & PERFORMING ARTS					
Art Studio	1	1,000	30' x 34'	North light preferred, acid-resistant sinks	
Kiln Room		80	-	High ventilation required	
	1				
Music Room	1	1,000	30' x 34'	Acoustic isolation, tiered risers preferred	
Instrument Storage		250	-	Humidity controlled	
Stage / Platform	1	800	-	Connected to Gym or Cafeteria	
5.0 PHYSICAL EDUCATION & DINING					
Gymnasium	1	4,000	50' x 80'	Wood floor, divider curtain recommended	
PE Office	1	150	-	Glass view into Gym	
PE Storage	1	400	-	For mats and equipment	
Cafeteria (Dining)		3,000	50' x 60'	Acoustic dampening essential	
Kitchen / Servery	Space Name	1,200	-	Delivery access required	Design Notes

Autism Education Wing

Category	Space Name	Qty	Area (NSF)	Rec. Dimensions	Design Notes
6.0 SPECIALIZED CLASSROOMS					
PAC Classroom (Pre-K/K)	2	950	30' x 32'	En-suite toilet & changing, direct accessible exit	

Primary Autism Class (1-3)	2	850	28' x 30'	Includes in-room "Quiet Corner" (25 sf)	
Upper Autism Class (4-5)	2	850	28' x 30'	Pre-vocational focus, storage for task bins	
Transition / De-escalation	3	80	8' x 10'	Padded walls, dimmable lights, located between classrooms	
Personal Care Room	1	200	12' x 16'	Accessible shower, adult changing table, lift	High ceiling (12'+), structural support for swings
7.0 THERAPEUTIC CORE					
Sensory Gym (OT/PT)	1	1,200	30' x 40'		
Snoezelen Room (White Room)	1	400	20' x 20'	No windows, fiber optics, bubble tubes, soft floor	
Life Skills Apartment	1	800	25' x 32'	Mock studio: kitchenette, laundry, bed, living area	
Social Skills Group Room	1	450	20' x 22'	Round table setting for group therapy	
Therapist Office (OT/PT/Speech)	2	150	-	Private documentation space	Private meeting space for parents/staff
8.0 AUTISM SUPPORT & STAFF	IEP Conference Room	1	350	15' x 22'	
Staff Respite Room	1	300	-	"Off-stage" area for staff mental health breaks	
Observation / Data Room	1	150	-	One-way mirror into Sensory Gym (optional)	
Wing Storage	1	250	-	For adaptive equipment (wheelchairs, standers)	Design Notes

Category	Space Name	Qty	Area (NSF)	Rec. Dimensions	En-suite toilet & changing, direct accessible exit
6.0 SPECIALIZED CLASSROOMS					
PAC Classroom (Pre-K/K)	2	950	30' x 32'		
Primary Autism Class (1-3)	2	850	28' x 30'	Includes in-room "Quiet Corner" (25 sf)	
Upper Autism Class (4-5)	2	850	28' x 30'	Pre-vocational focus, storage for task bins	
Transition / De-escalation	3	80	8' x 10'	Padded walls, dimmable lights, located between classrooms	

Summary of Areas

DEPARTMENT / ZONE	TOTAL NET SQ. FT.
Part 1: General Ed & Shared Core	~41,500 NSF
Part 2: Autism Education Wing	~9,200 NSF
TOTAL NET AREA	50,700 NSF
Mechanical / Walls / Circulation (+35%)	17,745 SF
ESTIMATED GROSS AREA (GSF)	~68,445 GSF
DEPARTMENT / ZONE	TOTAL NET SQ. FT.

5.4 Program Development: Site Data and Autism-Inclusive Precedent Analysis

The spatial program has been developed through two complementary lines of inquiry: site-specific data collected from Reston, Virginia, and comparative analysis of the six autism-inclusive school facilities examined in Chapter 4.

Site Data from Reston, Virginia

The demographic and spatial analysis of Reston and the existing Lake Anne Elementary School site provided critical quantitative and qualitative parameters for the program. The thirty-minute drive radius analysis revealed the distribution of autistic students within the broader community, informing the scale and capacity of the proposed facility. Field documentation of the existing building identified key deficiencies: spatial fragmentation, compromised green spaces, and unpredictable

circulation patterns that directly shaped the programmatic priorities. The surrounding community's principles of radical inclusion, social equity, and the integration of live and work informed the program's relationship to the neighborhood, particularly in the design of shared spaces that bridge school and community.

Insights from Autism-Inclusive Precedents

The six autism-inclusive school facilities analyzed in Chapter 4 provided direct, built evidence for how specific programmatic elements support neurodiverse learners.

Sant'Elia Nursery School informed the central courtyard organization and clear zoning between primary and auxiliary spaces. Its rationalist approach to creating child-scaled environments with protected outdoor areas directly influenced the Secure Agora concept and the relationship between learning pods and shared spaces.

Saint Benedict Chapel contributed essential insights into material authenticity and atmospheric creation. The chapel's manipulation of light and acoustics influenced the design of Learning Pods and Recharge Nooks, particularly in creating environments that support emotional regulation through sensory calibration.

Aalto Studio demonstrated the integration of human-centered modernism with natural environments. The studio's contextual response informed the building's site relationship with the Reston landscape, while its use of warm materiality and organic forms contributed to the non-institutional character of learning environments.

Sensory Arts Garden and Pavilion provided evidence-based strategies for sensory zoning and user control. The garden's sensory zones informed graduated sensory experiences throughout the program, while its non-stigmatizing integration of therapeutic features influenced the design of Sensory Pods and transition spaces.

Synthesis

Combining the Reston site data with insights from the six autism-inclusive precedents, the program is calibrated to the specific demographics, environmental conditions, and community context of the site while grounded in proven design strategies for neurodiverse learners. The resulting program responds to both the universal needs of autistic students and the particular conditions of Reston, Virginia.

Chapter 6: Site Selection and Analysis

6.1 Introduction: The Role of Site in Neurodiversity-Inclusive Design

Site selection and analysis are not merely preliminary steps in the architectural process but foundational to the success of an autism-inclusive elementary school. The physical, social, and sensory context of a site directly shapes how students, families, and staff experience the school environment. A well-chosen site can reduce commuting stress, provide restorative natural conditions, and foster meaningful connections between the school and the broader community. Conversely, a poorly sited school can amplify sensory challenges, isolate students from community resources, and undermine the goal of selective integration. This chapter examines the site selected for this thesis, Reston, Virginia, and specifically the Lake Anne Elementary School site, through multiple analytical lenses, including geography, history, urban density, pedestrian networks, and natural environment.

