

Redefining the Classroom:

Incorporating Sensory Cognizant Design Strategies

by
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AUTHOR'S DECLARATION

*I hereby declare that I am the sole author of this thesis.
This is a true copy of the thesis, including any required final
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*I understand that my thesis may be made electronically
available to the public.*

ABSTRACT

The perception of space is generated and understood by the multi-sensory orchestration of our five senses: sight, sound, taste, touch and smell. Through the heightening and/or reduction of specific senses the mind generates emotional reactions as a response to the external environment. As architects we are directly accountable in the way the built environment is designed and how it may impact the user's emotions and perception of space. This multi-sensorial approach towards perceiving architecture and the ideology of designing for all the senses is commonly referred to as haptic design. In recent years the architectural profession has begun to move towards understanding the range of disabilities that can alter how one travels through space. However, not all disabilities are supported by organizations that regulate the rules of accessibility and design. Autism Spectrum Disorder (ASD) is a cognitive impairment that can affect one's neurosensory response and interactions with the built environment. The intentions of this thesis are to understand how architects can better approach the challenges of sensory design in order to create environments that are inclusive for all individuals. The research examines the state of Ontario elementary school classrooms and the lack of design sensitivity towards students with autism and other sensory processing disorders. Through the exploration of spatial qualities, materiality and the methodology of design collaboration, architecture can be used as a tool to better understand how to diversify spaces into sensory inclusive environments.

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LIST OF ABBREVIATIONS

ASD	Autism Spectrum Disorder
ADD	Attention Deficit Disorder
ADHD	Attention Deficit Hyperactivity Disorder
CDC	Centers for Disease Control and Prevention
C-PTSD	Complex post-traumatic stress disorder
ECT	Electro-Convulsive Therapy
PDD	Pervasive Developmental Disorders
SEA	Special Equipment Amount
WAO	World Autism Organization

INTRODUCTION

As I near the completion of my thesis and the end of my academia years, I have been reflecting on what it means to be a student and how much that has changed. During a time of a global pandemic and the social uproars for inclusivity, we are witnessing changes and new realities occur on multiple scales. Students without a classroom, homes now offices and the reliance on Amazon and screens to help stay connected. In moments like these when we are asked to pause we become aware of true impact of our built environment.

What Is Inclusivity?

Inclusivity is the approach towards creating environments that promote equal respect and opportunity for all individuals regardless of their race, sex or disability. It is the understanding that our society is made of unique differences that have the right to be recognized and supported through design. The root of my thesis is centered around the process and understanding of inclusive architecture and what it may look like. In order to strive for positive and lasting change in our community we must ensure that our environments are centered around the core values of our society: inclusivity, equity and diversity.

The British Design Council is an organization of architects, designers, programmers and researchers. The council champions the power of design and the ability it has towards improving social, economical and environmental challenges.¹ In 2004, the council developed the Double Diamond as a visual tool and method of framework for designers to reference when tackling the challenges of innovative design.² The intentions of the Double Diamond design process resonated with the objectives of my work and became the primary structure of my thesis (see Fig. 0.2). The four components of the Double Diamond approach towards innovative design are: **Discover**, **Define**, **Design** and **Deliver**. Each section contains a series of subtopics and key themes that are prevalent in the development of my work.

The first phase, **Discover**, establishes the impact the external environment has on human emotions and perception of space. An introduction to cognitive impairments and the lack of sensory diversity in elementary schools lays the foundation on which the thesis will challenge. A hypothesis is proposed explaining the objectives and intentions of my work.

The second phase, **Define**, establishes key themes and forms of methodology that will be used in the thesis.

The third phase, **Design**, analyzes the key insights I have learned and how they can be integrated into a series of design strategies. The design proposals will be developed and presented to a user group meeting in order to review and gain feedback.

The fourth phase, **Deliver**, will conclude the main artifacts and proposed design strategies. This section will feature personal feedback and evaluation on the impact my design proposal has on different users.

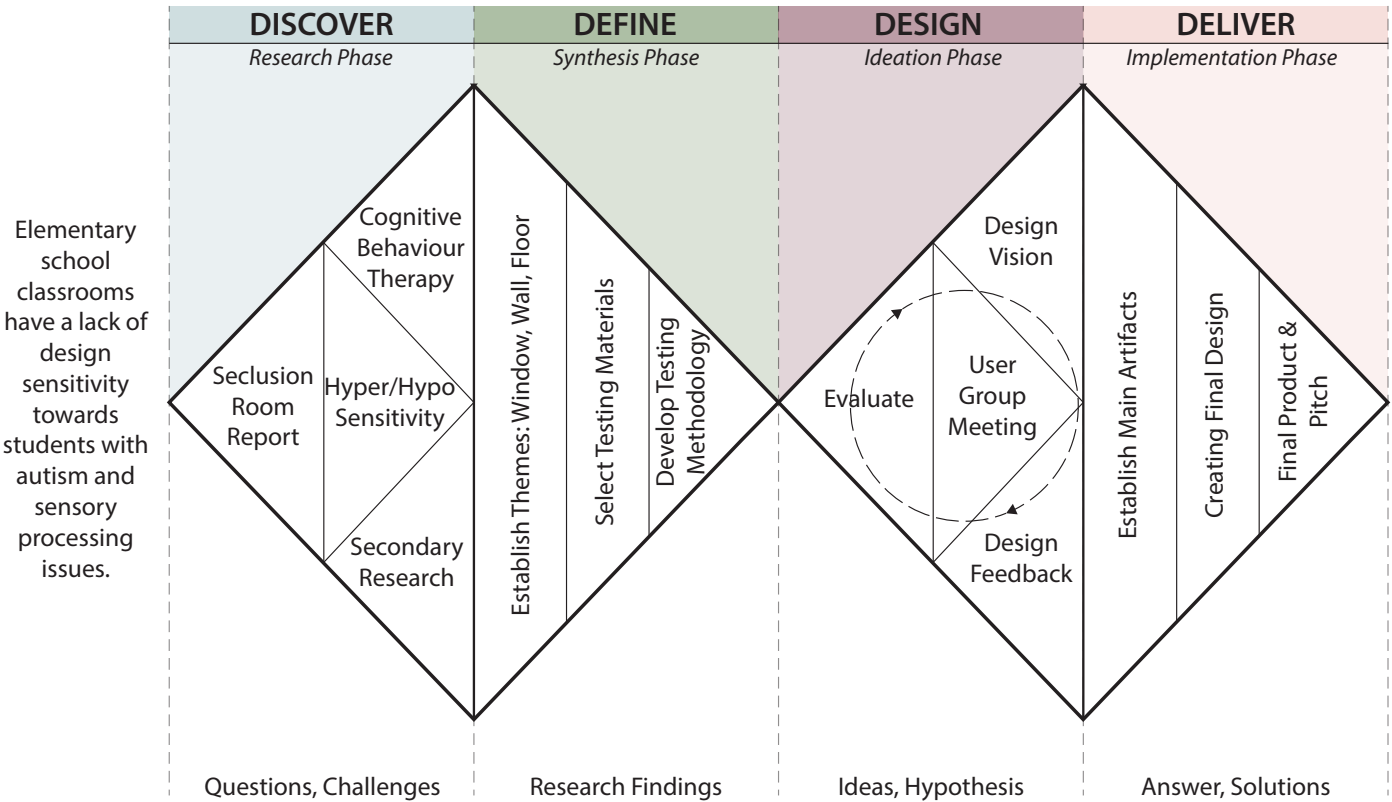
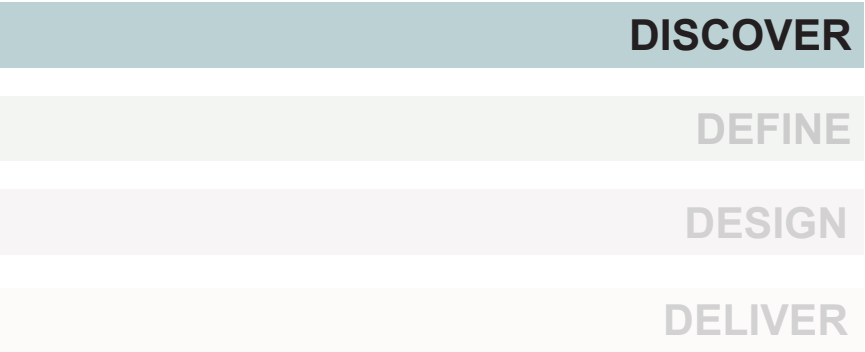


Fig. 0.1 Double Diamond design framework originated from the British Design Council.

1 "What is the Framework for Innovation? Design Council's Evolved Double Diamond." Accessed Nov 7, 2020.
2 What is the Framework for Innovation? Design Council's Evolved Double Diamond.

1.0 | ARCHITECTURE & THE “NORM”



The process of how we perceive space is composed of the interactions and reactions between sight, sound, taste, touch and smell. Through the heightening and/ or reduction of specific senses the mind generates emotional reactions in response to one's surroundings. As architects we are directly responsible for the way the built environment is designed and its impact on individuals. The spatial qualities and characteristics are all within the scope of the designer to create environments that are beautiful both on the surface level and at the experience of the user. In order to design meaningful spaces, architects must have a clear understanding of how environments impact different human experiences.

Architects have been the key accomplices and enablers of marginalizing space to fit our perception of the “norm.” We often design our built environments for what we believe to be a reflection of the ideal user: an able bodied white male. This perception of the ideal human form has been prevalent in architectural history and continues to be referenced to this day. The origins of the able-man can be traced back to Le Corbusier’s diagram of the Modular Man (Fig. 1.1) and classical architecture that relied heavily on the human body as a form of proportional measurement (Fig. 1.2).

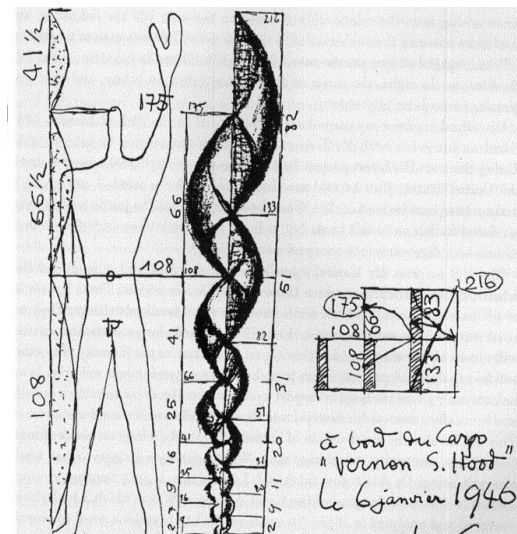


Fig. 1.1 Le Corbusier's Modular Man

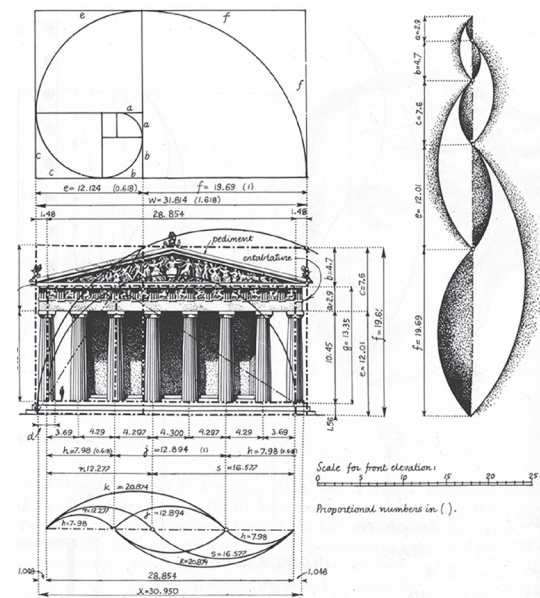


Fig. 1.2 Human body used as a scale for architectural proportion

If we take a closer look at present day architecture we can uncover traces of a lack of diversity and user representation in the field of design. This is most visually evident when examining architectural renders of proposed public places. Renders are images that feature a preconceived storyline of how users may interact with the architecture of the space once it is built. However, a closer examination of these images reveal the preprogrammed ideology of the norm continuing to manifest in design. On the following page are renders of KPMB Architects' winning design proposal for the Jack Layton Ferry Terminal and Harbour Square Park in Toronto (Fig. 1.3). In these renders we see people from all ages and racial backgrounds interacting with the terminal, indicating the representation of the cultural diversity that exists in Canadian society. However, a large portion of our community continues to be underrepresented in our images of the proposed future. Individuals with mobility impairments such as those needing wheelchairs, support animals and white canes are rarely featured in renders. Although this is done unintentionally, it does reveal the lack of awareness and representation of different user types and further reinforces the pre-conceived notion of designing for the "norm."



Fig. 1.3 KPMB Architects renders for Jack Layton Ferry Terminal & Harbour Square Park Innovative Design Competition

Generalizing the human race as a standard creates superficial parameters as to what is considered to be acceptable and in doing so reject those who do not confide within these physical constraints. The reality is that the human body exists in a range of forms and abilities. In recent years the architectural profession has begun to move towards the understanding of a range in the different types and degrees of disabilities that may alter how one travels through space as opposed to a standard/norm. In Ontario there are currently four committees/ documents that govern accessibility for buildings and public spaces:

National Building Code (Section 3.8):

- Accessibility requirements used when designing federal buildings

Ontario Building Code:

- Barrier free design for interior and exterior (ramps, stairs)
- Tactile attention indicators, visual fire alarms

Accessibility for Ontarians with Disabilities (AODA):

- Barrier free requirements for exterior (sidewalk, outdoor stairs, ramps)
- Does not govern interior spaces

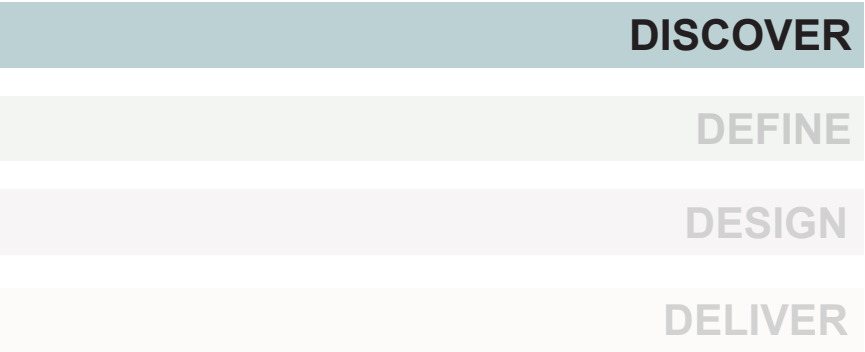
Municipal Zone By-Law:

- Barrier free requirements applied only if they are more restrictive than AODA

Not all disability types are physically visible and supported during design & accessibility discussions. Autism Spectrum Disorder (ASD), learning disabilities, dementia and down syndrome are some of the many cognitive impairments that can influence one's behavior and interactions with the built environment. However, they are often disregarded by organizations that regulate the rules of accessible design. In 2017, Statistics Canada released an updated survey designed to ensure a better coverage of individuals with different disability types including those that are less visible such as cognitive impairments and mental health. The survey found that 1 in 10 youth in Canada have one or more disabilities and that 4 out of 10 individuals with disabilities are considered to have a severe or very severe disability.³ With these statistics revealing a large population of Canadians living with disabilities it is imperative that we design and address the different users in our society. The intentions of my thesis are to explore architectural design through the lens of youth with neurosensory conditions in order to understand how architects can better approach the challenges of sensory design.

³ Statistics Canada. *Canadian Survey on Disability, 2017*. Canada, 2018.

2.0 | COGNITIVE IMPAIRMENTS



Cognitive impairment refers to a wide range of disabilities that can impact one’s communication skills, problem solving, self-help and social ability. The type of limitation and level of severity can range depending on the individual and form of impairment. Some of the most commonly recognized examples of cognitive impairments include autism, downs syndrome, ADD, ADHD and dementia.⁴ For this thesis we will be looking at autism in greater depth and its unique relation to architecture.

Autism Spectrum Disorder (ASD) encompasses a broad range of cognitive conditions and/or neurosensory deficiencies that can present difficulties in one’s social skills, communication and behaviour.⁵ The term spectrum refers to the wide variation and levels of severity amongst individuals with ASD including forms of severe autism, Asperger’s or PDD (Fig. 2.1). According to the Centers for Disease Control and Prevention (CDC), it is estimated that currently 1 in 54 children fall onto the autistic spectrum and that these numbers are steadily increasing as further discoveries and accurate understandings of the spectrum continue to be made.⁶

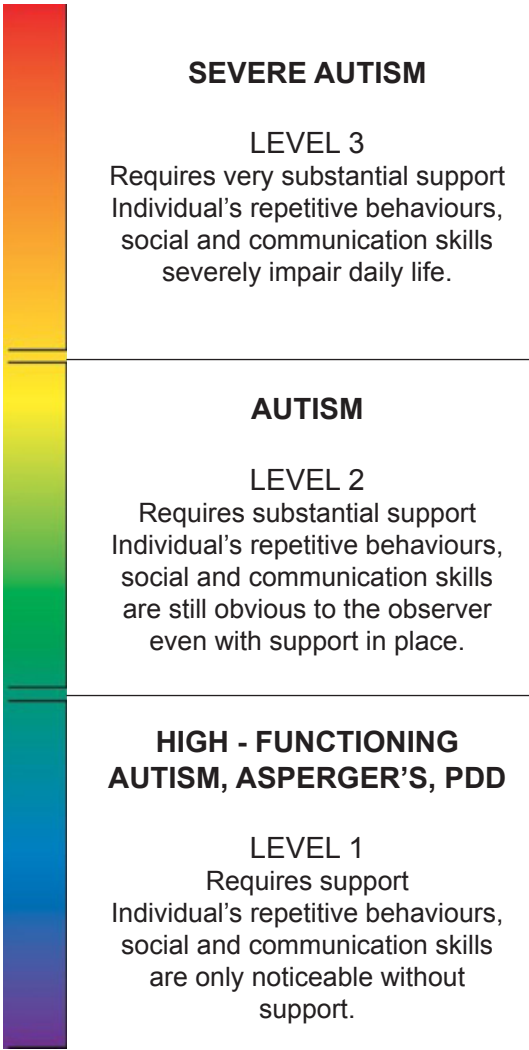


Fig. 2.1 Autism Spectrum Disorder Chart

One of the most commonly recognized indications of ASD is a form of sensorial sensitivity. Individuals on the spectrum can experience difficulties in processing sensory input from their external environment which can lead to uncontrollable emotional breakdowns, anxiety and overwhelming uncertainty. The terms hypersensitivity and hyposensitivity are often used when describing the intensity of sensory stimulation experienced between the individual and their environment. The level of overstimulation or under stimulation experienced by someone with ASD varies and is as unique and specific as the individual themselves.⁷ This is commonly referenced is a popular phrase used amongst the autism community that if you have met a child with autism you have only met one child with autism. Designing for individuals on a spectrum becomes a perplexing task in understanding how designers can create an ideal environment that meets the diverse needs of all of its users. Currently there are no guidelines nor governing identity that oversees built environments to ensure that the spaces we design are inclusive to those with neurocognitive impairments. It is important that with a growing awareness of the autism community, architects begin to have discussions about design and the impact it has on those with sensory sensitivities.

⁴ “WebAIM: Cognitive - Introduction.”
⁵ Faras, Ateeqi, Tidmarsh. “Autism Spectrum Disorders;” *Ann Saudi Med* (July, 2010): 295.
⁶ “Data and Statistics on Autism Spectrum Disorder | CDC.”

⁷ “Sensory Differences - National Autistic Society.”

2.1 | AUTISM THROUGHOUT TIME

1900-1940

During the pre-discovery of ASD, autism was stigmatized with a negative cogitation and diagnosis of ‘mental retardation.’ Individuals were to undergo invasive treatments such as electro-convulsive therapy (ECT) and insulin shock therapy in attempts of “curing” the disorder.⁸ For those with exceptional skills and considered ‘genius’ on the autistic spectrum, were often labeled as “idiot savant” or “learned idiot.”⁹ The lack of an accurate diagnosis and acceptance into society subject the autistic community to discrimination and in many cases child euthanasia. During the Nazi regime many children on the spectrum were labeled as physically inferior and eliminated as a result of not fitting in with the Volk: the fascist ideology of a pure Aryan race.¹⁰

1940-1950

Institutionalized hospitals such as the Maudsley Hospital in South London and many across Europe began to act as treatment centers for those with autism, schizophrenia and psychosis.¹¹ Photographs of some of these centers captured the harsh reality in which children lived in overcrowded dorms and even cages (Fig. 2.2 & 2.3). Understanding what we know now about sensorial sensitivity being a key indicator of



Fig. 2.2 Maudsley Hospital child psychiatry ward. London, UK



Fig. 2.3 Room in Am Spiegelgrund Clinic, Vienna (1940-1945)



Fig. 2.4 Temple Grandin’s Humane Livestock Slaughterhouse

ASD, we can assume that the overstimulating and insensitive environments in which these children were treated would have certainly contributed to the severity of the breakdowns, and aggravated underlying conditions. The resort to panic would have also further branded the misperception that ASD was an incurable disease that needed to be treated in an institutionalized or hospital environment.

1970’s

American professor Temple Grandin became a popular figure amongst the autism community and livestock industry. Grandin’s research and publications centered on the impacts of environmental design. Grandin believed that the panic and anxiety caused from feeling over stimulated was directly associated with the external environment. She advocated for re-designing spaces in order to reduce distractions and provide forms of psychological measures to handle stress.¹² This research extended to an interest in livestock and the re-design of slaughterhouses into a more humane and stress-less procedure for animals. Grandin advocated for the use of semicircular chutes as to imitate the natural movement of the cattle, in order to reduce visual distractions and provide a calming sense of familiarity, as if the animals were returning back to their grazing fields (Fig. 2.4).

⁸ Donovan, John and Caren Zucker. “The Early History of Autism in America.” *Smithsonian*, January, 2016.

⁹ Ammari, Elham. “Prodigious Polyglot Savants: The Enigmatic Adjoining of Language Acquisition 2013. Potentials.” *International Journal of Business and Social Science* no. Vol. 2 No. 7 (April, 2011): 158-160.

¹⁰ Baron-Cohen, Simon. “The Truth about Hans Asperger’s Nazi Collusion.” *Nature* 557, no. 7705 (May 8, 2018): 305-306.