6.2 Reston, Virginia: Location and Cultural Context

Geographic Location

Reston is in Fairfax County, Virginia, approximately twenty-five miles west of Washington, D.C. The community is situated within the Washington metropolitan area, accessible via the Dulles Toll Road (Route 267) and the Fairfax County Parkway (Route 286). The Reston Town Center metro station, served by the Silver Line, provides rapid transit connections to Washington, D.C., Tysons Corner, and Dulles International Airport. This regional accessibility is critical for the proposed autism-inclusive elementary school, as it ensures that families from across Fairfax County and surrounding jurisdictions can reach the facility within a reasonable commute. The site analysis defines a thirty-minute driving radius as the primary service area, accounting for the demographic distribution of autistic students and the transportation patterns of their families.



Figure 37. Little-Art-Gallery-Lake-Anne

Reston was founded in 1964 by Robert E. Simon Jr., whose vision was to create a planned community that balanced modern convenience with human-scale design. Simon named Reston after his initials (R.E.S.) and the suffix "-ton," meaning town. From its inception, Reston was conceived as a "live, work, and play" community, an alternative to the suburban sprawl and urban decay that characterized much of postwar America. This founding philosophy prioritized diversity, affordable housing, the importance and dignity of the individual, and the integration of live and work within the same community. Art and culture have been central to Reston's identity. The community established the Reston Community Center, the Reston Art Gallery, and the Greater Reston Arts Center (GRACE), and it hosts annual events such as the Northern Virginia Fine Arts Festival. Public art is integrated throughout Reston's villages, including sculptures, murals, and landscape installations. This cultural richness offers opportunities for the proposed school to engage with local arts organizations, providing autistic students with access to therapeutic and educational programming beyond the school walls.

6.3 Lake Anne Community: Density, Housing, and Pedestrian Networks

Community Design Principles

Lake Anne Village Center was the first village center built in Reston, completed in 1966. Designed by the architectural firm Whittlesey, Conklin, and Ross, Lake Anne was conceived as a mixed-use, pedestrian-oriented hub. The village center includes residential apartments, townhouses, single-family homes, retail spaces, a community center, and the historic Lake Anne Elementary School itself. The surrounding residential clusters are tightly integrated with commercial amenities, creating a walkable neighborhood where daily needs are within a five-to-ten-minute walk of most homes.

Urban Density and Housing Diversity

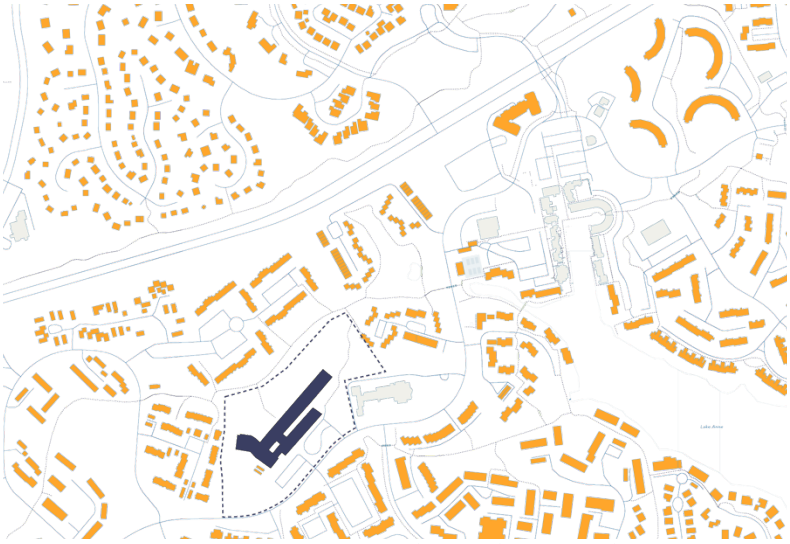


Figure 38.Housing Diversity diagram by Wenjie Zhuang

The housing stock around Lake Anne is notably diverse. Within a half-mile radius of the elementary school site, there are single-family detached homes, townhouses, garden apartments, and mid-rise condominium buildings. This diversity of housing types means that the student population naturally reflects a range of socioeconomic backgrounds, a key consideration for a public school intended to serve all autistic learners regardless of family income. The density is moderate, with clusters of three-to-four-story buildings concentrated around the village center and lower-density single-family neighborhoods radiating outward. This pattern allows the school site to be accessible to a high concentration of families while remaining embedded in a residential rather than purely institutional context.

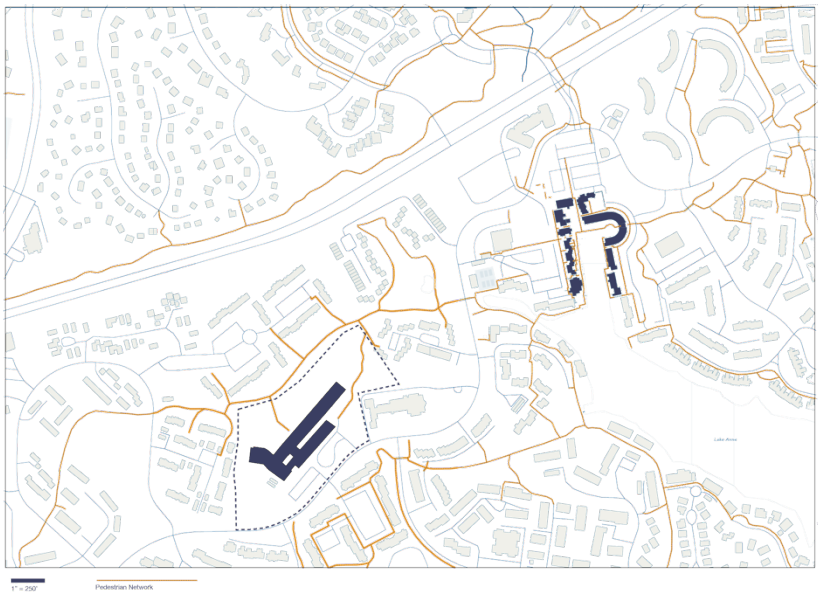


Figure 39. Pedestrian Network Diagram by Wenjie Zhuang

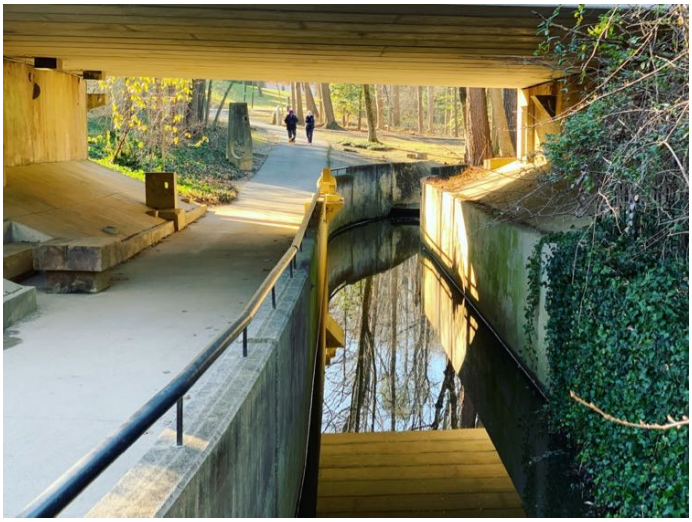


Figure 40. Fairway Drive Underpass

Lake Anne benefits from an extensive pedestrian network originally designed to encourage walking and reduce automobile dependence. Sidewalks, paved trails, and boardwalks connect the elementary school to the village center, the lakefront, and surrounding residential areas. The Reston Association maintains over fifty-five miles of pathways throughout the community, many of which pass through or near the Lake Anne site. Key infrastructure elements include pedestrian underpasses that allow safe passage beneath major roadways without crossing traffic, as well as bridges that connect residential clusters across natural features such as streams and ravines. These underpasses and bridges ensure continuous, car-free pedestrian routes, eliminating the

need for students and families to navigate high-speed intersections or unprotected crosswalks.

The Walk & Roll Program, supported by Fairfax County Public Schools and local parent organizations, encourages safe walking and biking to school. For autistic students, who may experience anxiety related to chaotic drop-off and pick-up zones, a well-designed pedestrian network offers an alternative to the high-stress environment of the car loop. The presence of underpasses and bridges further reduces unpredictable encounters with vehicular traffic, allowing students to follow a consistent, predictable route to school each day. The ability to arrive by foot or bike, accompanied by a parent or caregiver, can reduce morning sensory overload and establish a calm transition into the school day.

School-Community Integration



Figure 41. Lake Anne Plaza

Lake Anne Elementary School is not isolated from its surroundings. The school building sits adjacent to Lake Anne Plaza, a vibrant commercial and civic center that includes restaurants, shops, a farmers' market, a library, and community gathering spaces. This adjacency is unusual for a public elementary school and represents a significant asset for the proposed design. Rather than treating the school as a fortress separated from the community, the redesign can strategically bridge the two. Shared spaces such as the library, plaza, and lakefront pathways can be used by both students and residents, fostering the "selective integration" that the thesis advocates. Autistic students can practice real-world social and life skills in a supportive, graduated environment, moving from fully protected school spaces to semi-public thresholds and finally to public community spaces as their comfort and competence allow.

6.4 Lake Anne Elementary School Site: Natural Environment and Existing Conditions

Natural Environment and Tree Canopy



Figure 42. 53% Tree Canopy Coverage Diagram by Wenjie Zhuang

The Lake Anne Elementary School site is characterized by an exceptional natural environment. The property sits on the edge of Lake Anne, a man-made reservoir that serves as the visual and recreational anchor of the village center. Surrounding the school building are mature trees, including oaks, maples, and pines, providing a dense tree canopy that shades the site during summer months. According to site documentation, the broader Reston community maintains a 53 percent tree canopy coverage, and the elementary school site itself benefits from significant green space. This natural setting is not merely aesthetic but therapeutic. Research reviewed in Chapter 2 establishes that exposure to green space reduces stress, restores attention, and supports sensory regulation. For autistic students who may experience heightened sensory and social stress throughout the school day, direct access to nature, not as a distant view but as an immediate, reachable environment, is essential.

Existing Building Conditions and Challenges



Figure 43. Lake Anne Elementary School in the 1960s



Figure 44. Today's Lake Anne Elementary School

The existing Lake Anne Elementary School building, constructed between 1961 and 1966, presents several challenges that the proposed redesign must address. First, the building suffers from structural obsolescence, with mechanical, electrical, and plumbing systems that no longer meet contemporary standards for indoor environmental quality. Second, the original courtyards and green spaces have been compromised over time, reducing opportunities for outdoor learning and sensory recovery. Third, the building exhibits spatial fragmentation, with disjointed circulation paths that lack predictability, a critical deficiency for autistic students who rely on legible spatial layouts to navigate independently.

Site Assets: Green Space, Pedestrian Access, and Community Connection

Despite its deficiencies, the Lake Anne site possesses irreplaceable assets. The lakefront location offers visual and acoustic respite, with water views and natural sounds that can serve as a calming backdrop to the school day. The dense tree canopy provides passive shading, reducing solar heat gain and creating cooler microclimates on the playground and outdoor learning areas. The pedestrian network connects the school directly to the village center, eliminating the need for students to cross high-

speed arterial roads. And the community itself, vibrant, diverse, and culturally rich, offers a real-world context for teaching life skills, social interaction, and community participation. The redesign must therefore be a renovation and transformation, not a replacement. It must preserve and enhance the site's natural and community assets while resolving the spatial and structural deficiencies of the existing building.

6.5 Synthesis: Site as Therapeutic Landscape

The Reston, Virginia site, and specifically the Lake Anne Elementary School property, offers a unique combination of assets for an autism-inclusive elementary school. Its regional location provides accessibility to a diverse population of autistic students. Its community context is walkable, dense, and integrated, supporting the thesis's goal of selective integration, where students can engage with the community at their own pace and comfort level. Its natural environment, with mature trees and lakefront access, offers restorative sensory experiences that directly support the therapeutic goals of the design. And its existing building, while challenged by obsolescence and fragmentation, provides a framework for transformation. The following chapter translates these site assets and challenges into a design proposal that balances overarching structure with individual flexibility, creating a school that is not merely located in Reston but is genuinely of Reston, rooted in its history, responsive to its community, and attuned to its natural landscape.

Chapter 7: Conceptual Testing of the Thesis

Introduction: From Research to Design Exploration

The preceding chapters have established the theoretical foundation, design principles, and site context for an autism-inclusive elementary school. This chapter documents the early conceptual explorations that translate this research into architectural form. The discovery phase presented here is not a finished design, but a testing ground a series of iterative massing studies, parti diagrams, and tectonic explorations that probe how the thesis question might be answered in built reality.

The central concept emerging from this discovery phase is organized around three architectural components: Dual Learning Ecosystems, a Shared Core, and Community Bridging. These components directly respond to the thesis question of balancing overarching structure with individual flexibility.