¹¹ Evans B. The foundations of autism: the law concerning psychotic, schizophrenic, and autistic children in 1950s and 1960s Britain. *Bulletin of the History of Medicine*. 2014

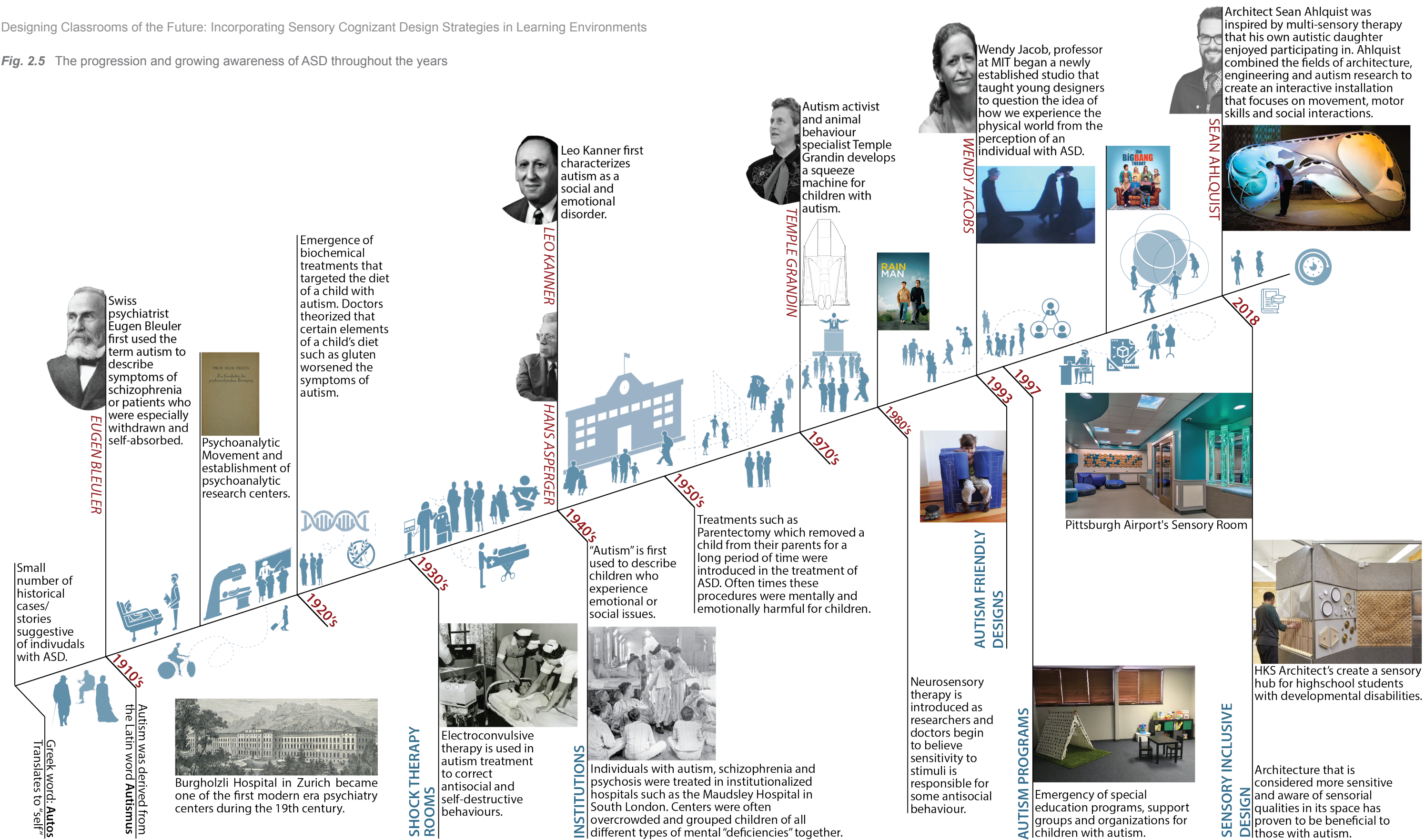
¹² Grandin, Temple. “Frequently Asked Questions - Anxiety.” Accessed November 3, 2019

1990's

Knowledge and understanding around the impact environmental design has on behavioral response began to raise awareness of individuals with neurosensory conditions. The terminology of hyper/hypo-sensitivity and the acceptance in the diversity of human experiences helped to push towards the de-stigmatization of ASD. By 1998, a global group consisting of parents, therapists and autistic individuals established the first World Autism Organization (WAO) that was dedicated to raising awareness and improving the lives of those on the spectrum.¹³

¹³ *Houston First U.S. City to Host the World Autism Organization Congress* – BestCities. Best Cities Global Alliance. 2018.

Fig. 2.5 The progression and growing awareness of ASD throughout the years



Psychoanalytic movement pushed for the research and treatment of mental disorders such as autism.

Individuals with autism needed to be "fixed" through extensive and emotionally harmful treatments used in institutionalized environments.

Awareness of the spectrum grew through the design field.

Emergence of unsensationalized/ grey centres that attempted to provide optimal environments for children on the spectrum

Re-designing spaces that are responsive and sensitive to individuals with sensory processing disorders.

2.2 | HYPERSENSITIVITY VS. HYPOSENSTIVITY

If you have met an individual with autism, you have only met one individual with autism - not all ASD is the same.

In 2013, the American Psychiatric Association determined sensory sensitivity as a possible indicator of ASD. Sensory processing impairments could range from forms of hypersensitivity to hyposensitivity and further help to determine one's location on the spectrum.¹⁴

Hyposenstivity

The lack of sensory stimulation experienced from the environment, prompting individuals to seek additional sensory information to help comprehend spaces. Examples of this behaviour include constantly touching things, placing objects in the mouth and turning up the volume very loud.¹⁵

Hypersensitivity

The heightening of sensory stimulation and the feeling of sensory overload that can cause environments to be uncomfortable and overpowering for its user. Examples of this behaviour include being distracted by common sounds, avoiding activities that may encourage different movements or noticing acute smells that others may not detect.¹⁶

¹⁴ "Sensory Differences - National Autistic Society."

¹⁵ George, Karen. "The Differences between Hyposensitivities and Hypersensitivities in Sensory Processing Disorder - Chicago Speech Therapy." . Accessed Nov 3, 2019

¹⁶ Karen. "The Differences between Hyposensitivities and Hypersensitivities in Sensory Processing Disorder - Chicago Speech Therapy."

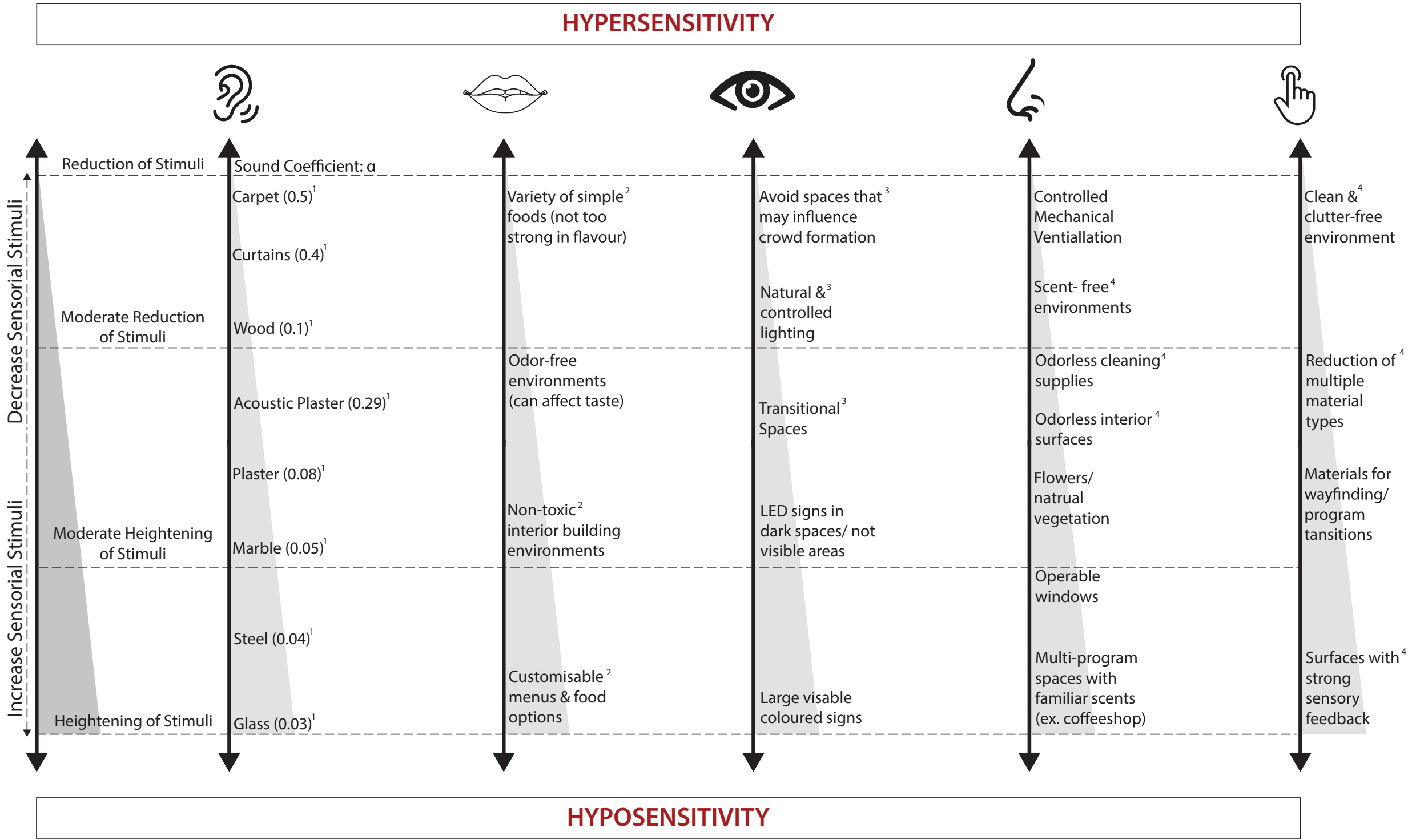


Fig. 2.6 Temple Grandin's Squeeze Machine

Some individuals on the spectrum have also said to experience both hyper and hyposensitivity for different senses and in some cases the same one. For example, certain individuals reported to have alert sensation sensitivity to light while appearing unmoved by sound. Temple Grandin has described herself as being hypersensitive to human touch but at the same time experiencing hyposensitivity and the desire of being held.¹⁷ Grandin's research and its application to human environments has led to the creation of the squeeze machine (Fig. 2.6) as a response to her hyper and hyposensitivity to touch. Grandin's invention applied the technique of deep tissue pressure therapy to help alleviate stress without the need of human contact, in order to provide calmness through the comfort of an artificial hug that was controlled by the user.

¹⁷ Grandin, Temple. Temple Grandin: Inside ASD. Autism Research Institute. Autism Research Institute.

Fig. 2.7 Diagram of different materials and spatial elements that can create a more comforting environment for someone with hypersensitivity or hyposensitivity



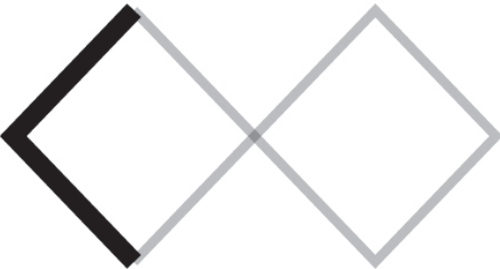
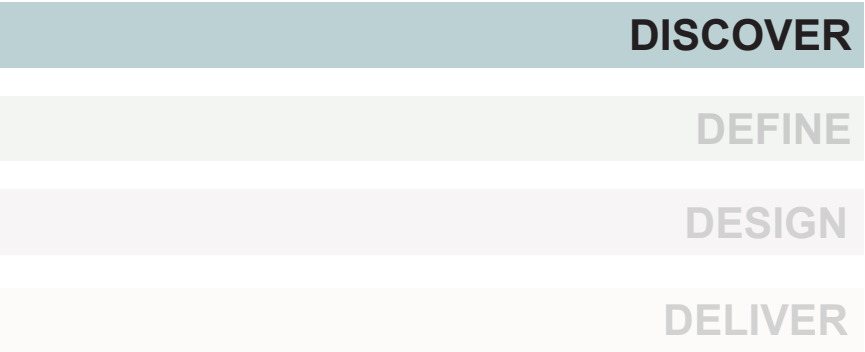
¹ Ricciardi, Paola and Mariagiovanna Lenti. "Sound Absorption Characterisation of Woven Materials. Case Study: Auditorium Restoration "; August.

² "Sensory Differences - National Autistic Society"

³ Beaver, Christopher. "DESIGNING ENVIRONMENTS FOR CHILDREN AND ADULTS WITH ASD ";October 30-November 2, 2006.

⁴ Adults with Autism Training Series Module Four V2 2012.

3.0 | SCHOOLS & SCREAM ROOMS



3.1 | CLASSROOM CONDITIONS

While researching ASD and the impacts environments have on neurocognitive conditions, I began to uncover a series of articles revealing the mistreatment of students with sensory processing disorders in elementary schools. A study conducted in Ontario reported that 72% of parents believe that their children who are on the spectrum do not receive the level of support needed from their schools and are oftentimes subject to neglect.¹⁸ In order to better address ASD in the classroom we need to have a clear understanding of current classroom conditions. After surveying a ‘typical Canadian sample set’ of public elementary schools in Hamilton - my home town, I began to understand why many schools were considered to be neglecting environments for students with neurosensory conditions. The Hamilton Wentworth District is one of 76 public school boards in Ontario. There are currently 96 elementary schools located in the district with an approximate total of 50,000 students.¹⁹ The map on the following page (Fig. 3.1) is a sample size of the different typology of elementary schools that currently exist on the Hamilton Mountain. We can see that the majority of schools were built during the postwar era (1945-1960) and post modernism era (1960-2000). Schools built during these periods were designed to be standardized and cost-conscious in part due to tight budgets. Subsequently, schools were built with little to no ventilation standards, lack of sound absorption and minimal natural lighting. These types of schools continue to represent a majority of elementary schools throughout Canada.

19 Nanowski, Natalie. “‘This is a Crisis Now’: Kids with Autism Need Better School Services, Survey Finds | CBC News.” . Accessed Nov 8, 2020.

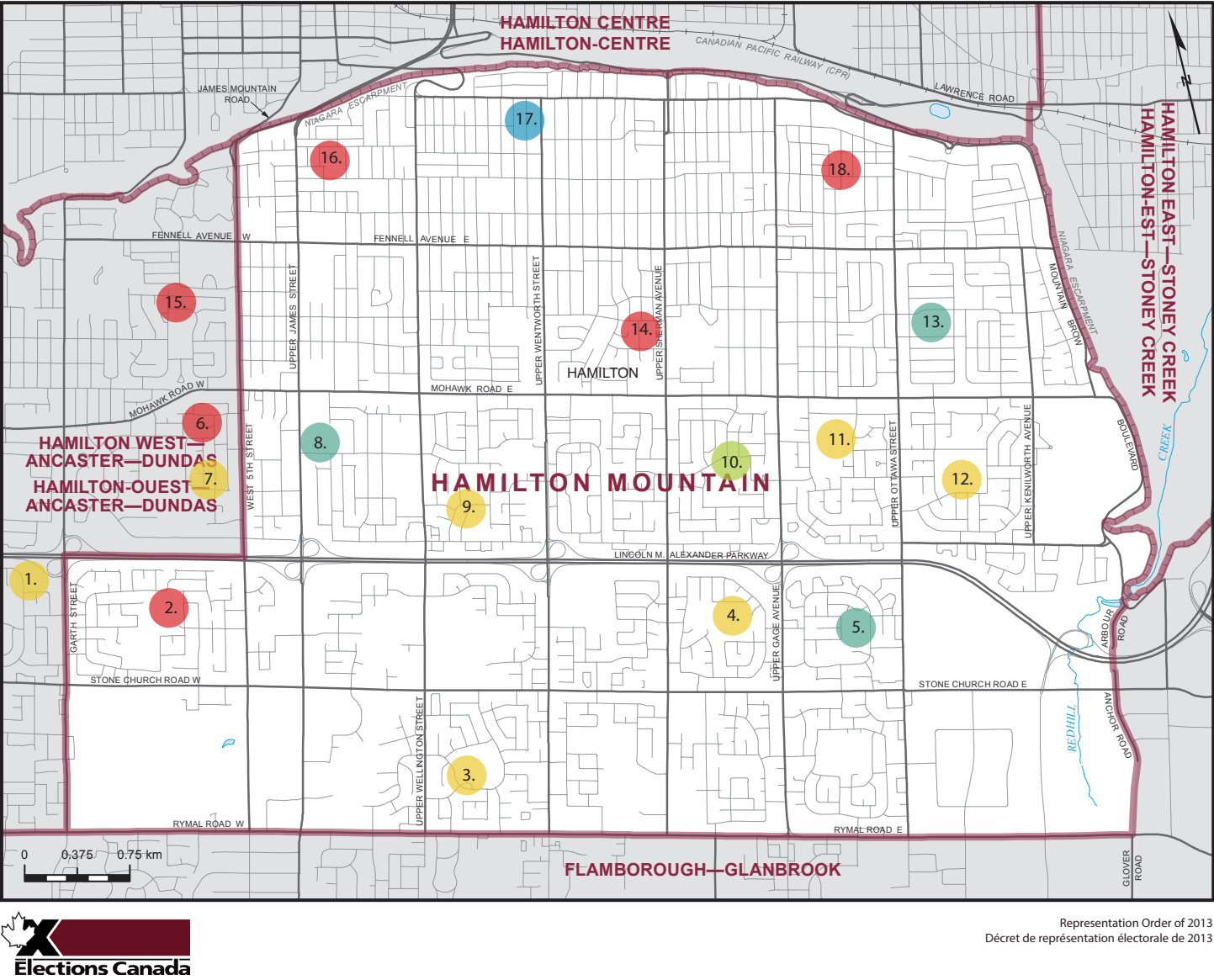
20 City of Hamilton. “Schools in Hamilton.” . Accessed Nov 9, 2020.

Over the years we have also seen the growing concern regarding classroom sizes that have begun to increase from 22 students to an average of 28 students.²⁰ The rise in classroom sizes acts as a catalyst in creating environments that are over stimulating and distracting rather than spaces intended for learning and success. The increase of students in a classroom that has a lack of sound absorption, no ventilation and little natural lighting significantly intensifies the levels of sensory stimulation produced from the environment. The increase in noise levels, smells and sights along with the reduced individualized attention a student may need to support complex behaviours can trigger emotional reactions from individuals who have autism, anxiety and sensory processing sensitivities. Expecting a child to focus in an environment that for them feels chaotic can make learning a difficult challenge for not only the student but also the teacher and the rest of the class. We can assume that with the rise of children diagnosed with ASD and the insufficient support in classroom conditions, we will continue to lack the facilities needed to ensure the success of every student. The images on the following page (Fig. 3.2 and Fig. 3.3) dissects an elementary school classroom in Ontario and pinpoints spatial elements that can be considered highly distracting and overstimulating for a student with sensory processing sensitivities.

20 Rushowy, Kristin and Rob Ferguson. “In a Surprise Move, Ontario Government Climbs Down on High School Class Sizes. Is a Deal Far Off?”

Public Elementary Schools Located on the Hamilton Mountain

Fig. 3.1 Public Elementary Schools located on the Hamilton Mountain, Hamilton, Ontario



1. R. A. Riddell Elementary School

2. James Macdonald Public School

3. Helen Detwiler Junior Elementary

4. Lincoln Alexander School

5. Cecil B Stirling School

6. Westwood Elementary School
7. Westview Elementary School

8. Ridgemount School

9. Pauline Johnson Public School

10. Lawfield Elementary School

11. Richard Beasley School

12. Lisgar Elementary
13. Huntington Park School

14. Franklin Road School

15. Buchanan Park Elementary School

16. Queensdale Elementary Public School

17. George L Armstrong School

18. Highview Public School

Typology of Elementary Schools

	<p>Pre-War Era (1900-1939)</p> <ul style="list-style-type: none">• Neoclassical facades with standardized and utilitarian classrooms featuring rows of desks• Spacious classrooms with high ceilings• Emphasis on daylighting, natural ventilation and the importance of outside views for student’s health²¹
	<p>Post-War Era (1945-1960)</p> <ul style="list-style-type: none">• Standardized classroom design with an emphasis on cost-consciousness• Low/no ventilation standards• Artificial incandescent lighting used throughout schools²²
	<p>Postmodernism (1960-2000)</p> <ul style="list-style-type: none">• Emphasis on prefab construction methodology• Windows replaced with mechanical ventilation systems and fluorescent lighting• Lack of sound absorption and natural lighting²³
	<p>21st Century (2001-Present)</p> <ul style="list-style-type: none">• Emphasis on environmentally friendly learning spaces• Natural lighting and ventilation• Focus on the health and wellbeing of students²⁴
	<p>Unknown - No data found</p>

21 Nelson, Bryn. “School Design through the Decades.” . Accessed Oct 10, 2020. /story/school-design-through-decades.
22 Nelson, “School Design through the Decades.”
23 Nelson, “School Design through the Decades.”
24 Nelson, “School Design through the Decades.”

Sensory Stimulation in the Classroom



Fig. 3.2 & Fig. 3.3 R.A.Riddell Elementary School, Hamilton, ON

- ① **LIGHTING**
Flicker of fluorescent lights can be irritating
- ② **CLUTTERED DISPLAY BOARD**
Difficult to focus solely on the screen/ blackboard
- ③ **PORTABLE PROJECTOR**
Produces excess heat and noise
- ④ **STANDARDIZED SEATING**
Does not encourage bouncing or rocking, which are forms of stimming/ self-soothing
- ⑤ **NO SOUND ABSORPTION**
Lack of carpet/ materials that would damper classroom sounds
- ⑥ **ART WORK DISPLAY WALL**
Bright colours and excess information can be visually distracting and overbearing
- ⑦ **WINDOWS**
Lack of natural lighting/ fresh air
- ⑧ **LACK OF ZONES**
No quiet zones or places designated for retreat when feeling overwhelmed
- ⑨ **FURNITURE**
One size fits all, lack of diversity in learning space

3.2 | THE PRACTICE OF SECLUSION



Fig. 3.4 School staff preventing child from leaving seclusion space



Fig. 3.5 Built seclusion space in classroom

The lack of resources and current classroom conditions have not only made learning a challenge in elementary schools but have also had severe repercussions. In recent years there has been extensive media coverage on the practice of seclusion in Canadian elementary schools. Newspaper headlines that read “Teacher locked a 6-year-old with autism in a storage room” and “Student with autism dragged ‘kicking and screaming’ to tiny padded room”²⁵ began to surface, revealing the hidden world of seclusion in schools. Seclusion spaces, also commonly referred to as “scream rooms” or “time-out rooms,” consist of a small storage-sized area located inside or outside of the classroom. Although they can vary in size and shape, the primary focus of the room is to act as a designated area in which a misbehaving student is placed in for a period of time until they calm down. Some scream rooms have even incorporated the use of padded walls to avoid a child injuring themselves out of frustration when in these tiny spaces. In a more extreme case, there have also been reports of scream rooms with lockable doors or doors being held shut by school staff while a student was inside.²⁶ Individuals with neurocognitive impairments such as ASD are often the ones subject to seclusion rooms based on their behaviour in the classroom. As we have covered in the previous pages, many elementary school classrooms throughout Ontario can be overstimulating and aggravate underlying conditions for individuals with neurosensory conditions.

²⁵ Urquhart, Catherine. “A Teacher Locked a 6-Year-Old with Autism in a Storage Room, and That’s ‘traumatizing’.”
²⁶ Willick, Frances. “Student with Autism Dragged ‘Kicking and Screaming’ to Tiny Padded Room, Says Mom | CBC News.”

As a response to the overstimulating environment, students with ASD may resort to emotional breakdowns and panic which can be misunderstood as “bad behaviour.”

Throughout Canada we have seen a growing number of students with autism and other complex needs reporting the trauma they have experienced in seclusion rooms. In 2017, Amanda Vaters discovered that her 8-year-old son Hayden was left sobbing on the bare floor of a small padded room at his Eastern Passage elementary school in Halifax. Hayden who was diagnosed with a preliminary of ASD along with possible ADHD revealed to his mother the fear he felt of being left alone in the room for over 30 minutes.²⁷ In 2018, an autistic boy in Alberta was stripped naked and locked in a seclusion room. The 12-year old boy was later found by his father whimpering on the floor while covered in feces.²⁸ Stories such as these expose the harsh reality of the emotional and physical trauma endured from the use of isolation. Although the intentions of seclusion spaces are to act as designated areas for students to calm down, it is difficult to imagine that a student would be able to relax when forcefully locked in a room and prevented from leaving.

27 Frances. *Student with Autism Dragged ‘Kicking and Screaming’ to Tiny Padded Room*
28 a4aontario. “2018 Report to the UN, Pt 5: Ontario Schools – use of Restraint and Isolation Rooms.” . Accessed Oct 11, 2020.



Fig. 3.6 Scream Room in Elementary School

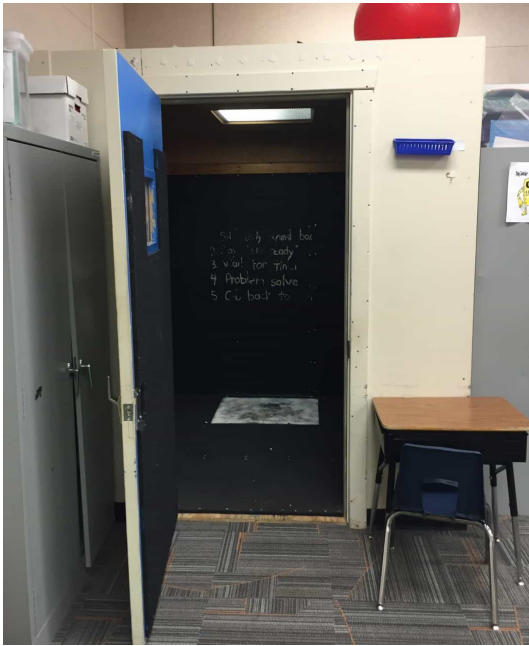


Fig. 3.7 Built seclusion space within classroom

REPORTED TRAUMA IN CANADIAN SCHOOLS

Newspaper headlines revealing the neglect and discrimination many students with ASD experienced while being in seclusion rooms.