Core Design Concept: Dual Learning Ecosystems Connected by a Shared Core

The design organizes the school into two parallel learning ecosystems flanking a central Shared Core.

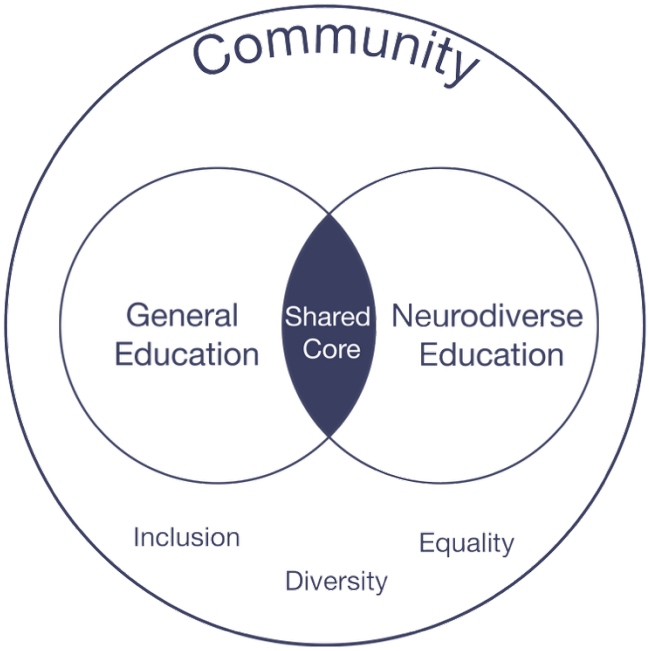


Figure 45. Project Parti Diagram

Dual Learning Ecosystems

The first ecosystem serves general education students (K-5). The second ecosystem serves autistic students in the neurodiverse wing. These two systems are designed as parallel but separate. This separation is not segregation but intentional

differentiation. Each ecosystem is calibrated to the specific sensory, social, and pedagogical needs of its users.

The Shared Core

Between the two learning ecosystems lies the Shared Core a central spine of communal spaces that includes the library, cafeteria, gymnasium, art and music rooms, and therapeutic facilities such as the Snoezelen room and sensory gym. This core serves as a bridge, allowing selective integration rather than forced integration. Students from both ecosystems can access the core independently or together, depending on their readiness and comfort level.

Community Bridging

The Shared Core extends beyond the school building to connect with the Lake Anne community. Public-facing spaces such as the library, parent resource lounge, and community courtyard are positioned at the school's edge closest to the village center, inviting gradual, controlled engagement between students and the wider world.

This tripartite organization, Dual Ecosystems + Shared Core + Community Bridge, directly answers the thesis question. The structure is provided by clear zoning and predictable circulation. The flexibility is provided by students' ability to choose when and how to cross thresholds between ecosystems and between school and community.

7.3 Massing Studies: Testing Scale, Zoning, and Site Fit

Contextual Influence: Curved Buildings and Lake Anne Plaza

The massing of the proposed design is not arbitrary but responds directly to its physical context. The Lake Anne Plaza, located immediately adjacent to the school site, features distinctive curved building forms that define the village center's character. The plaza's residential and commercial buildings employ sweeping arcs and rounded corners, creating a sense of enclosure around the central lake while maintaining visual permeability. These curved forms are not merely aesthetic, they shape public outdoor spaces, plazas, pathways, and gathering areas that feel both defined and open.

The proposed school massing draws from this contextual language. Rather than imposing a rigid, orthogonal geometry that would contrast sharply with the existing village center, the design adopts curved and circular forms that extend the architectural logic of Lake Anne Plaza onto the school site. This formal continuity helps integrate the school into the community rather than isolating it as an institutional outlier.

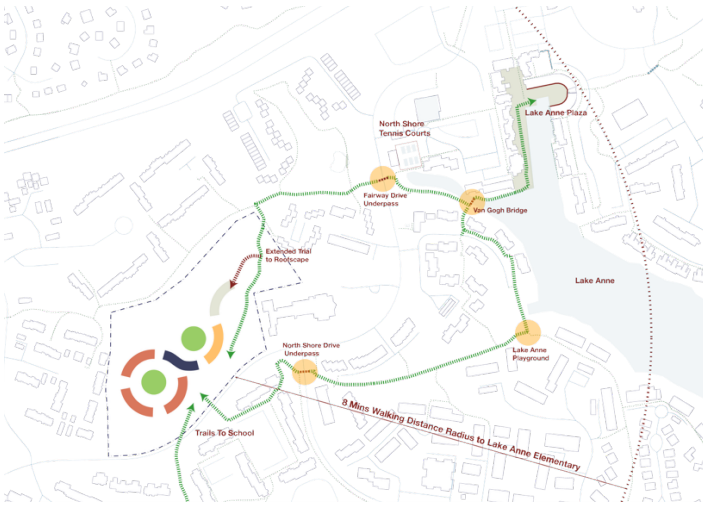


Figure 46. Parti Diagram Illustrated by Wenjie Zhuang

Curved Wings: Shaping Two Main Courtyards

The massing strategy organizes the program into two primary forms: a circular general education wing and a semicircular autism education wing.

Circular General Education Wing

The general education wing is conceived as a complete circle. This circular form serves multiple purposes. First, it creates a continuous perimeter that defines a protected central courtyard, an outdoor space that is visually and acoustically sheltered from surrounding streets and parking areas. Second, the circular geometry eliminates sharp corners and long, undifferentiated corridors, replacing them with a gentle, flowing circulation path that feels less institutional and more intuitive to navigate. Third, the circle's inherent symmetry provides a strong sense of order and predictability, reducing cognitive stress for all students but particularly for autistic learners who may struggle with disorienting spatial layouts.

Semicircular Autism Education Wing

The autism education wing takes the form of a semicircle a half-circle attached to the Shared Core. Like its circular counterpart, the semicircular wing defines a second main courtyard, this one dedicated primarily to the neurodiverse wing. The semicircular form offers several advantages specific to its users. The curved walls eliminate long, straight corridors that can feel oppressive or monotonous. The open side of the semicircle faces the Shared Core, creating a visual and physical connection between the two wings while maintaining clear boundaries. The courtyard defined by the semicircular wing is calibrated for sensory regulation, with varied degrees of enclosure, direct access to outdoor recovery spaces from each classroom, and visual connection to the lake and tree canopy beyond.