“The **trauma** that I endured in Grade 3 has stayed with me throughout my life and is at least partially **responsible** for several severe issues, such as **c-PTSD, depression, Dissociative Identity Disorder**.” ²⁹ (Ontario)

“In **Grade 3**, I was physically restrained by school staff on an almost daily basis. Frightened, I would often **try to escape by screaming, kicking...**” ³⁰ (Ontario)

“I was asked to **undress** prior to being locked alone and completely **naked in the isolation room**” ³¹ (Ontario)

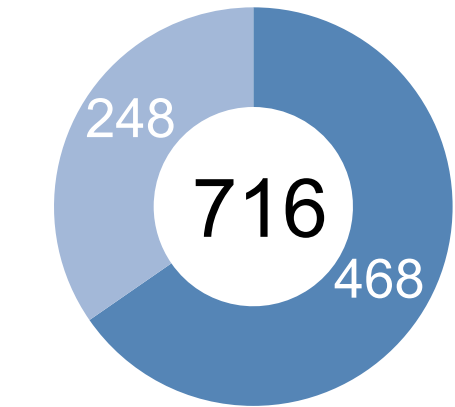
“**I told them to stop**. They were hurting me. They were pulling on my arms and it hurt” ³² (Nova Scotia)

29 a4aontario. *2018 Report to the UN, Pt 5: Ontario Schools*
30 a4aontario. *2018 Report to the UN, Pt 5: Ontario Schools*
31 CBC News. “Autistic Boy Locked Naked in Sherwood Park School Isolation Room, Lawsuit Alleges | CBC News.” . Accessed Oct 11, 2020.
32 Willick. “Student with Autism Dragged ‘Kicking and Screaming’ to Tiny Padded Room.”

3.3 | EDMONTON PUBLIC SCHOOL BOARD REPORT

Although there is plenty of evidence on the use of isolation in Canadian elementary schools, it is difficult to obtain affirmation from schools that practice seclusion. In 2019 the Edmonton Public School Board was challenged by parents to release a report stating the number of times seclusion spaces were being used within their district. The report revealed that in the month of September 2019 there were 716 incidents of seclusion spaces being used.³³ Of this, 468 of the incidents were said to be self-selected by students who used the spaces as a form of retreat to self-manage wellbeing. The other 248 incidents came from enforced isolation due to unsafe behaviour and endangerment to oneself or another student.³⁴ Although there have been multiple attempts to dissolve these spaces, the board continues to actively operate 137 seclusion rooms, revealing the sheer complexity towards the desire and need for self-selecting seclusion.³⁵ The government of Alberta has recently revised and released new standards governing the use of seclusion rooms. However, the document fails to address design guidelines/principles for how the seclusion rooms should look, revealing the lack of importance in the quality of spaces for children, especially those with sensory sensitivities.

Edmonton Public School Board
Seclusion Room Use: **Sept. 1-27, 2019**

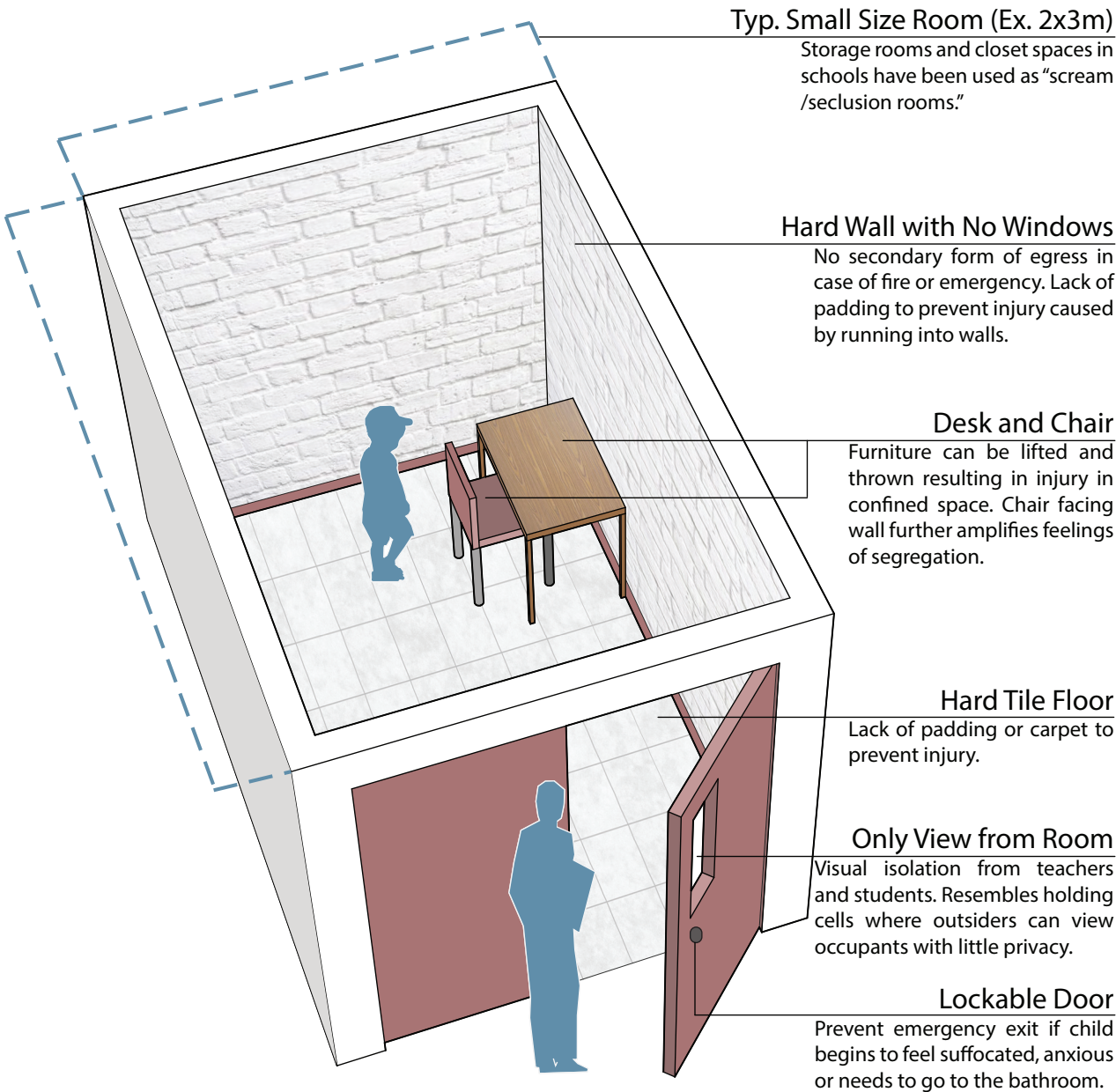


- Self- Selected Isolation
- Enforced Isolation

137 Active Seclusion Spaces

33 Morrison, Leona. *Seclusion Rooms - Request for Information #052*. Edmonton, 2019.
34 Morrison. *Seclusion Rooms - Request for Information #052*.
35 Morrison. *Seclusion Rooms - Request for Information #052*..

Fig. 3.8 Example of typical storage closet converted into Scream Room



Alberta requirements on the use of seclusion and/or physical restraint³⁶

- All seclusion environments are: safe, humane and abide by all building, safety and fire codes: free of items that may be harmful to students: and adequately lit, well-ventilated, and at a suitable temperature.
- There is continual visual and aural monitoring of any child/student throughout the period of seclusion or physical restraint.
- For a child/student who is unable to adequately express themselves through speech alone, school staff who are able to communicate with the child/student are present at all times if seclusion is used with such child/student.

36 *Standards for Seclusion and Physical Restraint in Alberta Schools*. Alberta: Alberta Education, 2019.

3.4 | THE NEED FOR SECLUSION

The use of seclusion rooms as a form of behavioural management has been widely prevalent in many cross disciplines, such as schools, correctional facilities, hospitals and psychiatric centers. In 2011, researchers Brenda Happell and Stefan Koehn conducted a study titled “Impacts of Seclusion and the Seclusion Room: Exploring the Perceptions of Mental Health Nurses in Australia.” The findings from the report revealed a significant acknowledgment from healthcare professionals that seclusion designated spaces often cause a strain in individuals and heighten emotions of fear, sadness, abandonment, dis-empowerment and confusion.³⁷ Despite these negative impacts, staff continue to actively use seclusion and see it as a way to manage safe environments for individuals with severe behavioural disorders. The study also recognized that often times there is little focus on how the seclusion rooms themselves look and that by identifying alternative therapeutic design approaches towards managing aggression, it may help to reduce the negative impacts and stigma associated with seclusion rooms.³⁸

While it may seem evident upon first glance the inhumane practice of seclusion spaces being used in schools, we need to recognize that a large number of students who reported to have used seclusion rooms have done so self-selecting. Seclusion rooms have been desired by students experiencing feelings of anger or anxiety and are looking for a space outside of their classroom to safely collect their emotions and do their assignments. They are able to regain control in a private place and have an opportunity to work through a situation by themselves rather than losing control in the classroom and in front of their peers. The fact that these small storage spaces are being chosen by students as a positive environment to work in and self sooth makes the situation all the more complex. We cannot simply remove seclusion spaces as there still exists a need for them, however as designers we have the tools to improve environments and be able to integrate them better into the classroom. We need to re-evaluate the design of classrooms themselves and ensure that the spaces in which children spend the majority of their day in is designed to promote success and respond to the different sensory needs of students. Most importantly we need to shift our focus from seclusion to retreat and create spaces designated for self-soothing and calming without being feared or labeled as scream rooms.

³⁷ Happell, Brenda and Stefan Koehn. “Impacts of Seclusion and the Seclusion Room: Exploring the Perceptions of Mental Health Nurses in Australia.” *Archives of Psychiatric Nursing* 25, no. 2 (Apr, 2011): 109-119. doi:10.1016/j.apnu.2010.07.005.
³⁸ Happell. “Impacts of Seclusion and the Seclusion Room: Exploring the Perceptions of Mental Health Nurses in Australia.”

3.5 | ONTARIO AUTISM PLAN & FUNDING

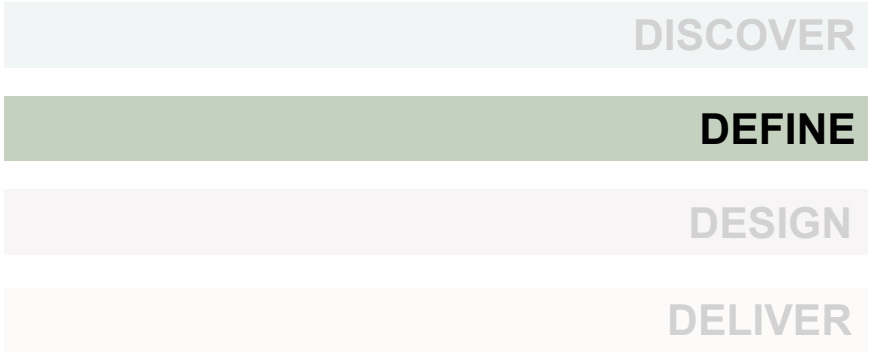
The Ford government in Ontario has recently announced changes to the provincial service and support plan for families with autism. The new autism program focuses on the age and total family income of a child rather than their specific needs. Families with an annual net income of under \$55,000 will be eligible for full funding.³⁹ Families who make over the net income will be eligible for partial funding despite their child’s needs/severity. These changes have sparked backlash from parents as many families are left to make up the difference for the cost of therapies and additional support out of their own pockets.⁴⁰ Families have had to compromise on savings allocated for food, bills and everyday expenses while some have had to discontinue support for their child(ren). With the increase in classroom sizes and the decrease in individualized teaching support and provincial funding, it becomes evident that there is a growing need for classroom environments to take on therapeutic functions. Designing learning environments that are flexible, adaptable and tailored towards individuals with sensory processing issues can help alleviate factors that would otherwise contribute to feelings of stress, anxiety and breakdowns.

39 McQuigge, Michelle. “What Exactly is Ontario’s New Autism Program? A Look at the Controversy it has Created.” . Accessed Mar 26, 2020.
40 McQuigge. “What Exactly is Ontario’s New Autism Program? A Look at the Controversy it has Created.”

For schools in Ontario there is allocated funding to subsidize the cost of essential equipment for students with special education needs. The Special Equipment Amount (SEA) Claim provides per pupil funding, meaning that specialty equipment is only assigned to a student that is referred or diagnosed by a qualified professional. If the student enters a new class or school, the equipment that is assigned to them will follow the student until graduation.⁴¹ Although the funding helps support students it does not address nor provide a long lasting solution. Many times young children are ineffectively diagnosed with learning or development impairments for years and instead are labeled as “problem children” who do not receive the appropriate support needed. In addition, we understand that ASD is measured on a spectrum and that certain cognitive impairments are not all physically visible nor considered very severe which can make the process of applying for funding challenging. It is also important to consider that equipment assigned to a student with special education needs can make others in the class view them as being different and lead to discrimination and bullying. Taking these factors into account I am interested in exploring the impact of redesigning classrooms into spaces for all. By creating an environment that promotes self-soothing techniques and are responsive to different behaviours, we can create better adaptive spaces that are able to support students.

41 Special Education Funding Guidelines Special Equipment Amount (SEA): Ministry of Education, 2016.

4.0 | METHODOLOGY



Another type of framework that was used during this thesis process was the method of Backcasting. The fundamentals of this approach were first outlined in 1990 by John B. Robinson from the University of Waterloo. Backcasting is a planning strategy that begins by defining the ideal future and works backwards to identify an approach that would connect the present day reality to the specified future.⁴² Although it would be ideal to design a brand new facility that was built with the intentions of sensory inclusivity, I would not be responding to the reality of what the situation actually is. The fact is that the majority of schools in Ontario and throughout Canada were built during a time when there was little understanding of the impacts of design on individuals with sensory sensitivities. Replacing all these schools with new facilities is neither realistic nor feasible and so it was important for me to address both the long term and short term questions that arise; How can architects tackle the challenges of sensory inclusive design for future projects and how can we modify current classroom conditions to make learning environments more inclusive for students with neurosensory conditions.

⁴² Dreborg, K.H., "Essence of Backcasting", *Futures*, Vol.28, No.9, (November 1996), pp. 813–828.

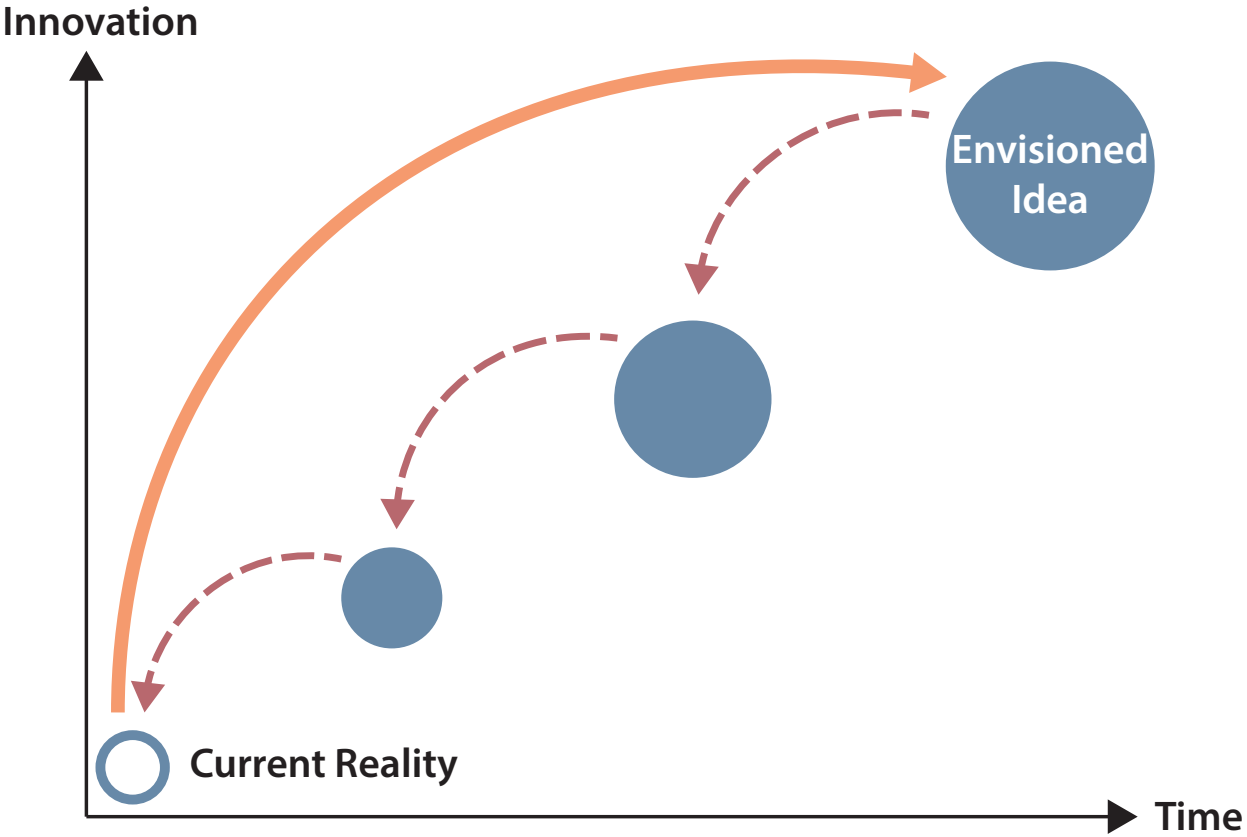
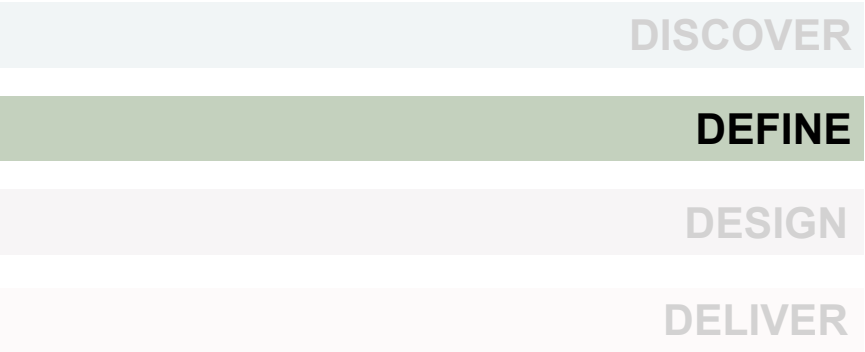


Fig. 4.1 Backcasting method outlined by John B. Robinson of the University of Waterloo

5.0 | SENSORY DESIGN DISCUSSION



5.1 | KEY INSIGHTS

After selecting the backcasting methodology as a planning strategy for my thesis, I began to take part in a series of informal design discussions with subject matter professionals in the fields of autism, teaching and therapy. I was interested in learning what experts thought of certain spaces, materials and environments in order to gage a better understanding of sensory inclusive design. Images of the spatial qualities and characteristics discussed during the design conversations can be found in the Appendix chapter of the thesis. After taking part in a series of virtual discussions I began to reflect on the conversations and generate important topics that I learned. Some key insights that emerged from my discussions were:

- 1. *Importance of developing a standard of what classroom environments should look like.*
- 2. *Importance of clean, simple and predictability in design.*
- 3. *Importance of examining and rethinking how we enter a space.*

KEY INSIGHTS OF SENSORY INCLUSIVE ENVIRONMENTS

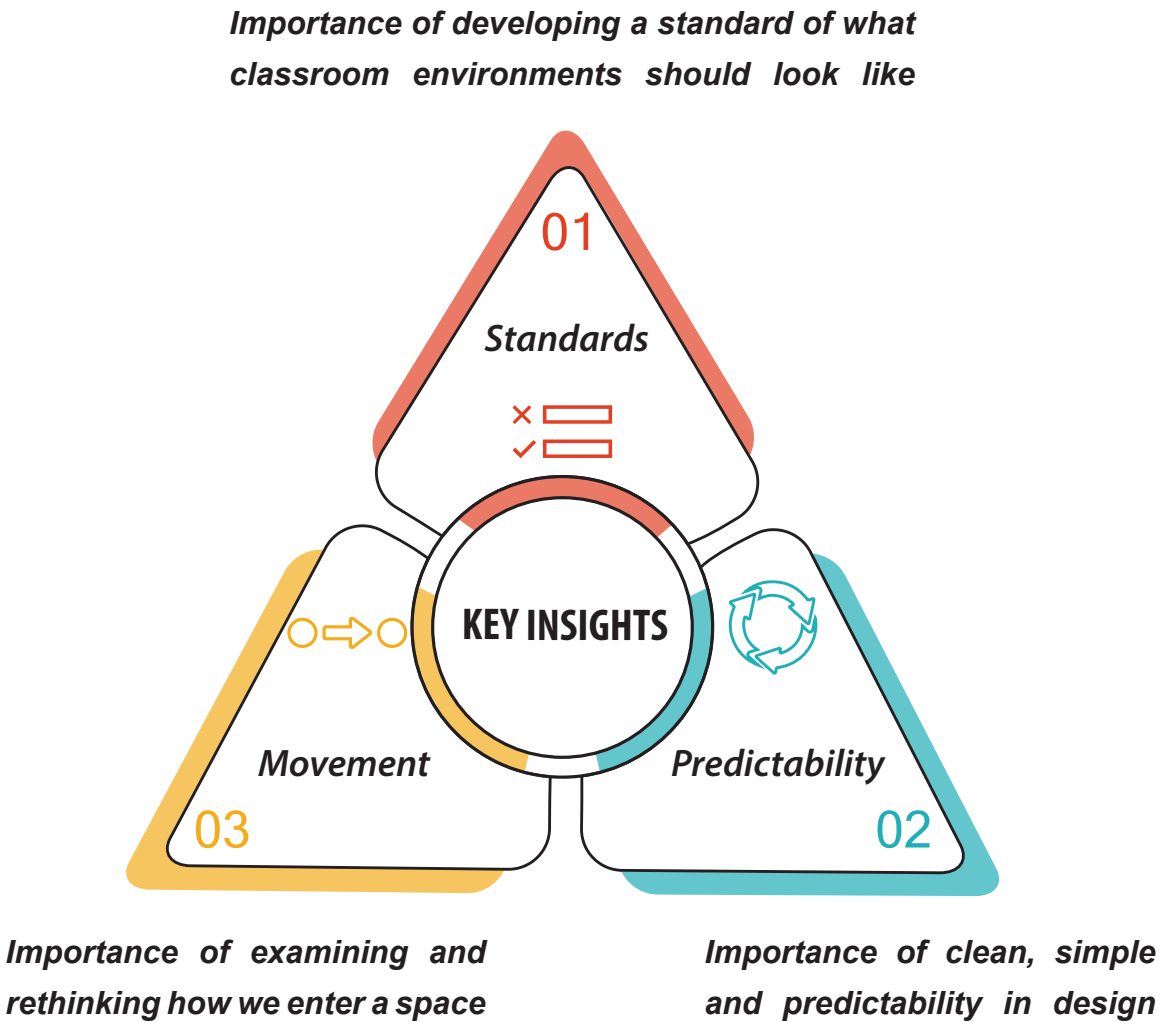


Fig. 5.1 Key Insights of Sensory Inclusive Environments

1. Importance of developing a standard of what classroom environments should look like.

It is often left to the respective teacher to choose how their classroom should look and function. As a result we see a spectrum of classroom conditions ranging from environments that are distracting and overstimulating, to spaces that are calming and sensory inclusive. When designing learning spaces we need to think about developing a design standard for classrooms. An example of design standards is the idea of shell based architecture that comes with pre-built spaces designated for retreat, teaching, etc. The benefit of this approach is that not only does it improve the overall standards for classrooms but also reduces the novelty phase by allowing all students regardless if they have a diagnosis to be able to access the different elements in their classroom.