Two Courtyards, Two Ecologies

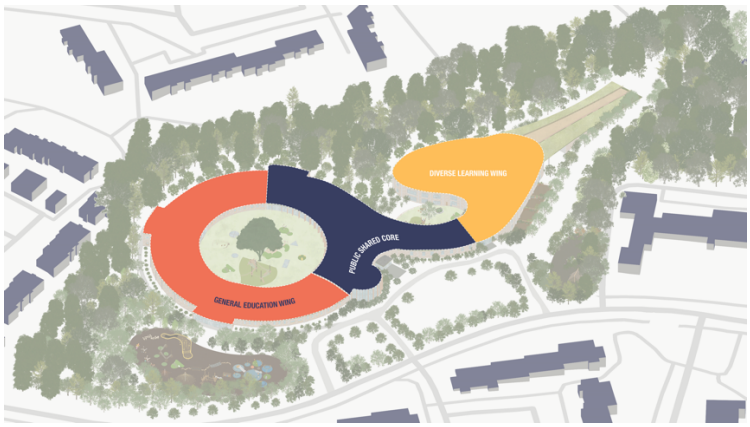


Figure 47. Massing Diagram on the Aerial View Illustrated by Wenjie Zhuang

The two wings shape two distinct courtyards, each serving a different user group and pedagogical purpose. The general education courtyard is larger, more active, and designed for group play and social interaction. The autism wing courtyard is smaller, more sheltered, and designed for sensory regulation, quiet retreat, and supervised outdoor learning. Both courtyards are visible from the Shared Core, allowing passive supervision while maintaining their distinct characters.

Walkable Roofscape: Connecting to the Community Trail

The massing strategy integrates a walkable roofscape that extends the site's pedestrian network vertically. The roofscape is designed as an accessible, gently sloping surface that connects the ground level to an elevated pathway.

The walkable roofscape is not merely a circulation device. It serves as an outdoor recovery space with panoramic views of the lake, tree canopy, and village center. The roof incorporates varied surfaces, such as grass, wood decking, and permeable pavers, to provide tactile variety. Seating niches and quiet alcoves are integrated along the pathway, offering opportunities for rest, reflection, or supervised observation of community activity below. For autistic students who may find the intensity of the school day overwhelming, the roof offers an elevated retreat, literally and figuratively, where they can regulate while remaining within the school grounds.

7.4 Testing Three Design Principles in the Autism Wing

With the overall massing established, the discovery phase next tested how the three design principles identified in the literature, predictability, sensory escape spaces, and outdoor green space, could be architecturally manifested within the autism wing.

Principle 1: Predictability

Circulation:

The circulation within the autism wing is designed as a continuous loop. This loop configuration offers several advantages for predictability. Unlike linear corridors that dead-end or branch unpredictably, a loop allows students to always move forward without encountering a terminus. The loop creates a clear, legible path that reduces anxiety about getting lost. Students can navigate the wing by following the loop, knowing that it will return them to the Shared Core without requiring complex wayfinding decisions.

Spatial Transition: Varying Corridor Width

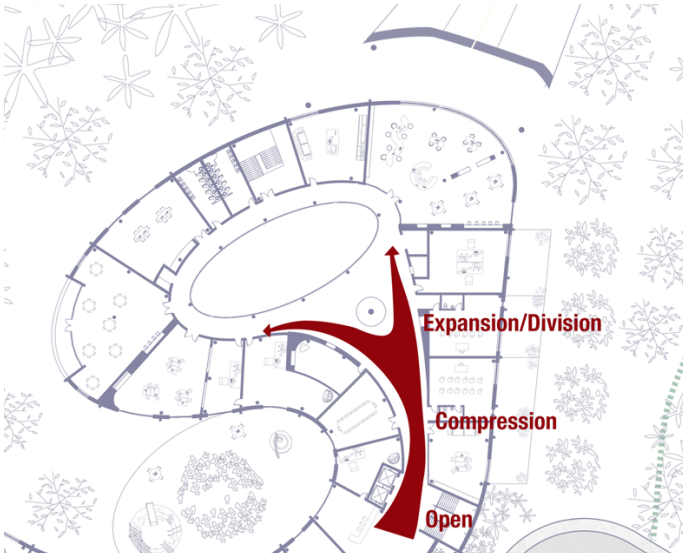


Figure 48. Spatial Transition Diagram Illustrated by Wenjie Zhuang

The loop is not uniform in width. The corridor width changes progressively from the entrance to the interior spaces. Near the Shared Core entrance, the corridor is wider, accommodating higher traffic volumes and providing a welcoming decompression zone. As the loop moves deeper into the autism wing, the corridor narrows incrementally, signaling a transition from public, high-stimulus zones to private, low-stimulus learning areas. This gradient of width serves as an implicit wayfinding cue that students can sense their location within the wing simply by the spatial compression or expansion around them, reducing the need for explicit signage.

Spatial Identity: Color-Coded Walls and Animal Graphics



Figure 49. Learning Zone Interior Perspective Illustrated by Wenjie Zhuang

Within the classroom cluster, each classroom is given a distinct spatial identity through two strategies.

First, the walls of each classroom are painted in different colors. This color-coding is not arbitrary. Each classroom has a unique color that is consistent throughout the wing, allowing students to identify their classroom from a distance by color alone, a critical accommodation for students who may struggle with reading room numbers or recalling spatial locations.

Second, animal graphics are added to the walls adjacent to each classroom door. Each classroom is associated with a specific animal, represented as a simple, friendly graphic at child-eye level. The combination of color and animal creates redundant cues: students can find their classroom by remembering either "the blue room with the koala" or "the yellow room with the Panda." This redundancy reduces cognitive load and supports independent navigation for students with different learning styles and memory profiles.

Together, the loop circulation, varying corridor widths, and color-coded animal graphics create a highly predictable environment where students can navigate independently, reducing anxiety and freeing cognitive resources for learning.

Principle 2: Sensory Escape Spaces at Multiple Scales

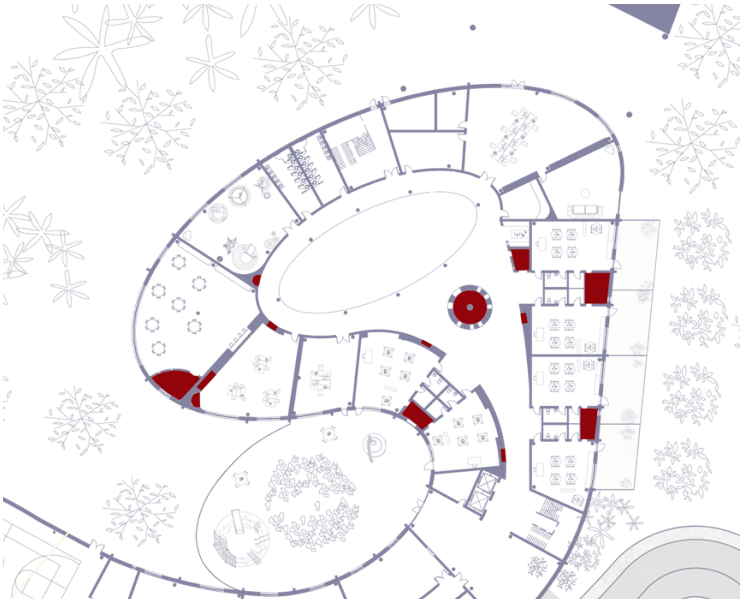


Figure 50. Escape Space Diagrwam Illustrated by Wenjie Zhuang

Rather than providing a single, isolated sensory room, the design distributes sensory escape spaces throughout the autism wing at three different scales and locations.

Escape Space in the Socializing / Dining Space:



Figure 51. Escape Space in the Socializing / Dining Space Illustrated by Wenjie Zhuang

A dedicated escape space is integrated into the socializing and dining area. The idea is to create a small escape room in a bigger room. This space is designed for students who become overwhelmed during group meals or social activities. It is

visually and acoustically separated from the main dining area but remains immediately accessible, allowing students to retreat without leaving the zone entirely. Soft seating, dimmable lighting, and sound-absorbing materials characterize this space.

Escape Space in the Group Study Room:



Figure 52. Escape Space in the Group Study Room Illustrated by Wenjie Zhuang

A smaller escape seating is embedded within each group study room. This space is intended for individual or small-group retreat during reading. It is sized for one to three students plus a supervising adult. The space creates a distinct "room within a room" that signals retreat without requiring a door or full enclosure.

Escape Space Embedded into the Hallway Wall:



Figure 53. Escape Space collaborated with the circulation Illustrated by Wenjie Zhuang

A third type of escape space is recessed directly into the hallway wall. These "recharge niches" are shallow alcoves, approximately three to four feet deep and four to five feet wide, carved into the corridor wall. Each niche provides 80 percent visual separation from the passing traffic of the hallway while remaining open and observable. These niches are equipped with a soft bench, a weighted lap pad, and a small window to the exterior. They allow students to take a brief sensory break without fully withdrawing from the classroom environment or requiring staff escort to a distant sensory room. Their location along the loop circulation means they are always nearby, no matter where a student is in the wing.

By providing escape spaces at multiple scales, large (socializing area), medium (group study room), and small (hallway niches), the design ensures that a retreat option is always within reach, reducing the distance a student must travel when overwhelmed and normalizing the act of taking a sensory break.

Principle 3: Outdoor Green Space

Beyond the two main courtyards shaped by the circular and semicircular wings, the design includes two additional types of outdoor green space.

Neurodiversity Courtyard



Figure 54. Neurodiversity Courtyard Illustrated by Wenjie Zhuang

The neurodiversity courtyard is positioned at the heart of the autism wing, directly linked to the natural wooden environment. This courtyard serves as a semi-enclosed outdoor space that brings natural light and air into the core of the wing while providing a protected environment for supervised outdoor activities.

Several classrooms have direct access to the courtyard through sliding glass doors, allowing students to move seamlessly between indoor and outdoor learning. The courtyard is also visually and physically accessible from the adjacent staff offices, enabling teachers and therapists to observe students from within the building

without needing to be physically present in the courtyard. This passive supervision supports student autonomy while ensuring safety.

Sensory Garden



Figure 55. Sensory Garden Illustrated by Wenjie Zhuang

A dedicated sensory garden is placed directly adjacent to the autism wing, accessible from the neurodiversity courtyard and the interior corridor. This garden is not a generic planted area, but a calibrated therapeutic environment organized into three distinct zones, each targeting different sensory modalities.

Zone One: Fountain Area (Auditory and Tactile)

The first zone features a fountain as its central element. The sound of flowing water serves as acoustic masking, buffering noise from the surrounding neighborhood and creating a calming auditory backdrop. Students can touch the water either by reaching into the fountain basin or through interactive water features, providing tactile engagement that can be either alerting or calming, depending on the student's sensory profile. The fountain's visual movement also offers a dynamic, predictable stimulus that can support visual tracking and attention.

Zone Two: Flower Bed Area (Olfactory and Visual)

The second zone is organized around raised flower beds at wheelchair-accessible heights. This zone targets the olfactory and visual senses. Aromatic plants, such as lavender, rosemary, mint, and other non-toxic, fragrant species, provide opportunities for olfactory exploration, which can have grounding and calming effects. The flower beds are planted with a carefully sequenced palette of colors, changing throughout the growing season. Bright, warm colors (yellow, orange, red) are concentrated in areas intended for alerting and engagement, cooler, softer colors (blue, purple, white) are used in areas intended for quiet reflection. This color sequencing provides visual interest without overwhelming sensory load.

Zone Three: Play and Touch Area (Proprioceptive and Tactile)

The third zone is designed for active, whole-body engagement. A climbing wall of graduated difficulty provides proprioceptive input, deep pressure, and joint

awareness that can be regulating for many autistic students. The climbing wall is sized for children and includes soft landing surfaces. Adjacent to the climbing wall are tactile play elements: textured panels (rough, smooth, bumpy, soft), digging areas with different soil textures, and manipulable natural materials such as pinecones, stones, and branches.

Embedded Seating Niches

Throughout the sensory garden, seating niches of varying sizes and privacy levels are integrated into the landscape. Some niches are small and recessed, designed for a single student seeking a quiet retreat. Others are larger and more open, accommodating small groups or a student with a supervising adult. Each niche is defined by changes in ground surface, planting density, or low walls creating a sense of enclosure without full visual occlusion. This variety allows students to choose the level of social and sensory exposure that matches their current need, from complete withdrawal to supervised engagement.

Outdoor Classroom



Figure 56. Outdoor Classroom Illustrated by Wenjie Zhuang

The outdoor classroom is directly connected to the autism wing classrooms. Sliding glass doors open from each classroom onto a covered porch that leads to the outdoor classroom. This direct access means that students can move from indoor learning to outdoor learning without navigating long corridors or waiting for scheduled transitions.

Buffering and Shading

A line of trees is planted between the outdoor classroom and the adjacent pedestrian path. This vegetated buffer serves two purposes. First, it visually and acoustically separates the outdoor classroom from passersby, reducing unpredictable stimuli that might distract or distress students. Second, the tree canopy provides critical shading during morning hours, when direct sun can be intense. The shade pattern shifts throughout the day and across seasons, offering a dynamic, predictable natural phenomenon that students can observe and anticipate.