2. Importance of clean, simple and predictability in design.

The pandemic has altered our perception of the classroom and the way we teach. As students re-entered schools in the fall, classrooms have been striped bare in order to reduce the virus spreading on surfaces. We have reversed back to the days of standardized rows of desks and a lack of diversity in the classroom. It is important to think of how design can be sustainable in case of future events and what materials can be easily cleaned and maintained. In addition to this, predictability in design can play an important role in reducing feelings of

overstimulation and uncertainty. As part of occupational therapy practices, children who are on the spectrum are encouraged to develop routines that help produce a calming feeling through the sense of familiarity. This approach can also be applied to design practices by reducing clutter and emphasizing way finding techniques and consistency in spaces.

3. Importance of examining and rethinking how we enter a space.

Entering the school, classroom or recess can be overwhelming for students with and without cognizant impairments. It can generate feelings of anxiety, stress and overstimulation from the sudden shifts in one's environment. Thinking about how we can create transition spaces from and to the classroom can help ease this sudden change. This insight can best be understood by imagining a gradient of spaces that feature semi-private thresholds designed to ease the transition into more public and unfamiliar/ uncontrolled environments.

6.0 | 6 PRINCIPLES OF DESIGN INCLUSIVITY



After developing a series of key insights based on the topics generated from the design conversations, I began to create a set of corresponding principles. The 6 Principles of Design Inclusivity were created as my response to the lack of awareness and support of individuals with neurosensory conditions in the building code and governing accessibility by-laws. The intent of the principles are to provide advice for designers who are interested in creating sensory inclusive environments. The principles are not hard set rules but my interpretations to question how we design and to be aware of how the environment can impact individuals with sensory sensitivities. I consider the principles to be universal design strategies that can be applied to not only schools and learning environments but extend to outdoor public places and areas of public gathering. Likewise, creating sensory inclusive environments does not only benefit children with neurocognitive conditions but can also benefit adults and society as a whole. Each of the following principles are part of the hexad diagram (Fig. 6.1) and include a set of drawings of how each principle can be applied through design and what should be avoided.

6 PRINCIPLES OF DESIGN INCLUSIVITY

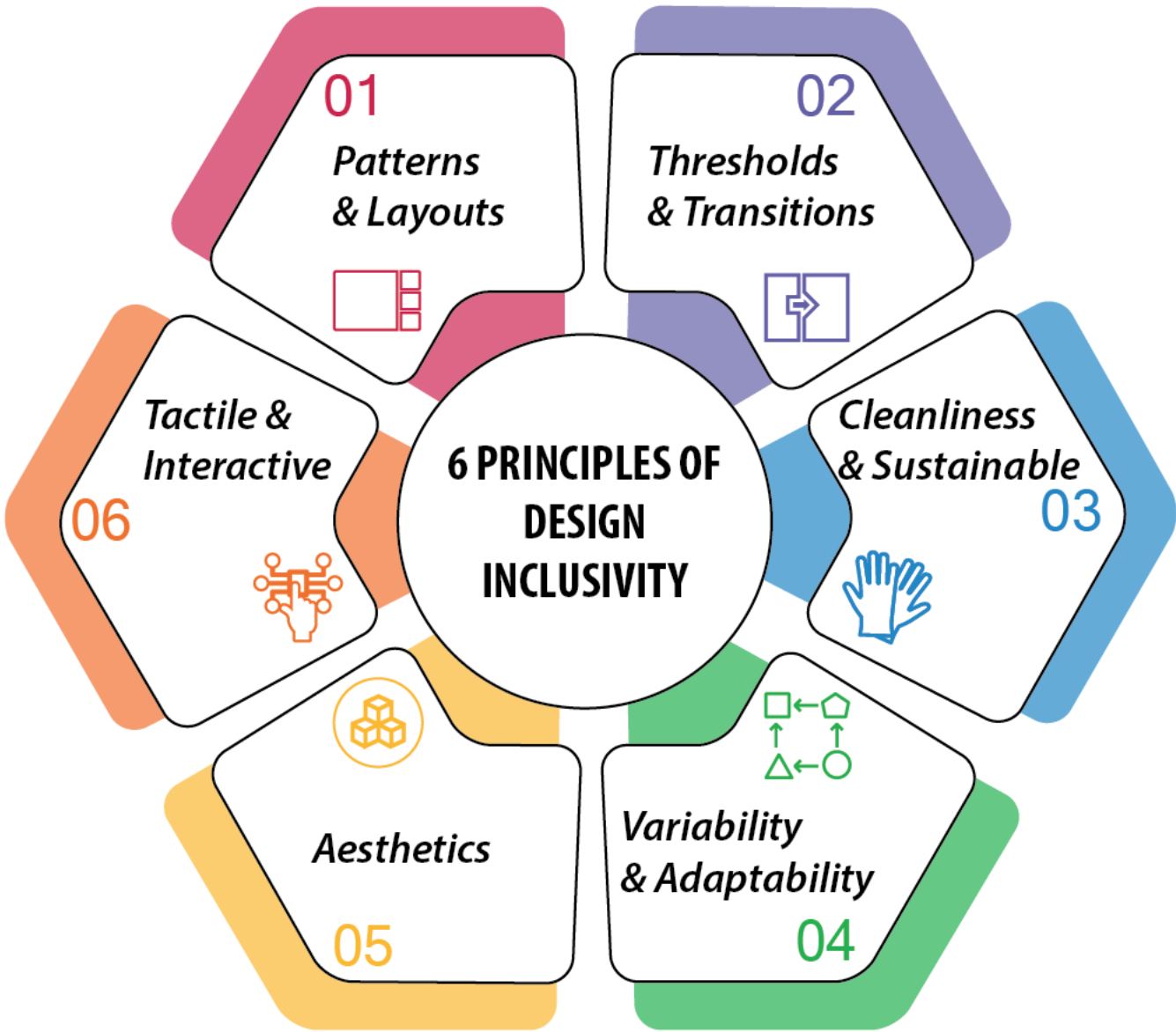
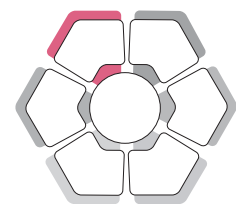
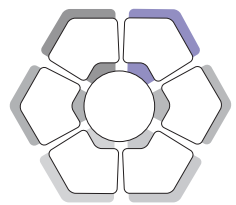


Fig. 6.1 6 Principles of Design Inclusivity Hexad



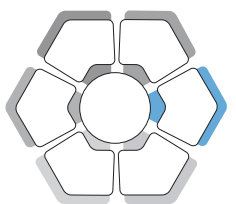
1. Pattern arrangements and layouts should avoid distractions and remain consistent throughout classrooms.

✓ DO		✗ DONT	
A. Line up floor grid	B. Consistency in classrooms	A. Stripes, diagonals and scattered colours	B. Clustered art and info walls



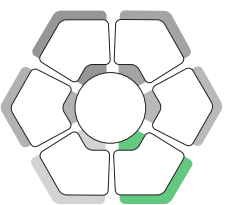
2. Thresholds and transitions should be transitory devices that mitigate and prevent abrupt changes in light, sound, smell, etc between two environments.

✓ DO		✗ DONT	
A. Accessible vertical actuation bar	B. Classroom & outdoor transition spaces	A. Over stimulating/ abrupt changes	



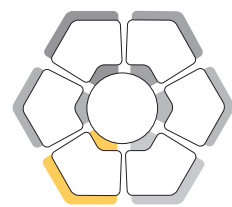
3. Physical components of the classroom should be portable or fixed and always easy to clean.

✓ DO		✗ DONT	
A. Systematic design	B. Built-in retreat space	A. Porous and absorbent material	B. Materials with strong odours



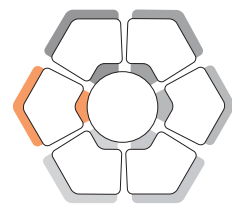
4. Provide variable levels of spatial enclosures that give individuals options to explore and choose environments that work for them.

✓ DO		✗ DONT	
A. Alcoves & tents	B. Alternative seating	A. Seclusion room (outside of class)	B. Selected seclusion spot



5. Use aesthetics to de-medicalize and de-institutionalize classroom environments. Dig into the idea of cool.

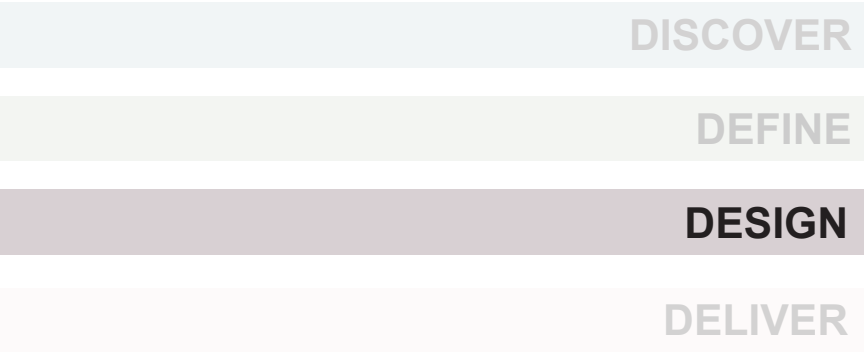
✓ DO		✗ DONT	
A. Find interesting colour schemes	B. Bring in nature/ green space & light	A. Typical rows of desks	B. Harsh bright/ flickering light



6. Design for tactile engagements and interactive designs to provoke whole body experiences and movements.

✓ DO		✗ DONT	
A. Programs that promote movement	B. Interactive installation	A. Depend solely on visuals	B. Only one student use

7.0 | ENVISIONED IDEAL



The process of designing sensory inclusive learning environments first begins with imagining what the ideal classroom conditions would look like. Referencing the backcasting methodology we covered in the previous chapter (Fig. 7.1), I began to explore the different ways I could incorporate the key insights and 6 Principles of Design Inclusivity in my interpretation of the envisioned space. I chose to focus on developing an elementary school classroom for grade four students with the intentions of maximizing diversity and flexibility in the learning environment. I began with referencing pre-existing dimensions and classroom standards in Ontario as the starting point of my work. The Toronto District School Board Elementary School Design Guideline is a handbook that governs the design and standards of renovations, additions and new elementary schools from junior kindergarten to grade 8.⁴³ This handbook provides example floorplans of typical classroom standards and layouts for schools in Toronto (Fig. 7.2). I chose to use the 70 sq.m prescribed classroom floor area approved in the design handbook as a starting point from which I built my interpretation of the ideal classroom. The following pages feature a series of illustrations of my thought process and how I was able to embody the 6 Principles of Design Inclusivity in my envisioned proposal.

43 Moore, Chris. *Toronto District School Board Elementary School Design Guideline*. Toronto, 2018.

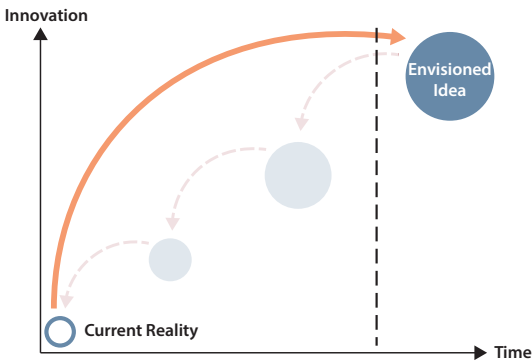


Fig. 7.1 Backcasting Diagram

TYP. REGULAR CLASSROOM STANDARDS

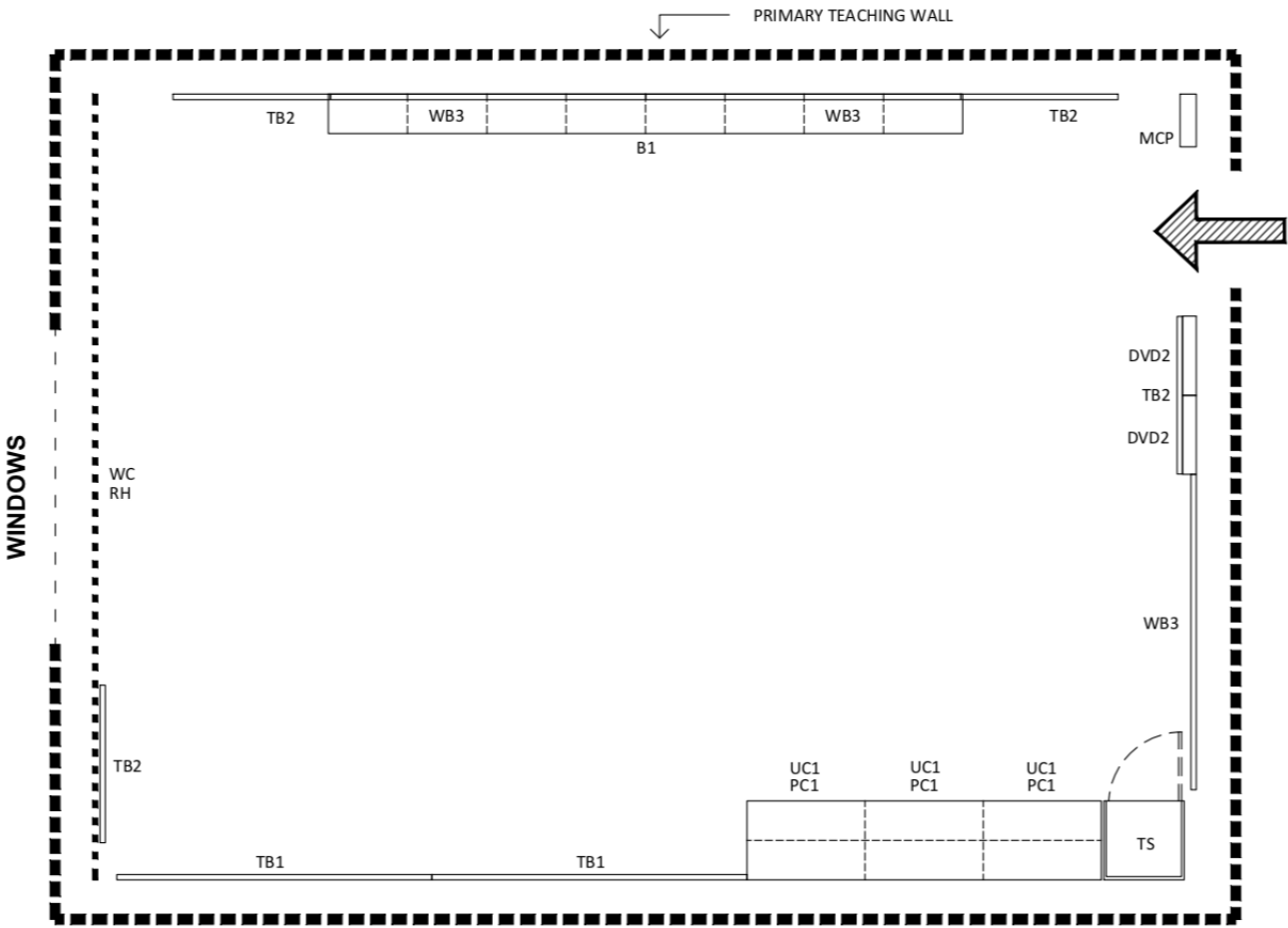
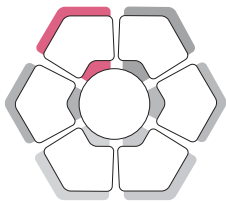


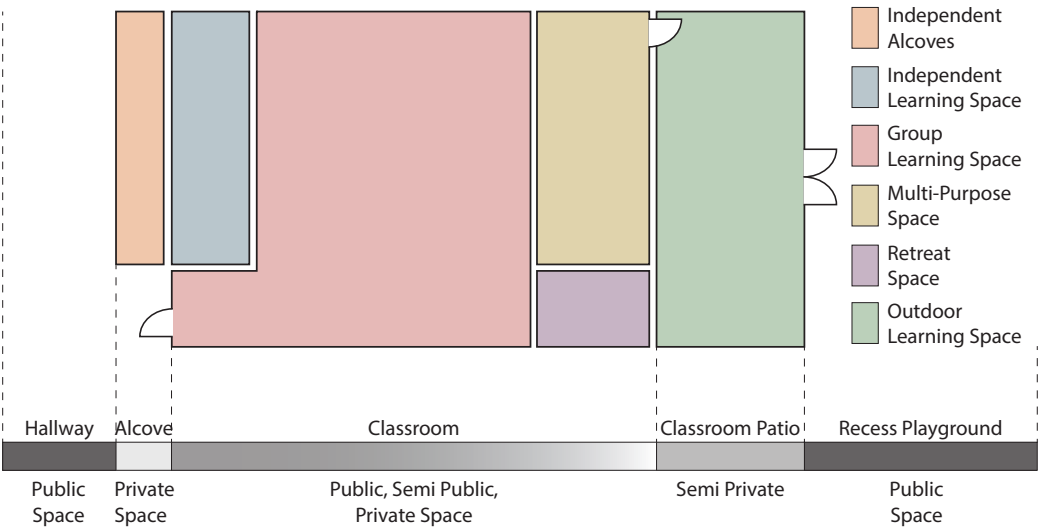
Fig. 7.2 Regular Classroom Sample Diagram - Toronto District School Board Design Handbook

Prescribed Floor Area EDU: 70 sq.m (750 sq. ft.)
Prescribed Floor Area TDSB: 70 sq.m (750 sq. ft.)

- | | |
|---------------------------------------|---|
| MCP Modular Control Panel | WC Roller Blinds |
| TS Teacher's Storage Closet | WB3 Whiteboard with Tray and Tackboard |
| UC1 Upper Cabinet with Doors | TB1 Tackboard with Maprail |
| PC1 Project Counter with Doors | TB2 Tackboard with Maprail |
| B1 Book Case | |



1. Pattern arrangements and layouts should avoid distractions and remain consistent throughout classrooms.



Very Stimulating

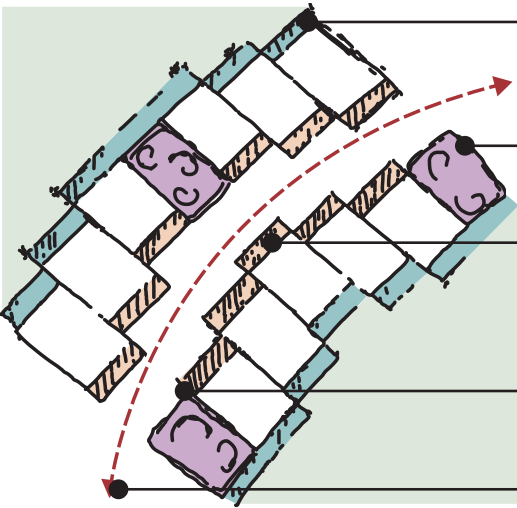
Classroom Layouts

Hallway, Recess, Gym, Front Entrance, Cafeteria

Classroom, Classroom Patio, Admin Office

Alcoves, Retreat Space, Library

Less Stimulating



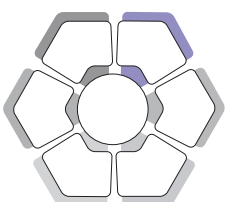
Transition Space Patio: Accomodating space between classroom and playground to allow for a smooth transition.

Sensory Retreat Space: Space designated for retreat located throughout the school.

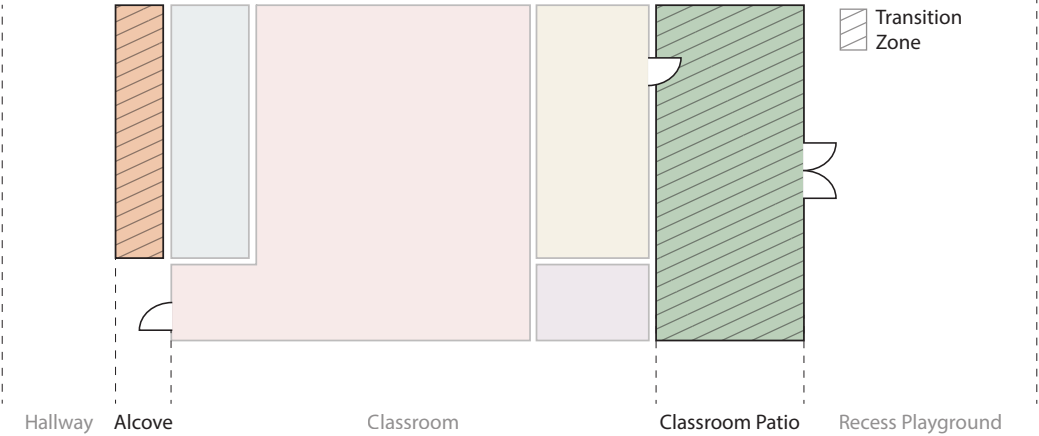
Transition Space Alcove: Accomodating space between hallway and classroom to allow for a smooth transition.

Staggered Classrooms: Provides visual breaks in order to reduce stimulation

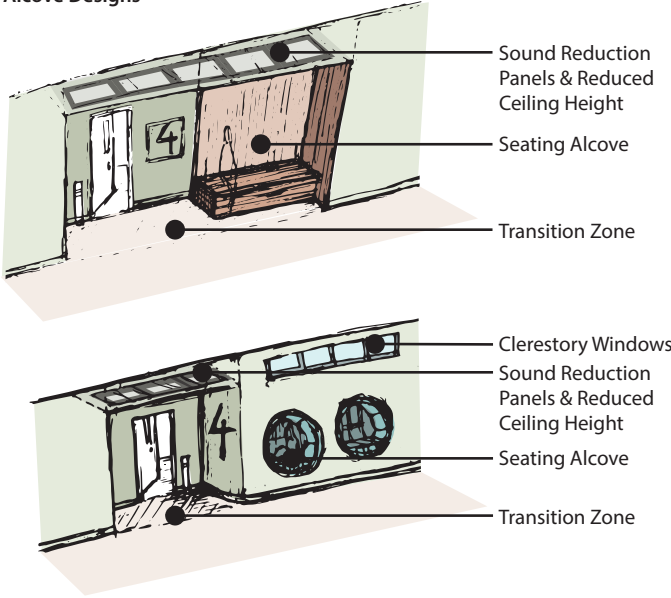
Curving Hallway: Reduces long view visuals which can cause anxiety for some students.



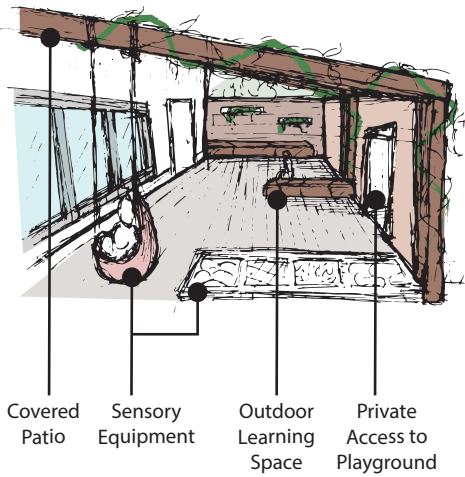
2. Thresholds and transitions should be transitory devices that mitigate and prevent abrupt changes in light, sound, smell, etc between two environments.

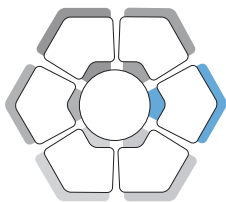


Alcove Designs



Classroom Patio Design





3. Physical components of the classroom should be portable or fixed and always easy to clean.

Soft Foam Tiles
Easy to clean, soft and vary in thickness when compared to traditional carpets.

LVT (Luxury Vinyl Tile)
More durable, quieter and warmer underfoot when compared to laminate floors

PVC Decking
Very little maintenance, weather resistant and easy to clean.

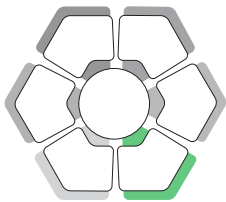
Exercise Ball:
Easy to clean, just needs a wipe down.

Seating Cushions:
Exterior sleeve can be taken off and placed in the washing machine.