The outdoor classroom is equipped with movable seating, a small whiteboard on wheels, and storage bins for outdoor learning materials. It is designed for structured instruction, small-group work, or independent study, extending the learning environment beyond the interior walls while maintaining the pedagogical supports of the indoor classroom.

Visual Access from Interior

Crucially, the outdoor classroom and sensory garden are visually accessible from inside the autism wing classrooms. Large windows provide clear sightlines from the classroom interior to both the outdoor classroom and the adjacent zones of the sensory garden. For students who may be reluctant or unable to go outside due to sensory sensitivity to weather, light, or temperature, the visual connection alone offers therapeutic benefit. They can observe nature, watch peers engaged in outdoor activities, and feel connected to the outdoor environment without leaving the regulated interior of the classroom.

This visual access supports the principle of selective integration: students can engage with the outdoor environment at their own pace, from full physical participation to quiet observation from within.

7.5 Conclusion: Summary of the Thesis and Future Direction

This thesis has investigated how architectural design can balance overarching structure with individual flexibility in an autism-inclusive elementary school. The research progressed from theoretical foundation to literature review, precedent study, program development, site analysis, and finally conceptual testing through massing studies and design exploration.

The literature review established three core principles that consistently emerge from research across neuroscience, environmental psychology, and educational practice: predictability, sensory escape spaces, and outdoor recovery spaces. These principles are not imposed from theory but are observed repeatedly in built-in evidence. The previous study of six autism-inclusive facilities confirmed that these principles are transferable across geographical and cultural contexts, informing the design strategies tested in this thesis.

The site analysis of Reston, Virginia, specifically the Lake Anne Elementary School site, revealed unique assets that shape the design: the curved architectural language of Lake Anne Plaza, the mature tree canopy, the lakefront, and the extensive pedestrian network of underpasses and bridges. These contextual conditions directly informed the massing strategy, which adopts circular and semicircular forms to extend the village center's logic onto the school site.

The discovery phase tested three design principles within the autism wing. For predictability, loop circulation, varying corridor widths, and color-coded walls with animal graphics create a legible, anxiety-reducing environment. For sensory escape

spaces, three scales of retreat were developed: a dedicated space in the socializing area, smaller spaces in group study rooms, and recharge niches embedded directly into hallway walls. For outdoor green space, three interconnected spaces serve the autism wing: the neurodiversity courtyard with direct classroom access and staff observation, the sensory garden organized into a fountain, a flower bed, and play zones with embedded seating niches, and the outdoor classroom buffered by trees for privacy and morning shade, with visual access from inside for students who cannot or prefer not to go outside.

The central organizational concept, dual learning ecosystems connected by a shared core, provides the overarching structure that autistic students need to feel safe while offering the individual flexibility they need to thrive. The circular general education wing and semicircular autism education wing shape two main courtyards, each calibrated to its users. The walkable roofscape connects the school to the community trail network, transforming the school from a destination into a node within the larger pedestrian network.

This thesis concludes that architecture can shift the educational model from forced integration to selective integration. By granting autistic students the spatial agency to regulate their own sensory and social exposure through predictable circulation, distributed escape spaces, graduated outdoor engagement, and visual access to nature, the proposed design reimagines the elementary school as an active therapeutic tool that truly empowers neurodiverse learners.

Building on this foundation, several directions remain for future development. Material and tectonic systems require deeper resolution, particularly ceiling structures that integrate acoustic absorption, lighting, and thermal comfort into a unified assembly, as well as floor and wall transitions that reinforce sensory wayfinding without relying solely on visual cues. While this thesis has focused primarily on the spatial design of the autism education wing, the same three principles, predictability, sensory escape spaces, and outdoor green space, can and should be applied to the general education wing. Doing so would create a more coherent school environment where selective integration is not forced but gradual, students from both wings would share a common sensory language, reduce the stigma of difference, and allow autistic students to move between wings with greater ease when ready. Threshold conditions between the two wings and the Shared Core also require further refinement, material shifts, light changes, and acoustic buffers that signal transition without abrupt sensory shock.

The relationship between outdoor green space and the autism wing also merits deeper investigation. The current design provides visual access and direct physical connections, but future work should examine how circulation patterns and activity trajectories move between interior and exterior spaces. Which routes do students naturally take from the classroom to the sensory garden? How does the placement of seating niches influence lingering behavior and social interaction? Where do students choose to retreat when overwhelmed, and how quickly can they reach their preferred

outdoor space? Mapping these behavioral patterns would allow the outdoor spaces to be better calibrated to actual use, rather than assumed use. Ultimately, this thesis offers a framework, the next step is to build it, occupy it, and learn from how it works.

Bibliography

Ainscow, Mel, and UNESCO. 2004. Special Needs in the Classroom: A Teacher Education Guide. 2nd rev. ed. Paris: UNESCO Pub.

Abraira, Victoria E, and David D Ginty. 2013. “The Sensory Neurons of Touch.” Neuron 79 (4): 618–639.

Brogaard, Berit, and Dimitria Electra Gatzia, eds. 2020. The Epistemology of Non-Visual Perception. New York, NY: Oxford University Press.

Buether, Axel, Axel Bufe, Markus Holzbach, and Martin Krampen, eds. 2014. Colour: Design Principles, Planning Strategies, Visual Communication. 1st ed. Munich: Edition Detail.

Bies, David A., Colin H. Hansen, Carl E. Hanson, and Deceased. 2024. Engineering Noise Control. Sixth edition. Boca Raton: CRC Press, Taylor & Francis Group.

Burns, Edward. 2006. IEP-2005: Writing and Implementing Individualized Education Programs (IEPs). Springfield, Illinois: Charles C Thomas.

Birren, Faber. 1961. Color Psychology and Color Therapy: A Factual Study of the Influence of Color in Human Life. New Hyde Park, N.Y: University Books.

Bauminger-Zviely, Nirit. 2013. Social and Academic Abilities in Children with High-Functioning Autism Spectrum Disorders. New York, NY: Guilford Press.

Chiang, Hsu-Min, ed. 2017. Curricula for Teaching Students with Autism Spectrum Disorder. 1st ed. Cham: Springer International Publishing.

Caldwell, Phoebe, and Jane Horwood. 2008. Using Intensive Interaction and Sensory Integration: A Handbook for Those Who Support People with Severe Autistic Spectrum Disorder. London: Jessica Kingsley Publishers.

Dalgliesh, Carolyn. 2013. The Sensory Child Gets Organized: Proven Systems for Rigid, Anxious or Distracted Kids. First Touchstone trade paperback edition. New York, NY: Touchstone.

Fowler, Susan. 2008. Multisensory Rooms and Environments: Controlled Sensory Experiences for People with Profound and Multiple Disabilities. 1st American paperback. London: Jessica Kingsley Publishers.

Grace, Joanna. 2022. Sensory Stories to Support Additional Needs: Making Narratives Accessible through the Senses. 1st ed. London: Jessica Kingsley Publisher.

Groh, Jennifer M. 2014. Making Space: How the Brain Knows Where Things Are. Cambridge, MA: Harvard University Press.

Gaines, Kristi, Angela Bourne, Michelle Pearson, and Mindy Kleibrink. 2016. Designing for Autism Spectrum Disorders. 1st ed. New York: Taylor & Francis Group.

Grandin, Temple, Kate Duffy, and Tony Attwood. 2008. Developing Talents: Careers for Individuals with Asperger Syndrome and High-Functioning Autism. Updated, expanded ed. Shawnee Mission, KS: Autism Asperger Pub. Co.

Harvey, Catherine. 2018. Difference Not Disorder: Understanding Autism Theory in Practice. London, U.K.: Jessica Kingsley Publishers.

Hanbury, Martin. 2012. Educating Students on the Autistic Spectrum: A Practical Guide. 2nd ed. Los Angeles: SAGE.

Hrach, Susan. 2021. Minding Bodies: How Physical Space, Sensation, and Movement Affect Learning. First edition. Morgantown: West Virginia University Press.

Hatwell, Yvette, Arlette Streri, and Edouard Gentaz. 2003. Touching for Knowing: Cognitive Psychology of Haptic Manual Perception. 1st ed. Amsterdam: J. Benjamins.

Hughes-Lynch, Claire E. 2012. Teaching Children with High-Functioning Autism: Strategies for the Inclusive Classroom. Waco, Tex: Prufrock Press.

Iyama-Kurtycz, Tina. 2020. Diagnosing and Caring for the Child with Autism Spectrum Disorder: A Practical Guide for the Primary Care Provider. 1st ed. 2020. Cham: Springer International Publishing.

Incorporating Applied Behavior Analysis into the General Education Classroom. 2023. 1st edition 2023. Cham: Springer International Publishing.

Jolicoeur, Pierre, Pierre Jolicoeur, Jeffrey N. Rider, and Ewald Neumann, eds. 2015. Mechanisms of Sensory Working Memory: Attention and Performance XXV. Amsterdam, Netherlands: Academic Press.

Kavaz, Merve. 2025. "Design Principles for a Special Education Center for Children on Autism Spectrum Disorder." ICONARP International Journal of Architecture and Planning 13 (1): 361–381. DOI: 10.15320/ICONARP.2025.328.

Klein, M. Diane, Ruth E Cook, and Anne Marie Richardson-Gibbs. 2001. Strategies for Including Children with Special Needs in Early Childhood Settings. Albany, NY: Delmar/Thomson Learning.

Kusuma Wardani, Nuril, and Bunga Fefiana Mustikasari. 2023. "Colour Preference on Picture Therapy Cards in Children With ASD." KnE Social Sciences, n. pag.

Kanakri, Shireen M., Mardelle Shepley, Louis G. Tassinary, James W. Varni, and Salah G. Fawcett. 2017. “Noise and Autism Spectrum Disorder in Children: An Exploratory Survey.” Research in Developmental Disabilities 63: 85–94.

Kohfeld, David L. 1971. “Simple Reaction Time as a Function of Stimulus Intensity in Decibels of Light and Sound.” Journal of Experimental Psychology 88 (2): 251–257.

Luiselli, James K., ed. 2014. Children and Youth with Autism Spectrum Disorder (ASD): Recent Advances and Innovations in Assessment, Education, and Intervention. 1st ed. Oxford: Oxford University Press.

Lehman, Maria Lorena. 2017. Adaptive Sensory Environments: An Introduction. Abingdon, Oxon: Routledge.

Moller, Aage R. 2003. Sensory Systems: Anatomy and Physiology. Amsterdam: Academic Press.

Mooney, Lindsey N., Haley B. Moore, J. P. Bastin, and Tracy J. Packiam Alloway. 2020. “Children with ASD Show Impaired Item-Space Recollection, But Preserved Item-Color Recollection.” Autism Research 13 (11): 1985–1997.

Orhan Korhan, ed. 2019. Indoor Environment and Health. London, United Kingdom: IntechOpen.

Palko, Milan, and Karin Deáková, eds. 2014. “Advanced Building Construction and Materials 2013: Selected, Peer Reviewed Papers from the 2013 International Conference on Advanced Building Construction and Materials 2013 (ABCM 2013), September 26-27, 2013, Kočovce, Slovakia.” Zurich, Switzerland: Trans Tech Publications.

Ring, Elmer, Patricia Daly, and Eugene Wall, eds. 2018. Autism from the Inside Out: A Handbook for Parents, Early Childhood, Primary, Post-Primary and Special School Settings. Oxford: Peter Lang.

Russell, Danielle, ed. 2022. Containing Childhood: Space and Identity in Children's Literature. Jackson: University Press of Mississippi.

Steg, Linda, Judith I. M De Groot, and British Psychological Society. 2019. Environmental Psychology: An Introduction. Edited by Linda Steg and Judith I. M. De Groot. Second edition. Chichester, West Sussex: John Wiley & Sons Ltd.

Shimokura, Reiko, Kaname Yanagiawa, and Shinko Sasaki. 2023. "Spatial Organisation of 'Therapeutic' Spaces for Autistic Children in Special Schools: Lessons Learnt from the United Kingdom Experience." Journal of Asian Architecture and Building Engineering 22 (2): 620–634. DOI: 10.1080/13467581.2022.2047982.

Volkmar, Fred R, and Lisa A Wiesner. 2017. Essential Clinical Guide to Understanding and Treating Autism. First edition. Hoboken, New Jersey: Wiley.

Venn, John. 2000. Assessing Students with Special Needs. 2nd ed. Upper Saddle River, N.J: Merrill.

Whitaker, T. Aisling, Cristina Simões-Franklin, and Fiona N Newell. 2008. "Vision and Touch: Independent or Integrated Systems for the Perception of Texture?" Brain Research 1242: 59–72.

Yergeau, Melanie. 2018. Authoring Autism: On Rhetoric and Neurological Queerness. Durham: Duke University Press.