Buckwheat Hulls:
- Hypoallergenic and dust mite resistant
- Malleable and non-shifting
- Organically sourced and environmentally friendly

Oat Seeds:
- Retains heat and temperature
- Heavier in weight, less stiffness and more malleab
- Organically sourced and environmentally friendly

Recycled Poly-Pellets:
- Non-toxic and no odour
- Malleable
- Machine washable



4. Provide variable levels of spatial enclosures that give individuals options to explore and choose environments that work for them.

Retreat Space:
Reduced height allows space to feel cosy and gives a sense of security through the comfort of being contained.

Classroom Space:
High ceiling heights can give a sense of freedom and help make the room feel brighter and larger when there are a large number of students.

Standing Desk

Detachable Desk

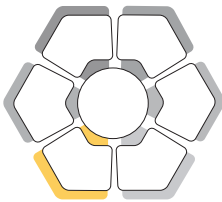
Wobble Chair

Floor Cushions

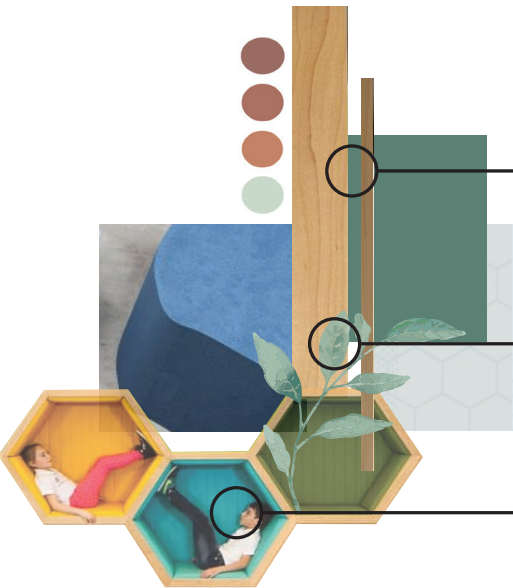
Balance Ball

Sensory Pod

Detachable Bench

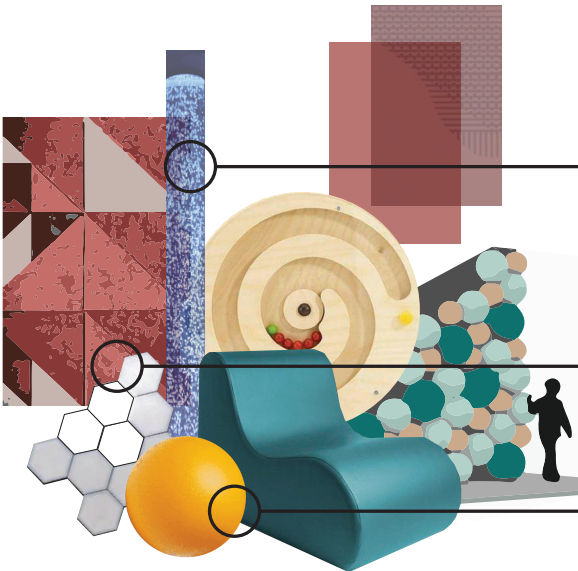


5. Use aesthetics to de-medicalize and de-institutionalize classroom environments. Dig into the idea of cool.



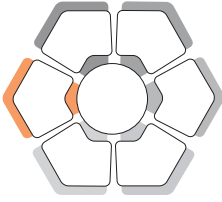
Classroom Material Pallet

- Earthtones:**
Soothing, less stimulating while still being interesting, cozy
- Nature/ Green Space:**
Stress reducing, soothing, boost mental and physical health
- Shapes and Accents:**
Interesting, excitement without being too overbearing



Retreat Space Material Pallet

- Sensory Stimulation Objects:**
Calming, accessible sensory output, helps engage individuals and focus on self soothing
- Sensory Reduction Elements:**
Sound absorption tiles and other elements that can reduce distractions and overstimulation
- Alternative Seating:**
Relaxing, interesting and inviting for students to use

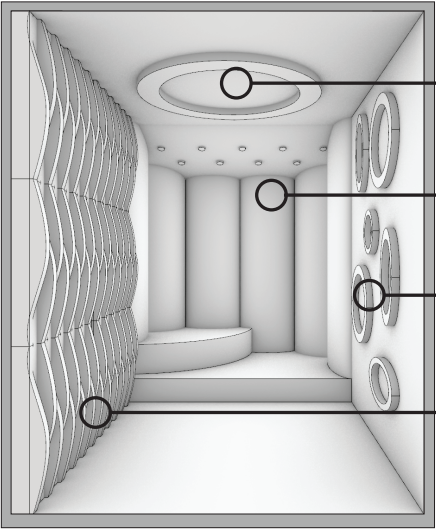


6. Design for tactile engagements and interactive designs to provoke whole body experiences and movements.



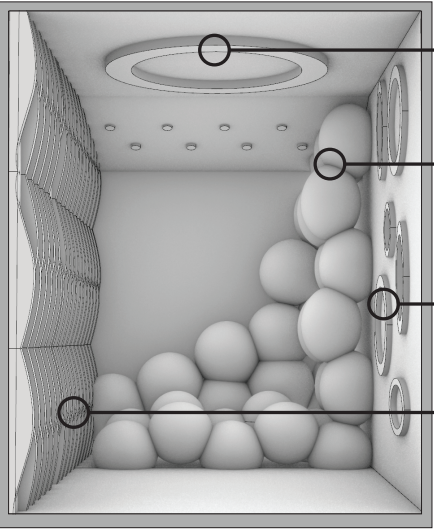
- Outdoor Learning Space
- Alternative Seating
- Digital Interactive Screen
- Sensory Stimulation Wall

A. Retreat Space - Tactile Engagement:



- Soft Ligting:**
Create soothing and calming atmosphere
- Crash Pad Walls:**
Absorb movement/ impact
- Digital Interactive Tiles:**
Sensory engaging and promote movement
- Attachable Sensory Wall:**
Promote whole body movement, sensory stimulating

B. Retreat Space - Tactile Engagement:



- Soft Ligting:**
Create soothing and calming atmosphere
- Ball Wall:**
Absorb impact, malleable, deep tissue pressure therapy
- Digital Interactive Tiles:**
Sensory engaging and promote movement
- Attachable Sensory Wall:**
Promote whole body movement, sensory stimulating

Idealized Classroom Design

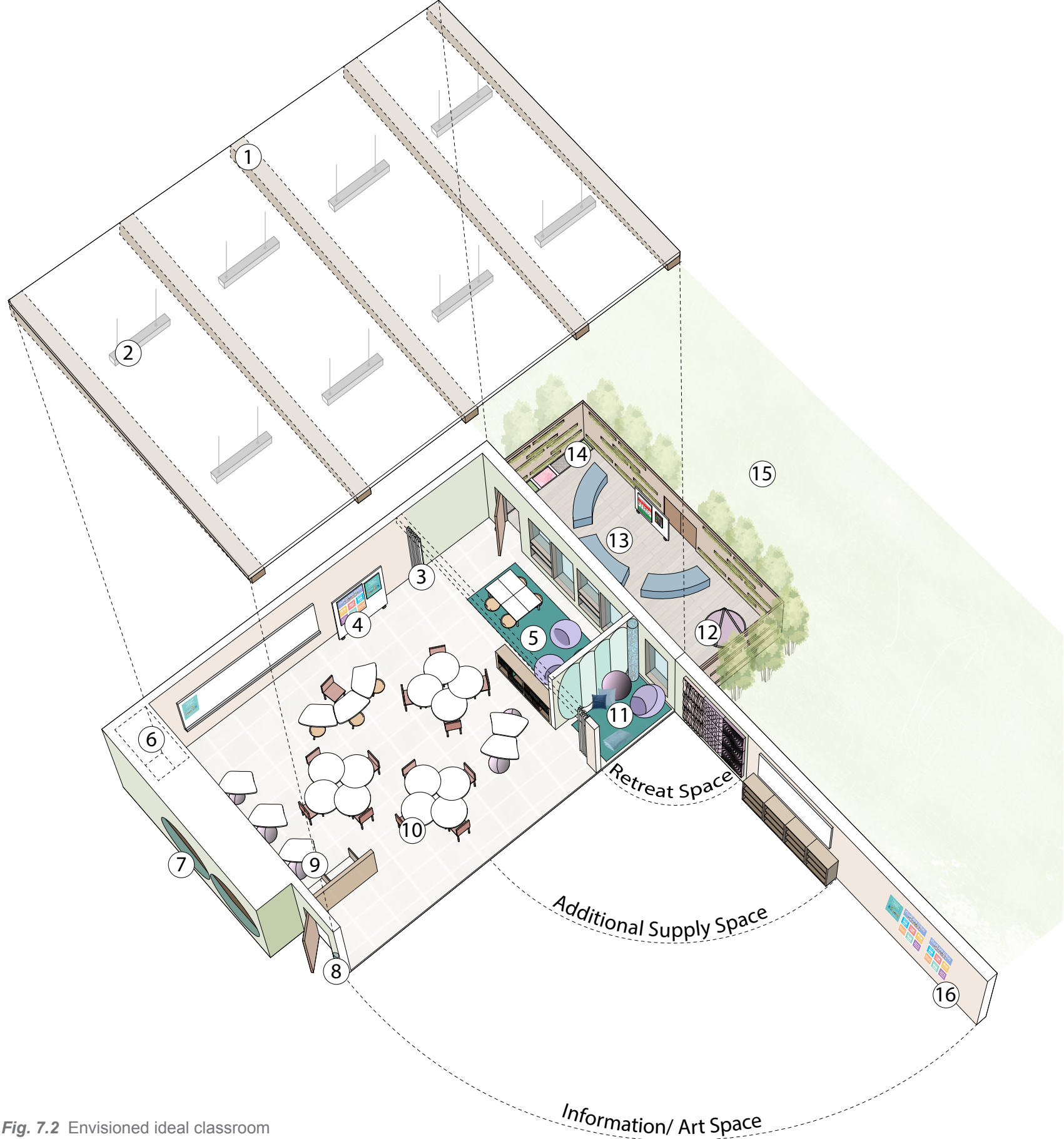
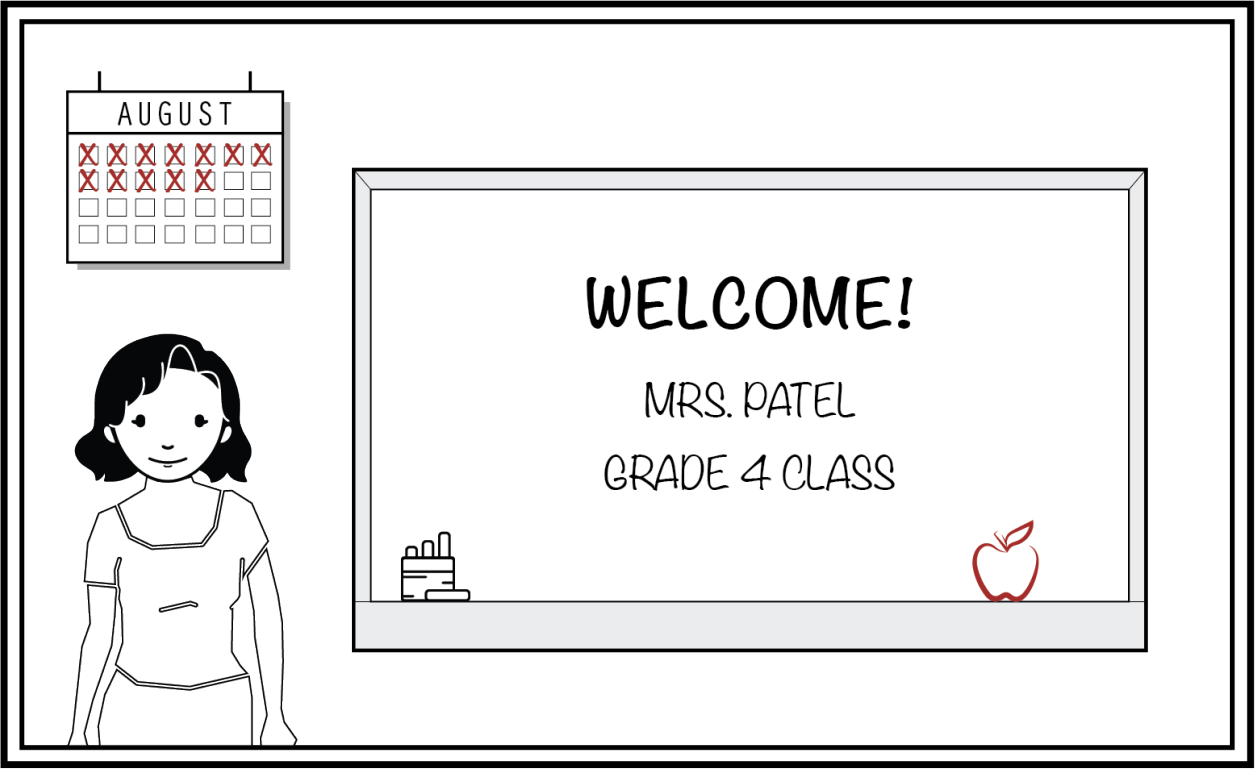


Fig. 7.2 Envisioned ideal classroom

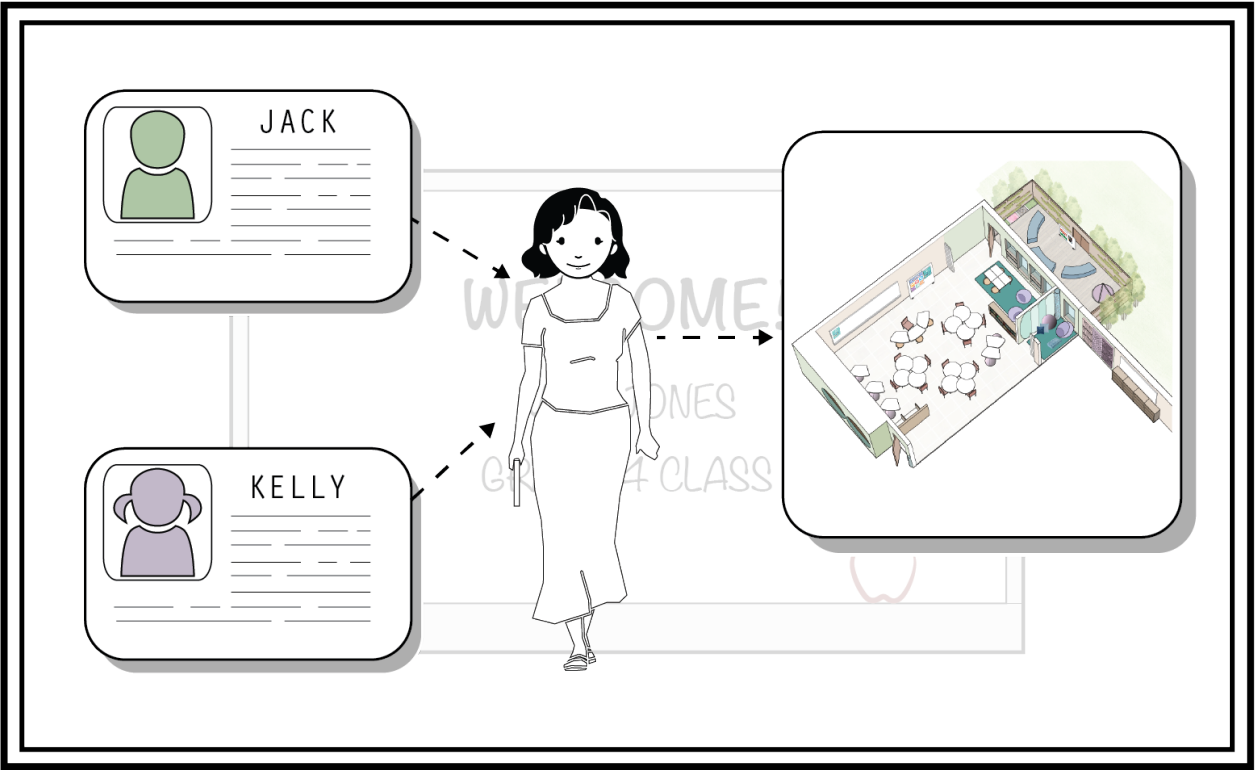
- ① **SOUND ABSORPTION PANELS**
Compressed mineral wood reduces general noise, clarify speech and limit reverberation within enclosed area
- ② **RECESSED LED LIGHT PANELS**
Converts direct light into indirect light which is softer and helps to improve student concentration and performance
- ③ **ROOM DIVIDER**
Helps to physically divide spaces and reduce visual distractions
- ④ **MOVEABLE DISPLAY WALLS**
Space to hang up learning materials that can be easily moved elsewhere when visual distractions need to be avoided such as during a test
- ⑤ **MULTI-FUNCTION FLOOR SPACE**
Provides floor time for group activities or independent learning and is used in therapy to help children self-regulate and improve communication skills
- ⑥ **SENSORY SUPPLY STORAGE**
Features noise canceling headphones, sunglasses and other objects that can reduce sensory stimulation for students in the class
- ⑦ **TRANSITION ZONE ALCOVES**
Acts as tents or private spaces for a student to have some time to themselves before entering a new environment
- ⑧ **ACCESSIBLE VERTICAL ACTUATION BAR**
Allows for a greater range of accessibility than the typical ada push button for students with MS or other mobile disabilities
- ⑨ **INDEPENDENT LEARNING SPACE**
Designated space with independent seating and standing desks
- ⑩ **ALTERNATIVE SEATING**
Chairs, exercise balls, floor mats, bean bags/cushions and standing desks
- ⑪ **RETREAT SPACE**
Designated space for self-soothing, comfort and relaxation accessible for any student in the class
- ⑫ **SWINGS/ WHOLE BODY EQUIP.**
Sensory stimulating equipment and objects
- ⑬ **OUTDOOR LEARNING SPACE**
Secure backyard classroom for outdoor teaching and semi-public/ private space during recess use
- ⑭ **SENSORY FLOOR WALKING PATH**
Helps to develop motor skills such as balance, hand-eye coordination and spatial awareness
- ⑮ **PLAYGROUND**
Playground connects behind each classroom's outdoor learning space and is used during recess
- ⑯ **ART/INFO DISPLAY WALL**
Designated space for announcements and art work located at the back of the wall to reduce visual stimulation

7.1 | STORYBOARDING

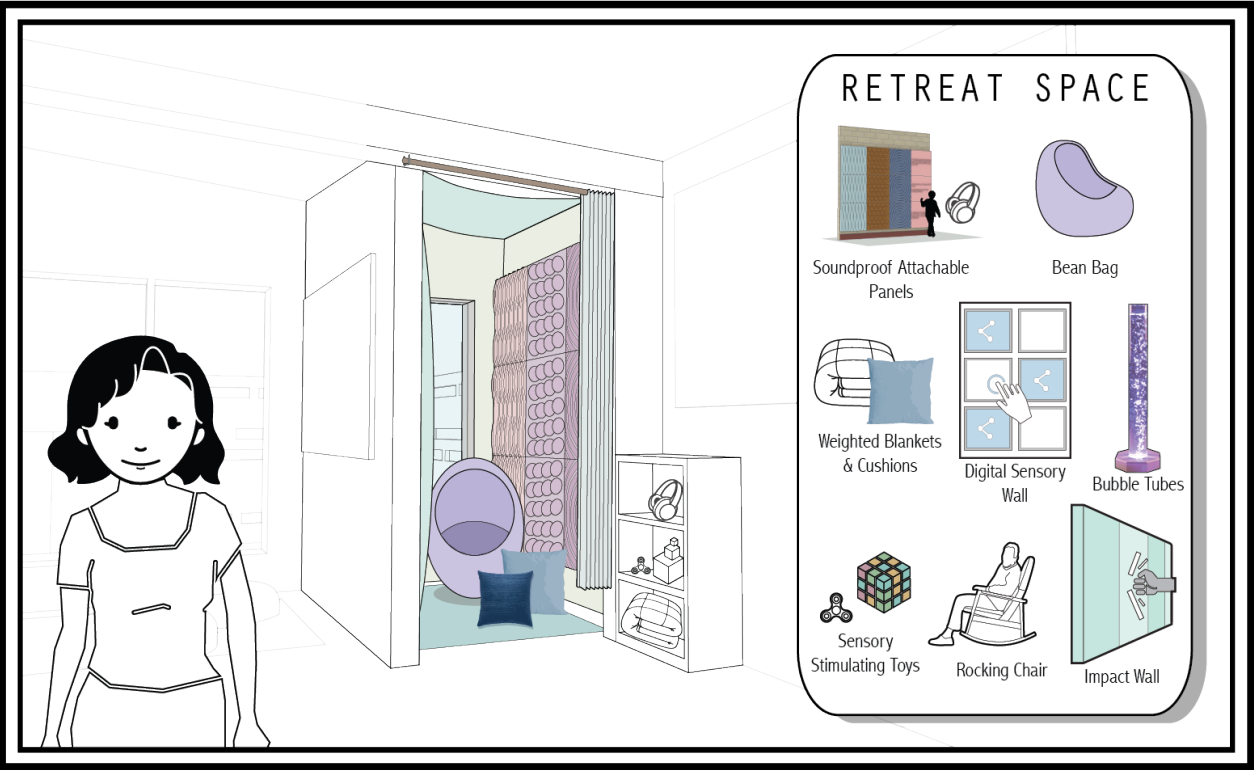
Along with illustrations of my envisioned classroom design, I also chose to present my work through a series of storyboards. Storyboarding is a technique that uses graphic representations to capture the most important elements of a project. I chose to use this strategy to further understand the envisioned classroom from a more human scale. The following pages feature two storyboards of different users interacting with the learning environment. The first storyboard is from the perspective of a grade 4 elementary school teacher preparing the classroom for the incoming students. The teacher reflects on the different elements in the classroom and how and when they can be used by the students. The second storyboard takes on the perspective of a grade 4 student who is on the spectrum and entering the first day of class. This narrative focuses on how the student is able to use the classroom to self-sooth and reinforce feelings of confidence and calm. The storyboards along with the envisioned classroom proposal were later presented for review during a user group. Comments and overall reflection on the use of storyboards during the user group meeting will be further discussed in Chapter 9.



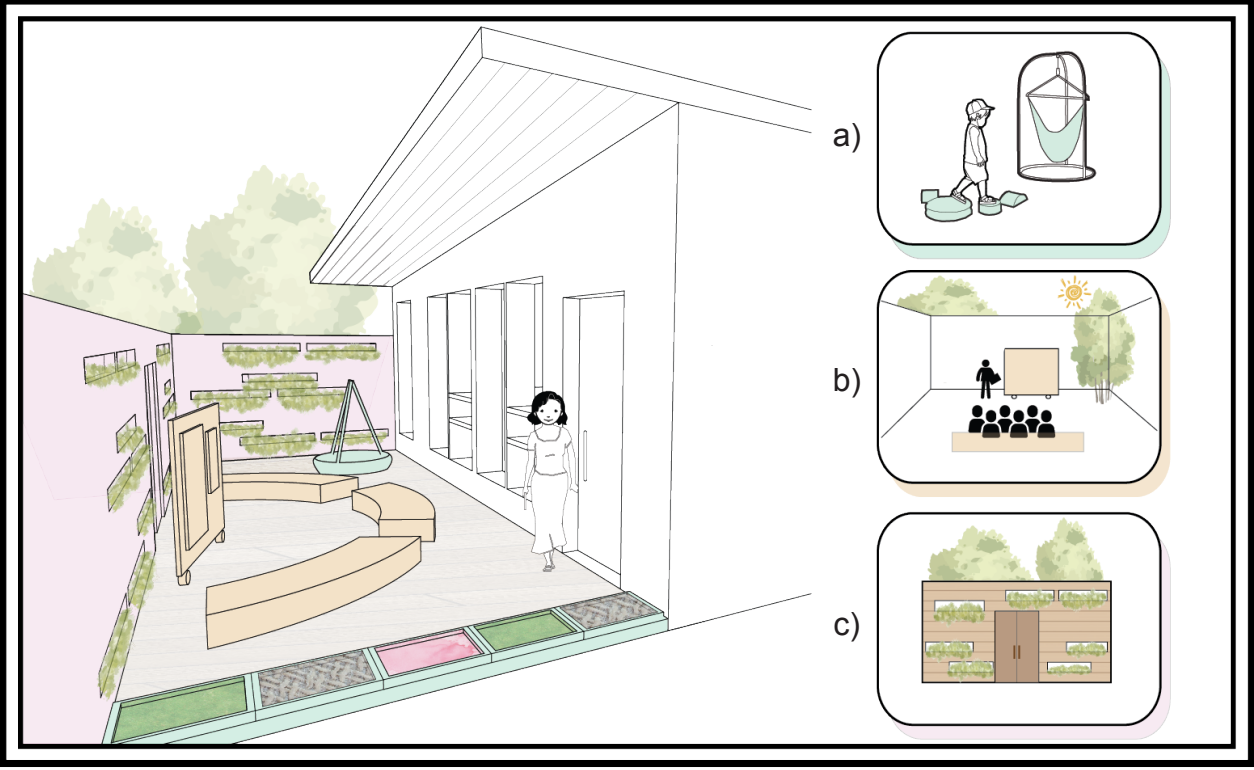
Hi, my name is Mrs. Patel and welcome to my grade 4 classroom! I am just getting the classroom ready for the start of the new school year. Let me show you what I have done with the room.



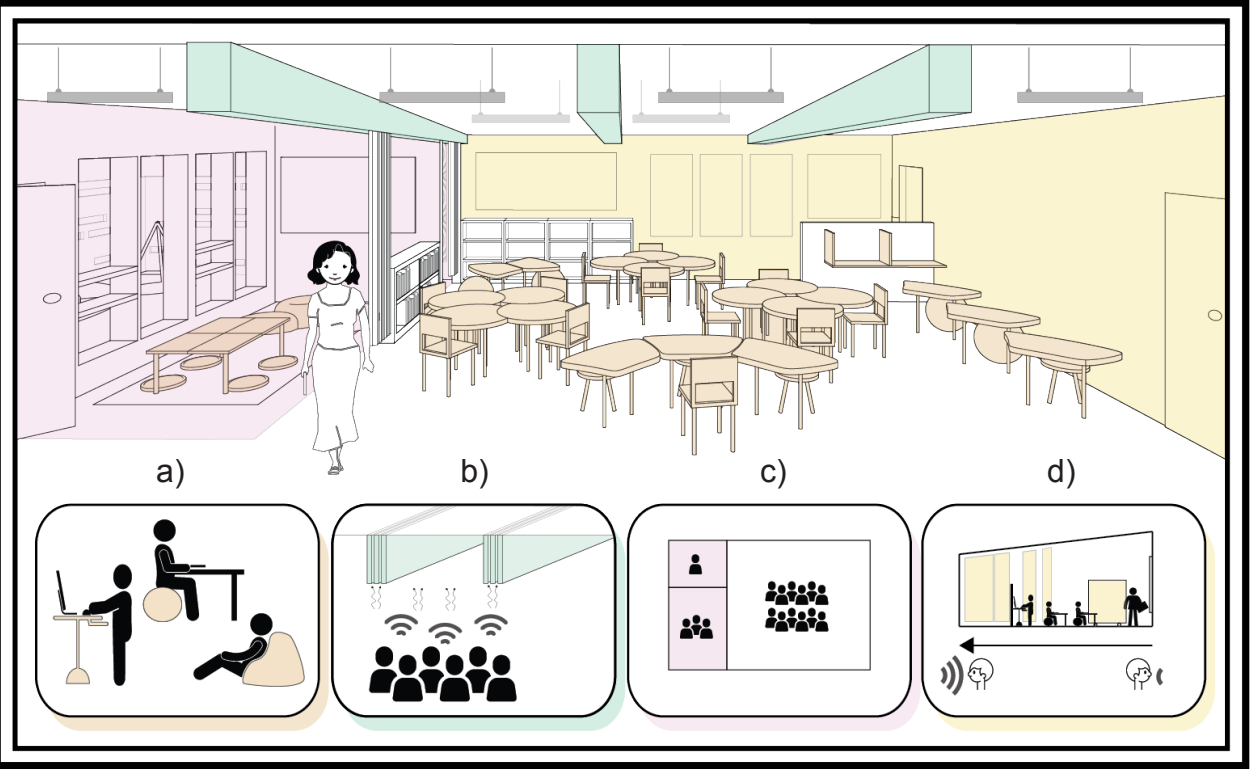
I am expected to have a class of 24 students this year. I have been told that one of my students has ASD and another with ADHD. What I have been looking at are ways to transform my classroom in order to provide resources for the diverse needs of my students.



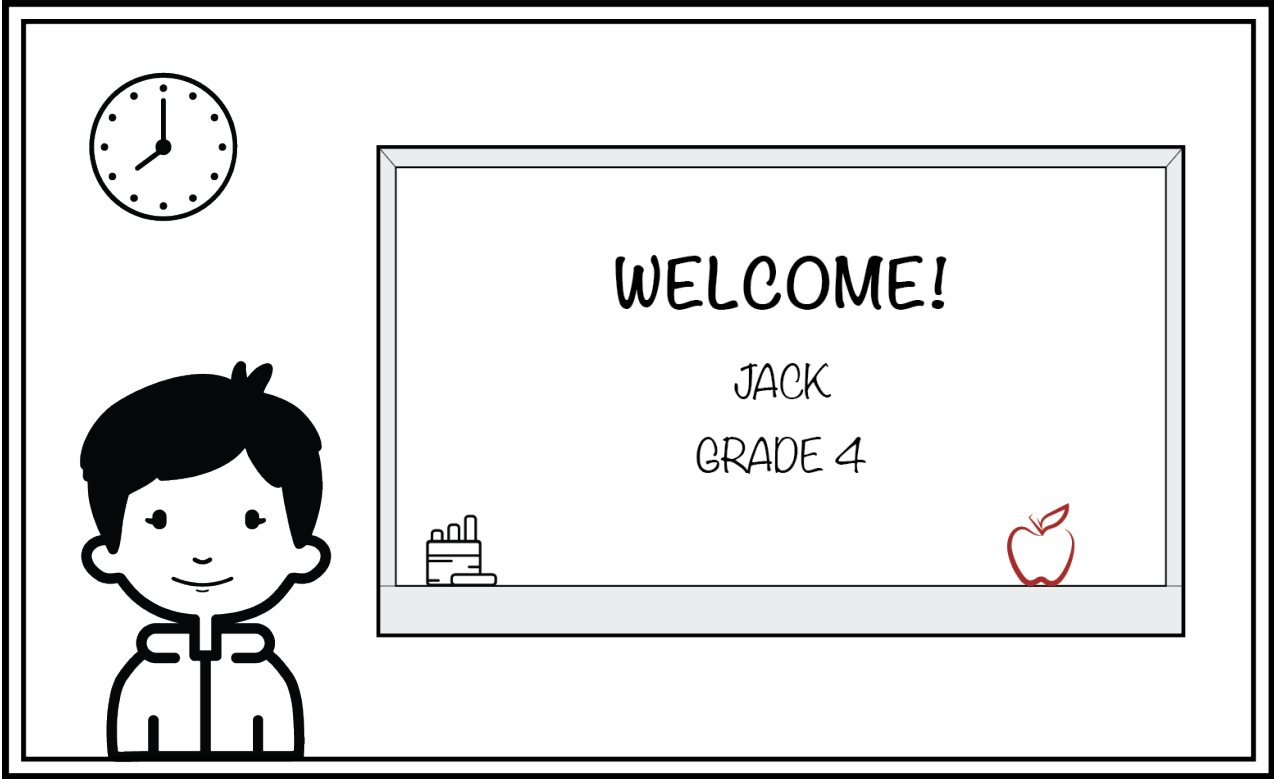
The classroom itself comes with a built space designed for retreat. The space is filled with different objects and elements that can be used by any student to help de-stress and provide comfort. In order to create a private space there is a curtain that can be drawn to reduce visual stimulation while preventing any child from being physically trapped in the area.



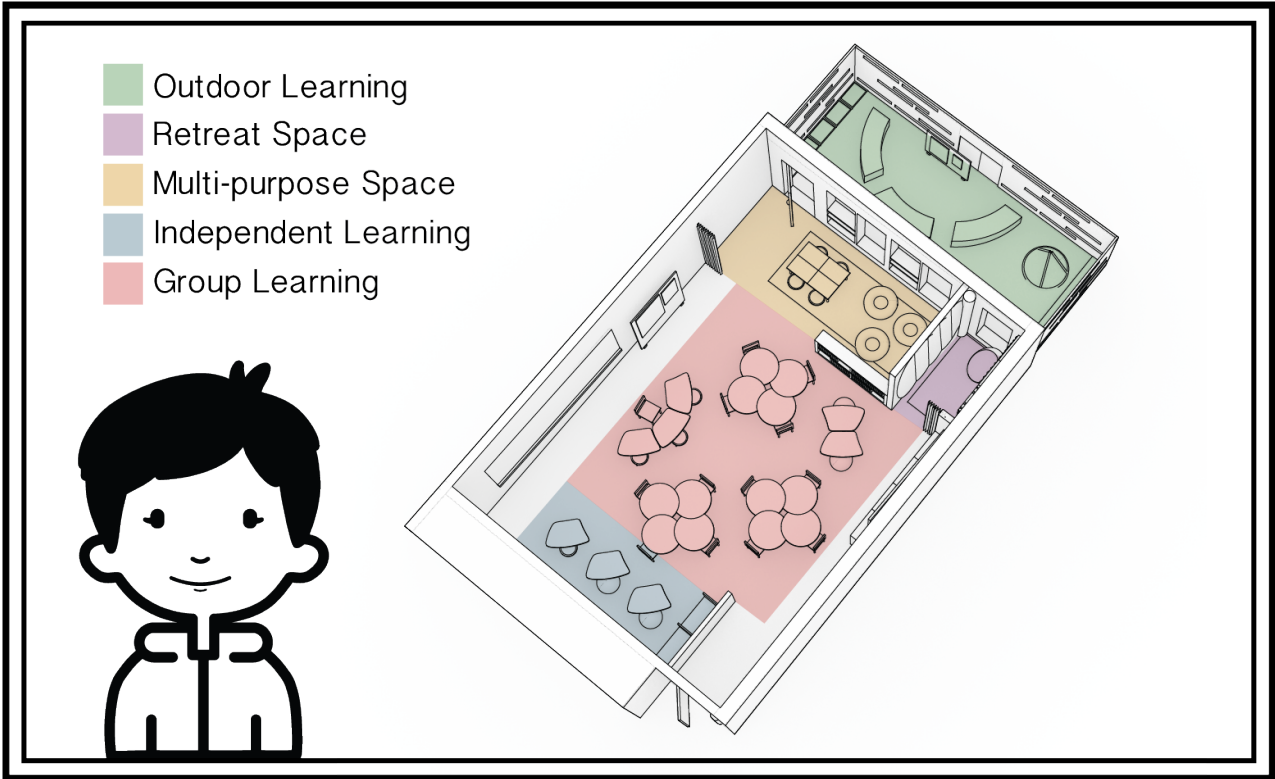
The classroom is also attached to its own private outdoor learning space that features: a) Sensory Equipment b) Alternative Place for Learning c) Safe and Secure Transition Space for student to go outside for recess or spend time in the semi-private space beside their classroom. When the weather is nice I like to take learning outdoors and allow students to sit outside while I teach.



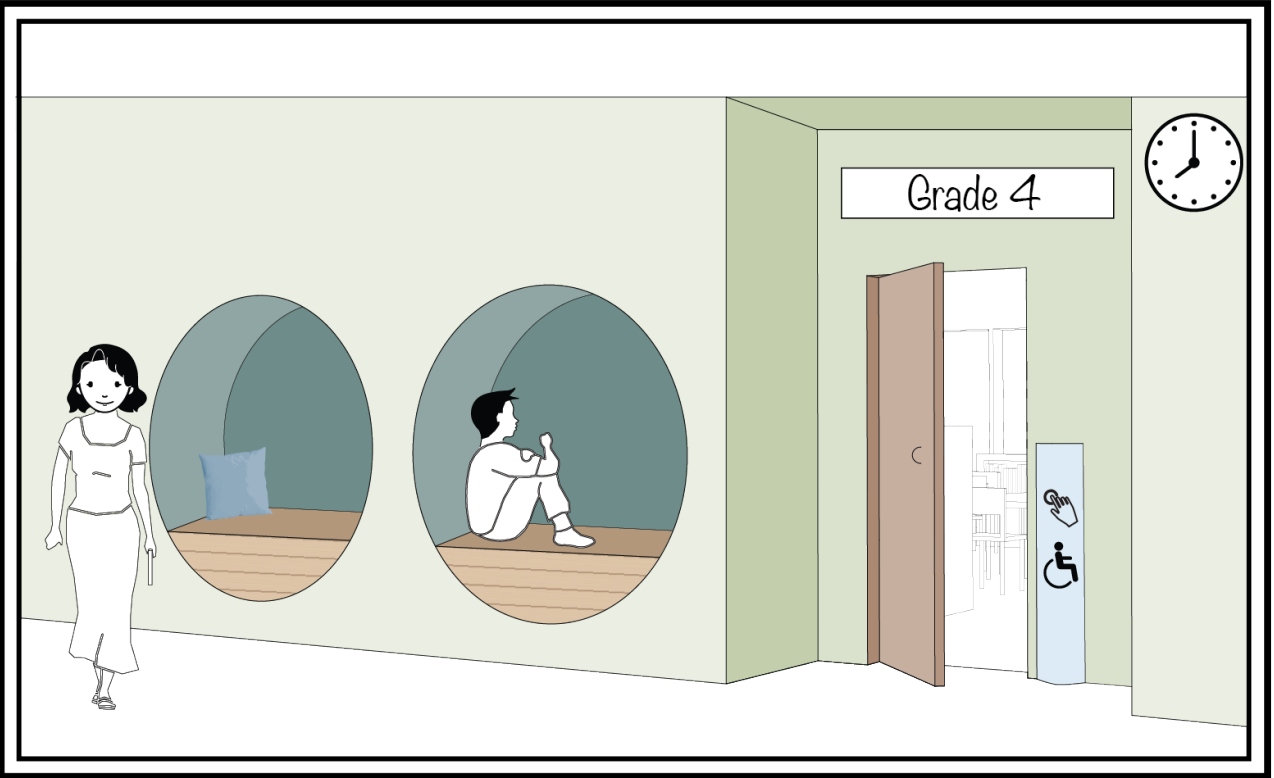
The classroom features a series of different elements that provide options for students in order to create a specialized place for learning such as: a) Alternative Seating b) Sound Reducing Panels c) Alternative Workspace Densities d) Visual Stimulation Strategies (ex. Less art and information in the front of the room and more towards the back of the classroom)



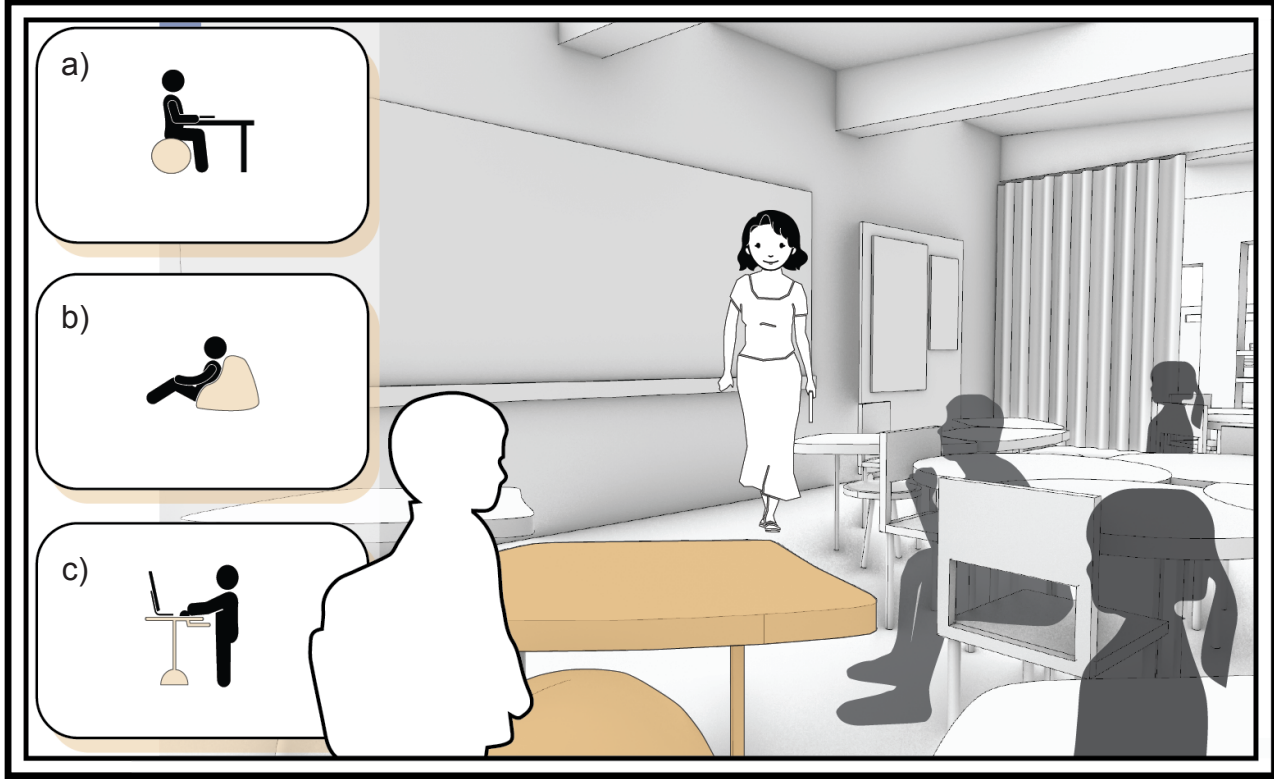
Hi my name is Jack and I am entering grade 4 this year! I recently found out that I am located on the spectrum so sometimes entering new environments can be very over stimulating and too much for me.



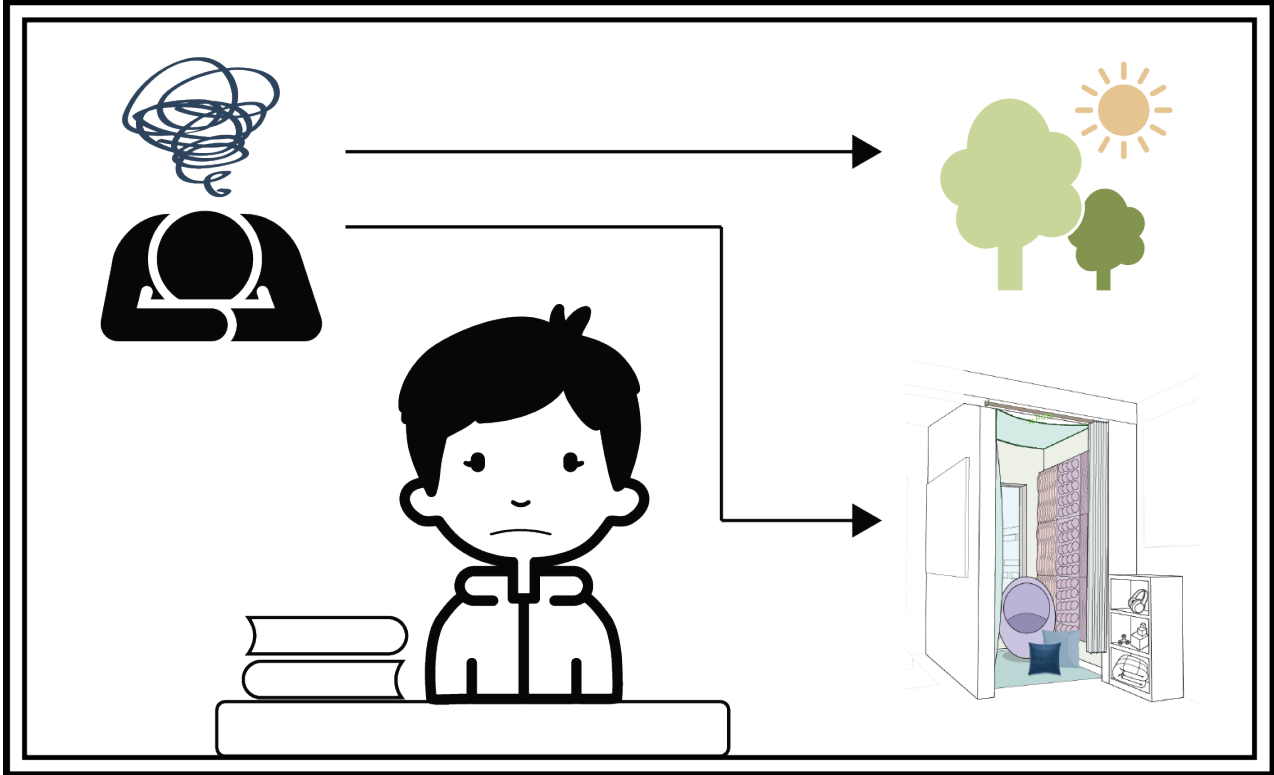
When I enter my class I feel a sense of familiarity. It has the same spaces as my previous class last year and although it looks a bit different I know there is an outdoor space, retreat space, multipurpose area, independent learning space and a group learning area. This sense of predictability helps to reduce some of the anxiety that was building up inside of me.



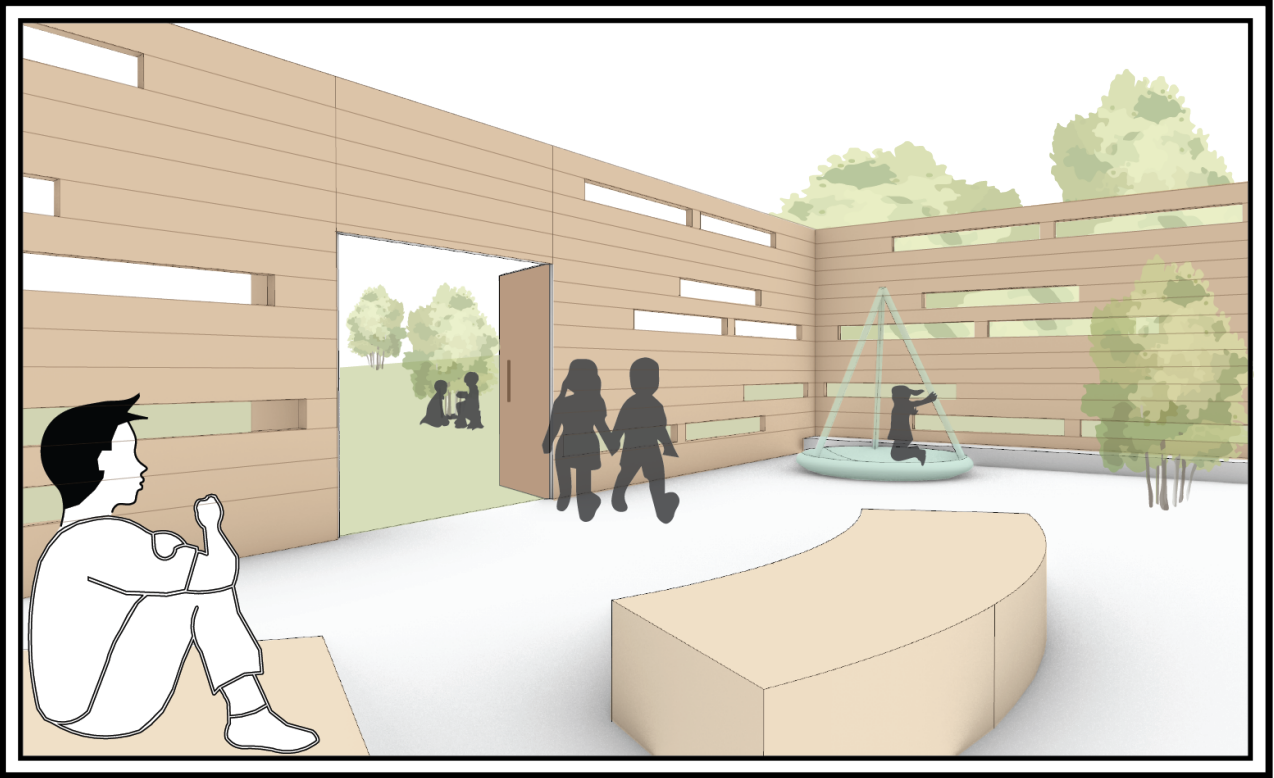
Before class starts I take some time for myself to sit somewhere quiet and comfy like the seating alcoves outside of my classroom. They are soft and help to absorb sound so that I can focus on getting ready to enter the classroom.



As class begins I decide to sit in the independent learning area. I am still feeling a bit anxious and overwhelmed so I sit on the exercise ball to help myself feel more calm. Here there are a number of different seating options available for me to use such as: a) Exercise Balls, b) Bean Bags/ Floor Seating, c) Standing Desks. Maybe later I will use the bean bags during reading time.

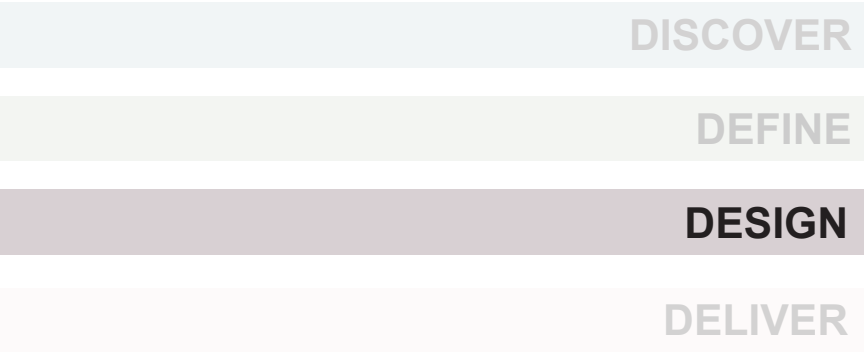


Sometimes I just have a bad day. I feel a built up of emotions growing inside of me and I have a hard time focusing in class. During these times I think of ways I can self-sooth, do I need some fresh air or do I need the comfort of the retreat space. In this classroom there are many spaces and objects that I am encouraged to use when I am feeling overwhelmed.



During recess time I like to stay in the comfort of the outdoor learning space. Sometimes I like to join the rest of my classmates in the open playground area but it can get too stimulating. Here in the outdoor learning space I have access to sensory equipment such as swings and a walking path designed to engage my senses.

8.0 | CURRENT REALITY



8.1 | ARCHITECTURE AND SENSORY DESIGN

After developing the envisioned classroom proposal I began to focus on design strategies that would respond to the current conditions in elementary schools. I was interested in understanding what could be introduced into classrooms that would specialize the learning environment and accommodate the diverse needs of the students. It was important that the proposed designs had minimal physical impact on the space but aide to create microclimates and options for students to personalize their environments into spaces for success. With this in mind I chose to develop a series of kit of parts that featured elements inspired by the sensory design discussions, key insights and the 6 Principles of Design Inclusivity. During this process I also began to research how architects responded to the challenges of designing for sensory inclusivity - specifically looking at small scale installations. I found the works of Sean Ahlquist and HKS Architect’s Sensory Hub to be unique projects that used design to celebrate and bring awareness of cognitive impairments.

Sean Ahlquist - Sensory Playscape

Professor and architect Sean Ahlquist, was inspired by the methods of multi-sensory therapy that his own daughter who has ASD participated in. Ahlquist combined the fields of architecture, engineering, human-computer interactions and autism research to create an interactive installation that was focused on movement, motor skills

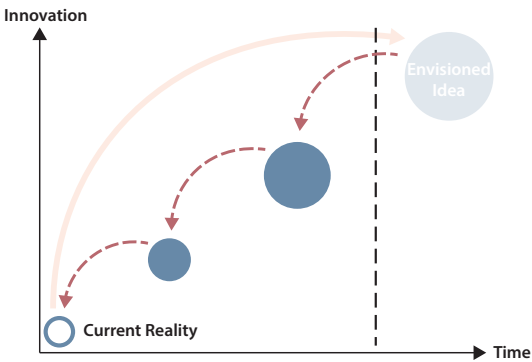


Fig. 8.1 Backcasting Diagram



Fig. 8.2 Playscape installation designed by Sean Ahlquist



Fig. 8.3 5 year old Ara Ahlquist interacting with the Playscape

and social interactions.⁴³ The installation features a textile mesh stretched across an exoskeleton, producing a tactile surface on which a Kinect Software is able to respond to the sense of touch and pressure from the user (Fig. 8.2).⁴⁴ This allows individuals to engage with the sensory playscape through interactive colouring and animations. The playscape focuses on three primary modes of interaction: physical movement, responsiveness to fine motor movements and visual and auditory feedback.⁴⁵ The installation produces multi-sensory feedback in response to its users and in doing so helps provide an overall sense of calmness through the action of play (Fig. 8.3).

⁴⁴ Ahlquist, Sean. "Social Sensory Architectures."
⁴⁵ Ahlquist. "Social Sensory Architectures."
⁴⁶ Ahlquist. "Social Sensory Architectures."

HKS Architects - Sensory Hub

HKS Architects is a design and research firm that collaborated with Sean Ahlquist and the Lane Tech College Prep High School in Chicago to develop a sensory well-being hub (Fig. 8.4).⁴⁷ The hub is designed to provide students who have sensory processing challenges a space to self-soothe and reset from a stressful situation. The hub is built of freestanding modules that split the space into three distinct zones: active, respite and cocoon.⁴⁸ The installation incorporates a variety of sensory integrative elements such as: fidget toys, Light Brite wall, musical instruments, weighted blanket, spin chair and other interactive and virtual elements. The cocoon structure placed in the middle of the room is built using tensile fabric, which provides a strong level of compression and deep touch qualities that are considered desirable and calming when a child is under stress.⁴⁹ What I consider most interesting in this project is the modularity of the structure and its ability to adapt to different environments. HKS Architects have also published a step-by-step instruction manual on how to assemble and create their sensory hub so that all institutions have an opportunity to create a sensory responsive environment for their students.⁵⁰

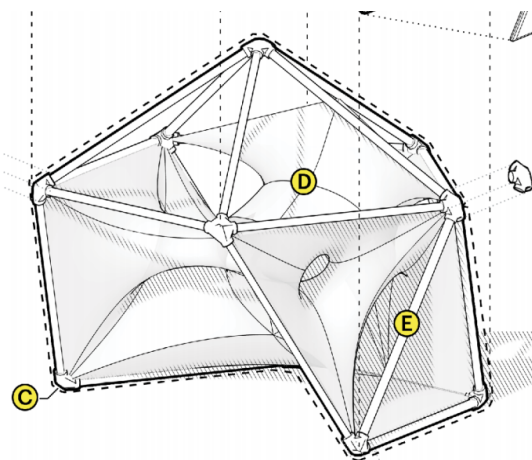


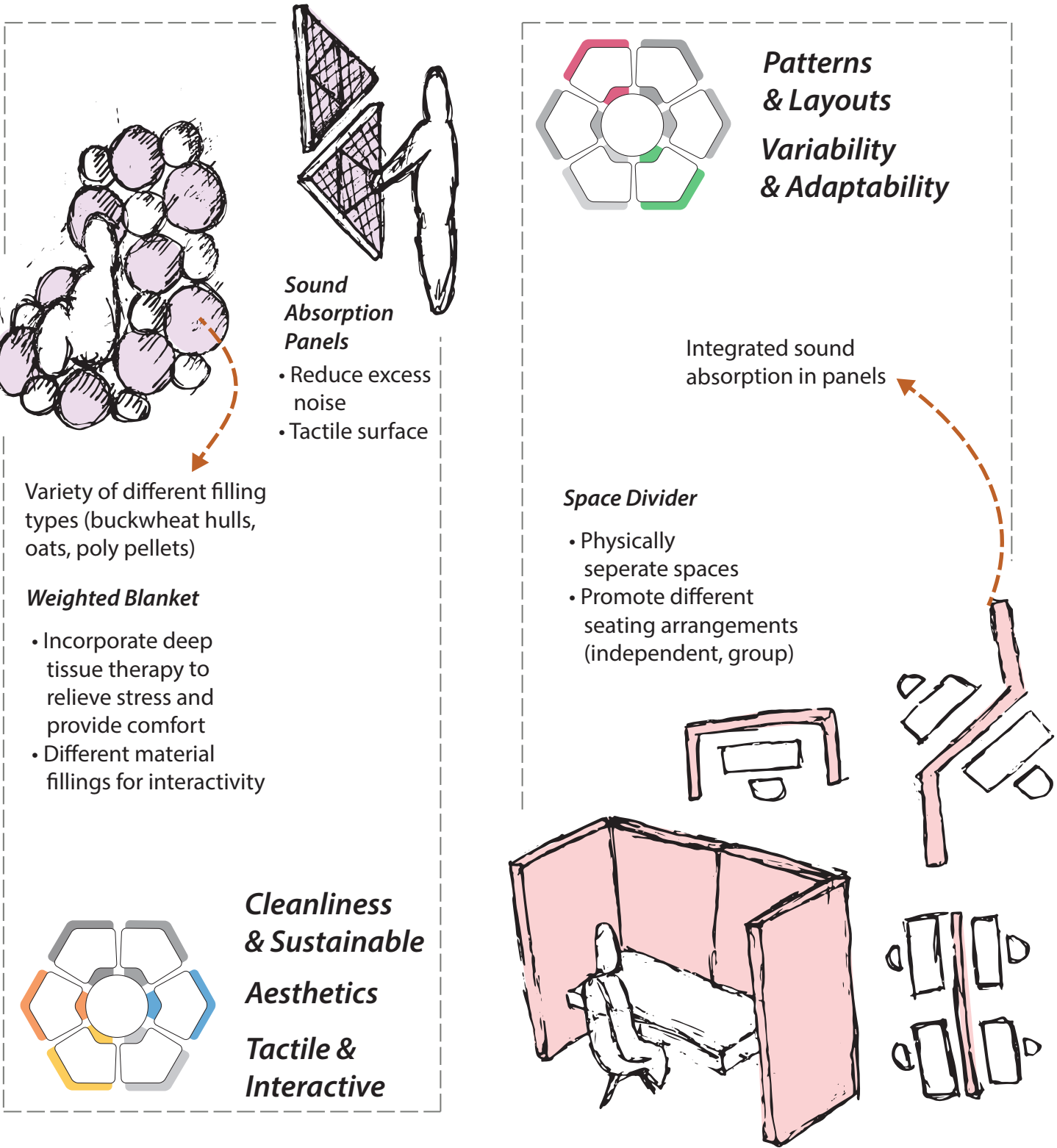
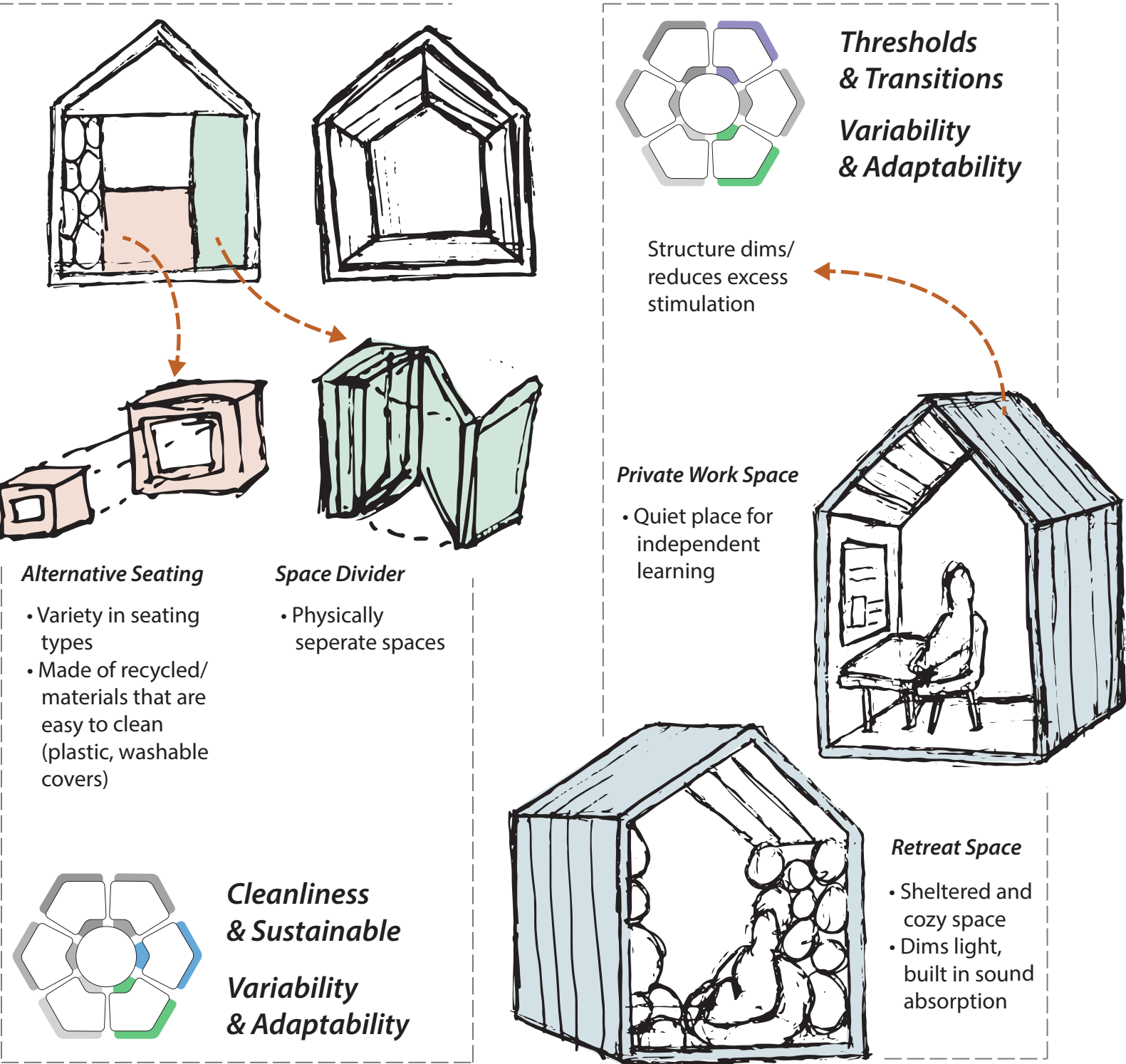
Fig. 8.4 Images of HKS Sensory Hub

Based on the different approaches architects and designers have taken towards creating a sensory inclusive environment, I chose to further explore the idea of creating a kit of parts. A kit of parts is a collection of components that can be assembled and used in a variety of different ways. The reason I have chosen this design approach as a possible strategy towards tackling current classroom conditions is because it provides flexibility and diversity without physically impacting the structure of the room. In addition, a kit of parts can be funded through SEA Claims and help enhance learning environments by promoting personalized spaces. The following pages feature two different design proposals I developed for the kit of parts. The two kits (HOUSE and BUILD IT) are made of elements and objects that were inspired from the design discussions and sensory therapy techniques practiced by individuals on the spectrum. The kits are designed to be universal, mobile and accommodating to the diverse needs of any student in the classroom.

47 Nanda, Upali. "Sensory Well-being for Adolescents with Developmental Disabilities: Creating (and Testing) a Sensory Well-being Hub | HKS Architects."
48 Nanda. "Sensory Well-being for Adolescents with Developmental Disabilities"
49 Nanda. "Sensory Well-being for Adolescents with Developmental Disabilities"
50 Nanda. "Sensory Well-being for Adolescents with Developmental Disabilities"

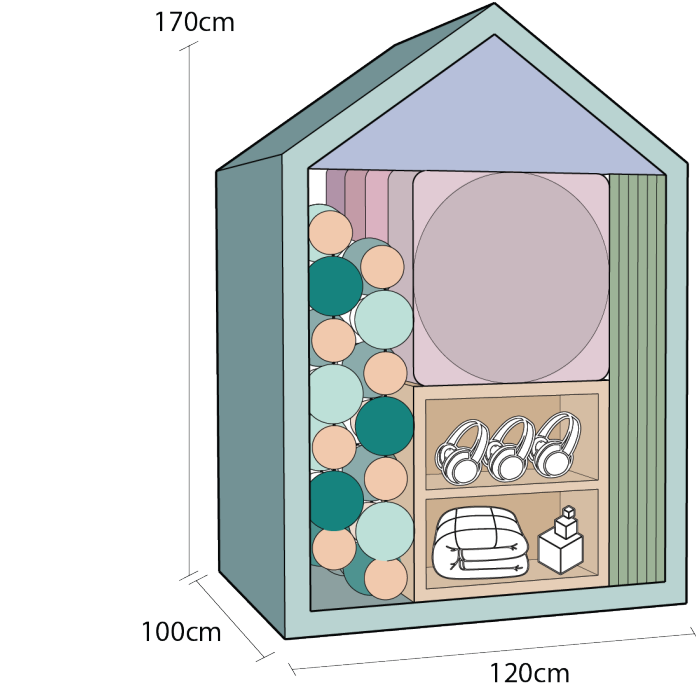
8.2 | KIT 1: HOUSE

Fig. 8.5 Parti Diagrams for Kit 1: HOUSE



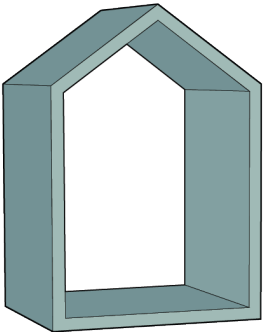
KIT 1: HOUSE

Fig. 8.6 Elements and application of Kit 1: HOUSE



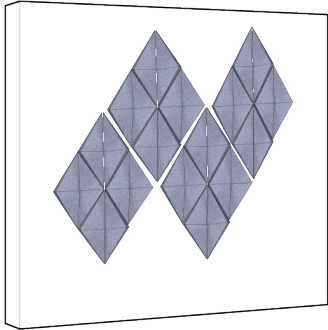
Made of 29 unique parts, **HOUSE** is able to transform the classroom into a series of microclimates that are accessible for all students. The kit features soundproofing panels, alternative seating strategies and sensory reduction elements that allow students to personalize their environments. Components of the kit are made of sustainable materials while the shell itself can be used as a private retreat space or quiet learning area. If the kit is no longer needed in one classroom it can be easily packed up and brought to another classroom, making it versatile and flexible to accommodate different learning spaces.

Retreat Space/ Private Work Space
w:120cm, d:100cm, h:170cm
x1



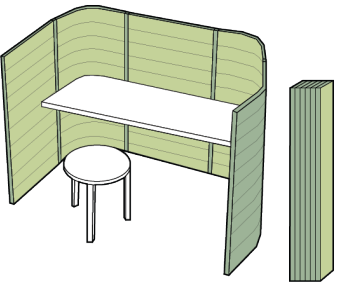
- Recycled plastics**
- Durable
 - Easy to Clean

Attachable Sound Absorption Panels
w:20cm, d:8cm, h:50cm
x16



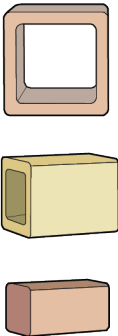
- Melamine Foam Sound Absorber**
- High Performance
 - Fiber Free
 - Class A Fire Retardant

Adjustable Sound Absorption Dividers
w:50cm, d:6cm, h:120cm
x2



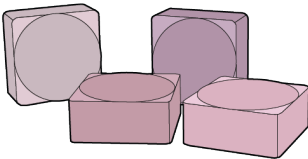
- Vitra Workbays**
- Versatile and Lightweight
 - Sound Absorption

Alternative Seating Heights
w:60/45/30cm, d:60cm, h:60/45/30cm
x1



- Recycled plastics**
- Durable
 - Easy to Clean

Alternative Density Seating
w:60cm, d:25cm, h:60cm
x4



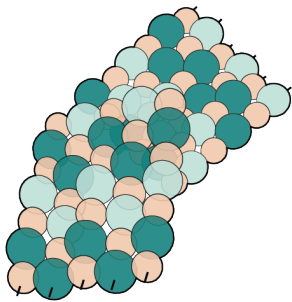
- Vinyl/ Washable Covers**
- Easy to Whipe/Clean
 - Variety of Options (Buckwheat Hulls, Oat Seeds, Poly Pellets, Feathers)

All Purpose Cabinet
w:60cm, d:40cm, h:60cm
x1

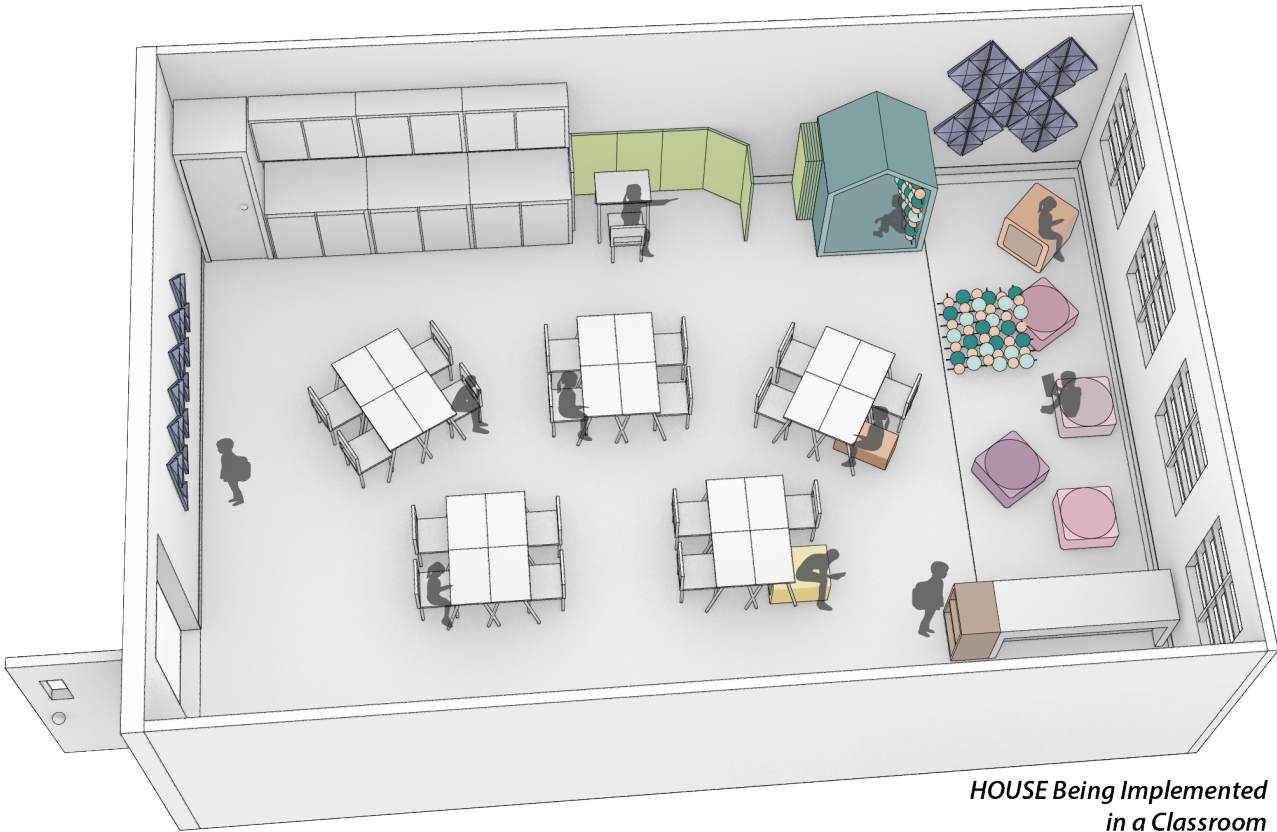


- Bamboo**
- Easy to Clean
 - Provides Extra Storage
 - Equipment used during OT practices/ assessments

Weighted/Adjustable Ball Lounger
w:100cm, h:120cm, 15lbs
x2



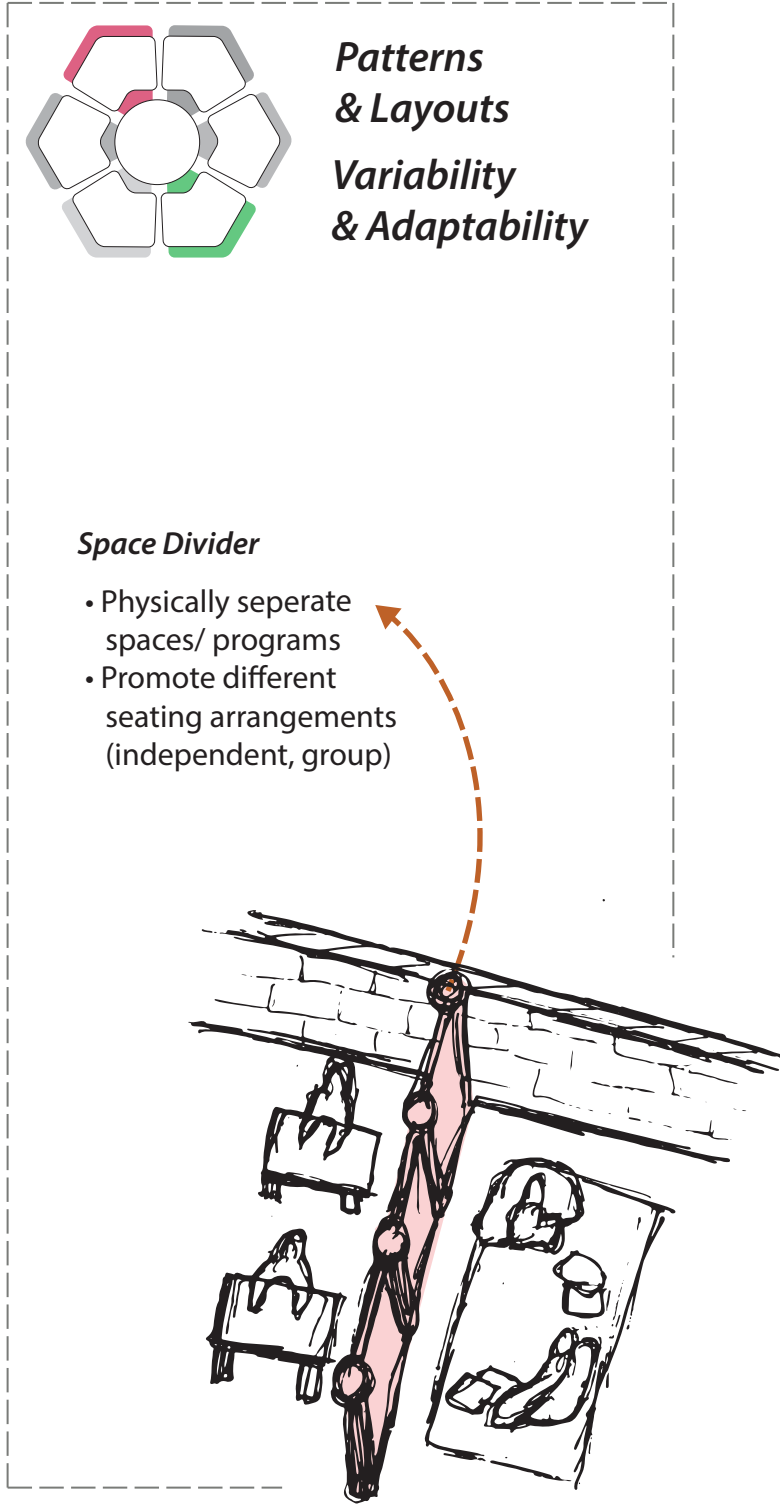
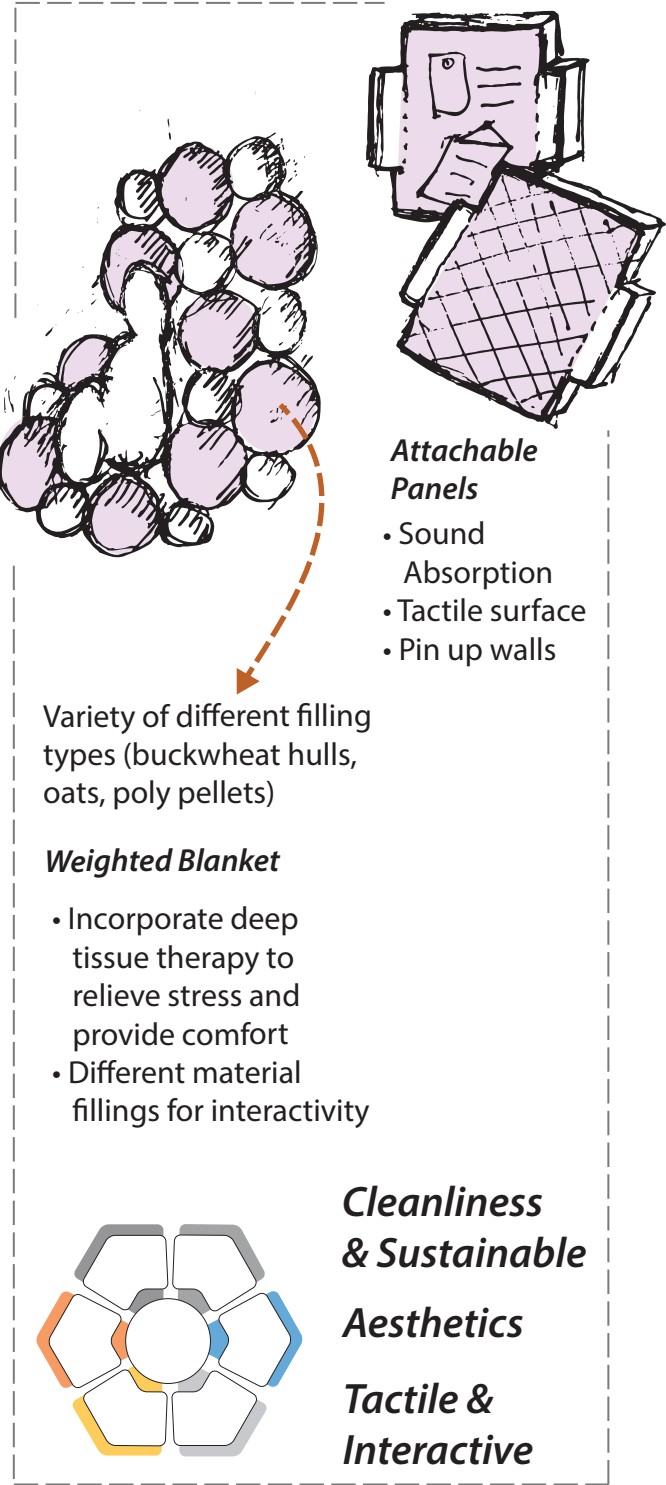
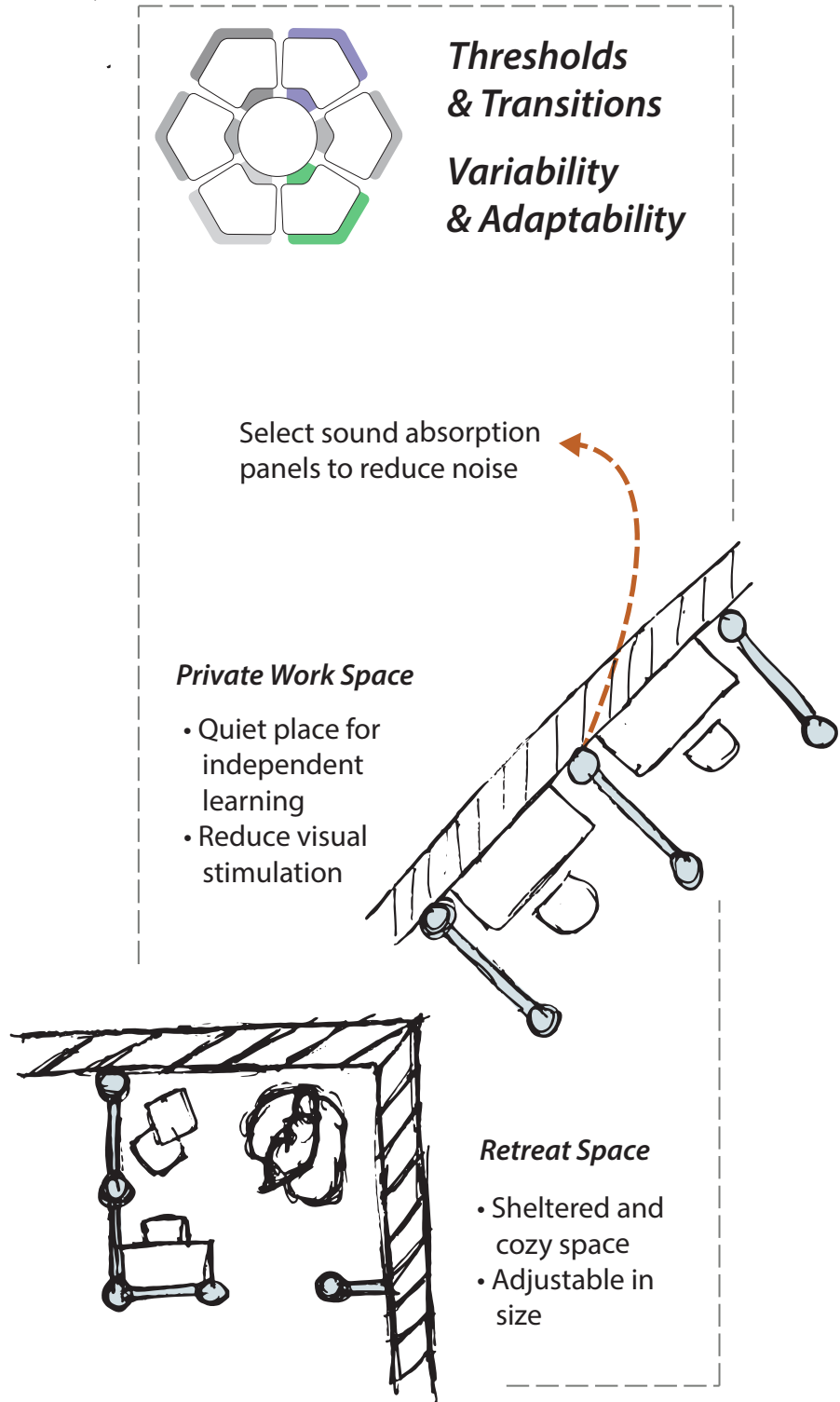
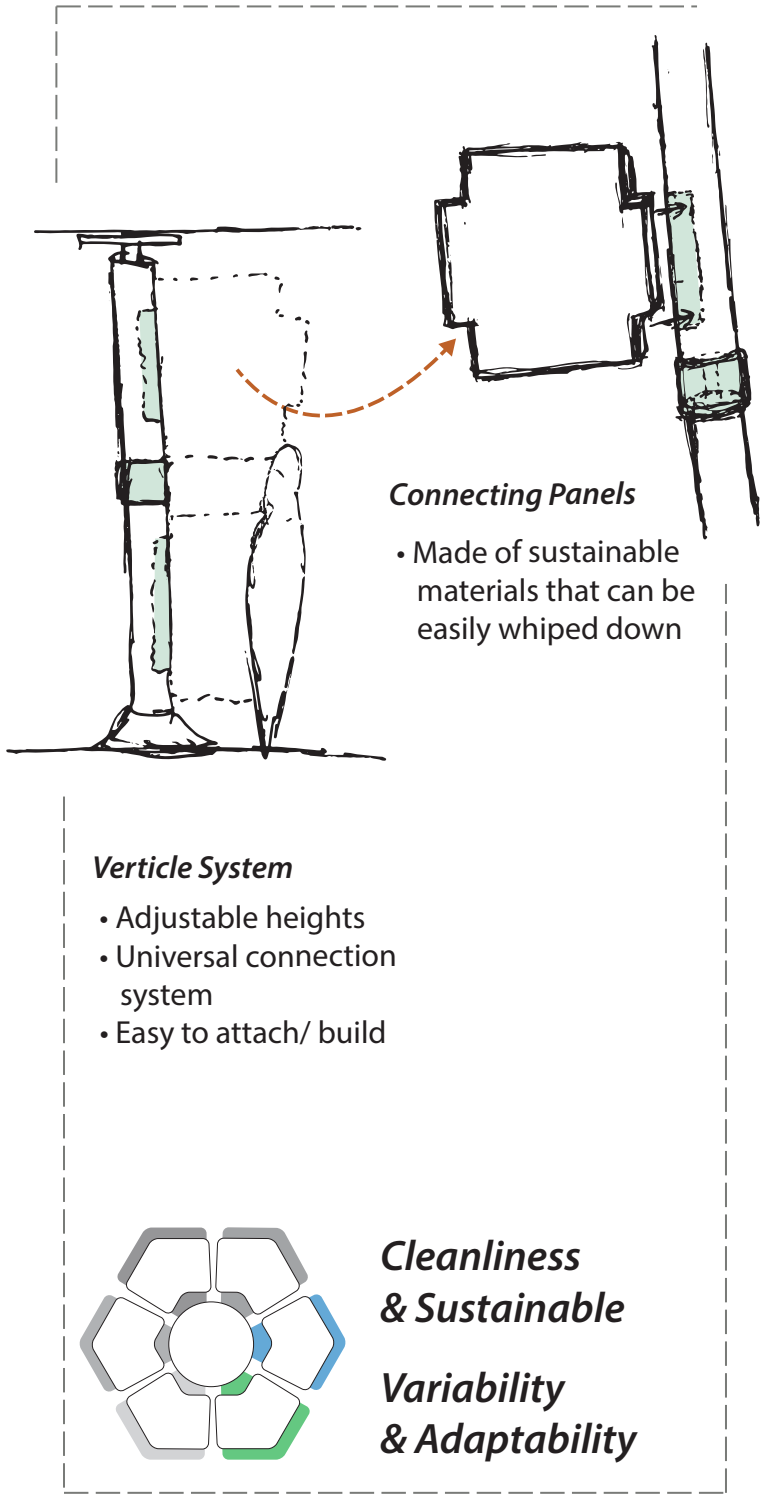
- Vinyl Covers**
- Easy to Whipe
 - Variety of Options (Buckwheat Hulls, Oat Seeds, Poly Pellets)



HOUSE Being Implemented in a Classroom

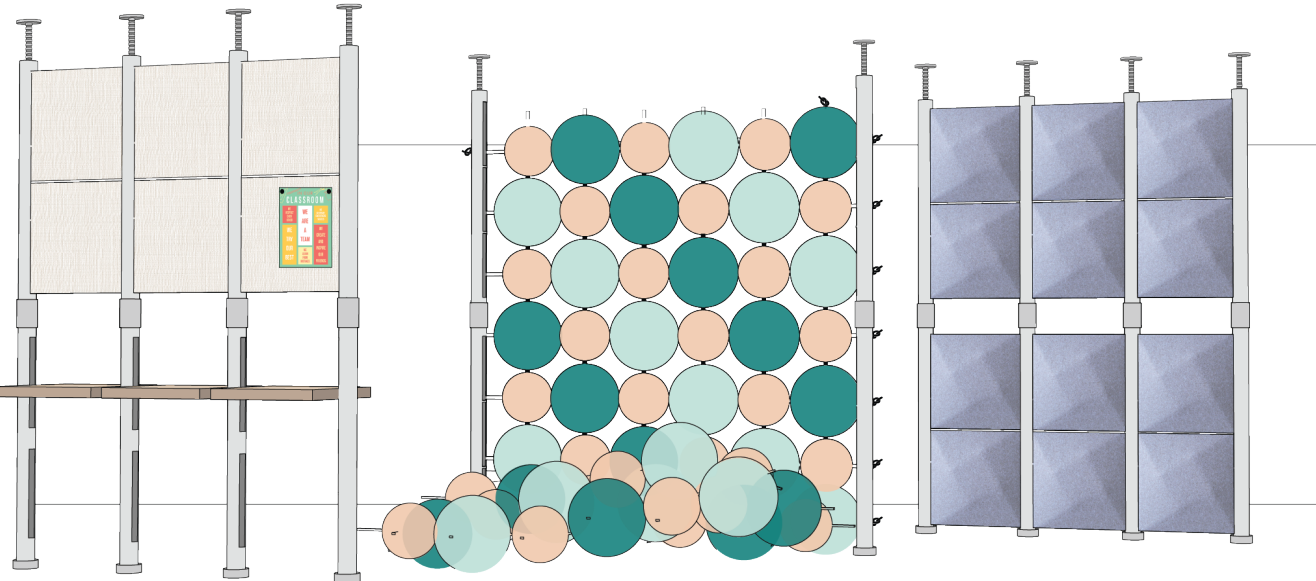
8.3 | KIT 2: BUILD IT

Fig. 8.7 Parti Diagrams for Kit 2: BUILD IT

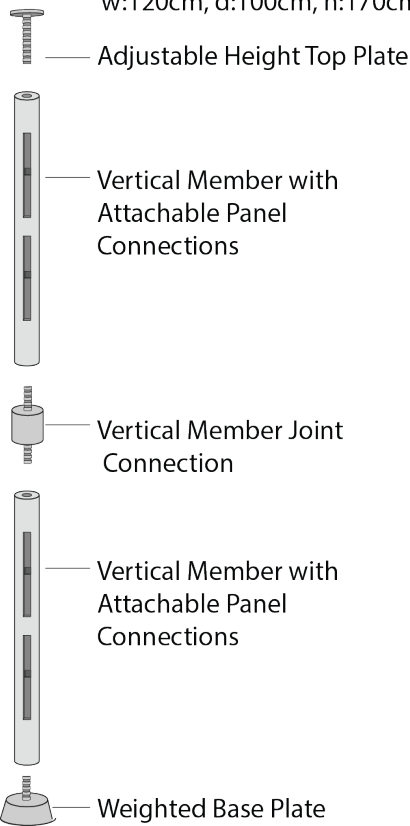


KIT 2: BUILD IT

Fig. 8.8 Elements and application of Kit 1: BUILD IT

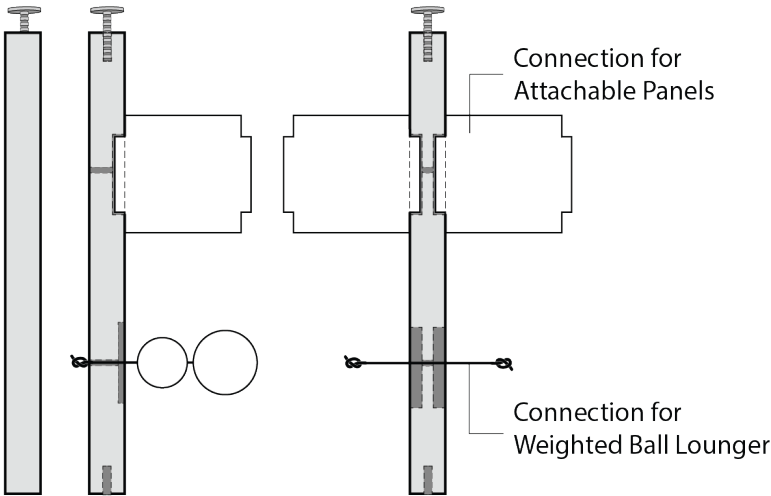


Vertical System Diagram
w:120cm, d:100cm, h:170cm

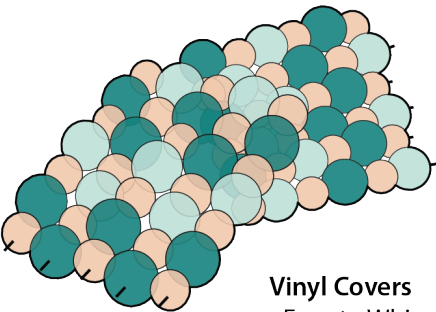


BUILD IT, is a system that creates temporary walls and rooms in a classroom, allowing teachers to develop physical environments and programming spaces for their students. The vertical members feature adjustable height plates that allow them to be attached and held securely in place by the floor and ceiling. The system also includes a number of attachable panels such as soundproofing panels, pin up boards and sensory boards that can be selected and used for the walls. The kit is able to create temporary physical spaces such as retreat areas or independent learning areas while having the flexibility to modify the classroom throughout the year.

Vertical Members
w:10cm, h:150cm

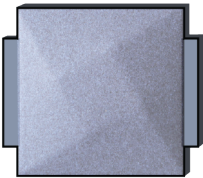


Weighted/Adjustable Ball Lounger
w:100cm, h:120cm, 15lbs
x1

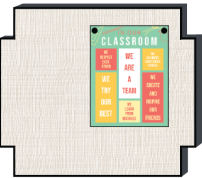


Vinyl Covers
• Easy to Whipe
• Variety of Options
(Buckwheat Hulls, Oat Seeds, Poly Pellets)

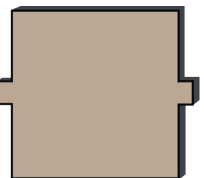
Attachable Panels
w:120cm, d:100cm, h:170cm



Sound Absorption



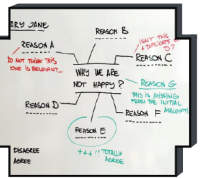
Pin Up Board



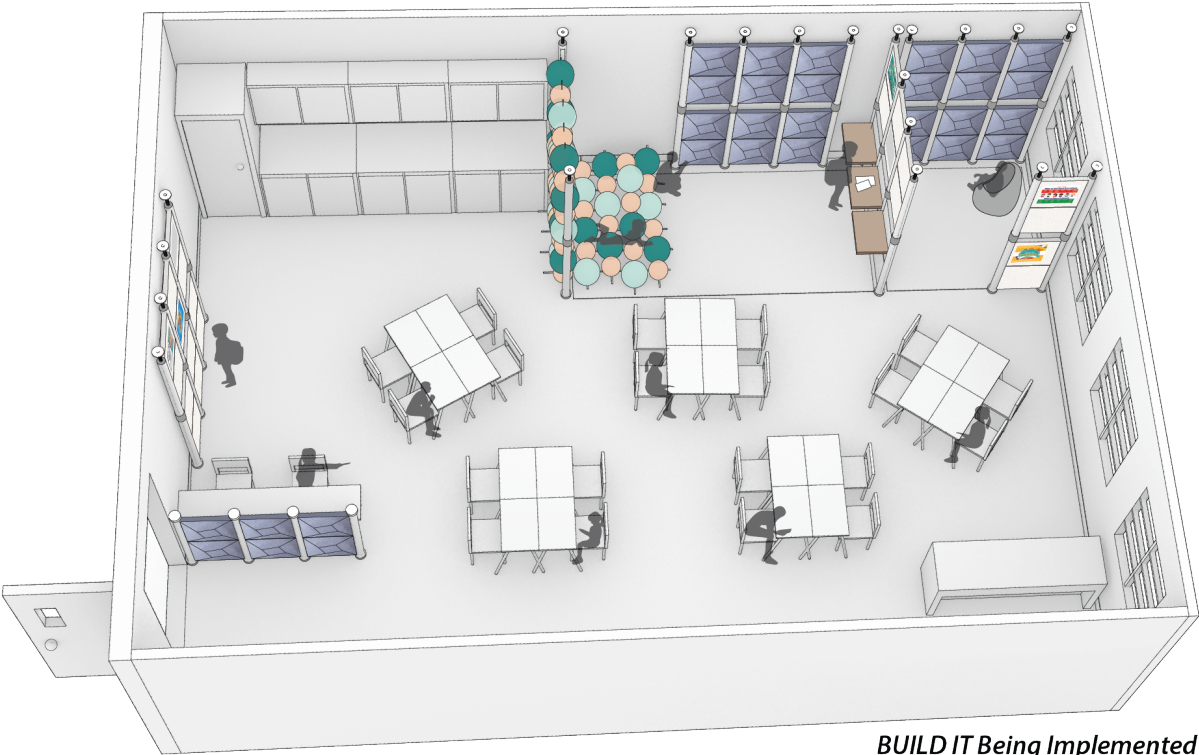
Standing Desk



Sensory Board

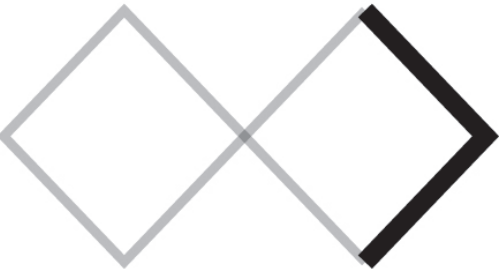
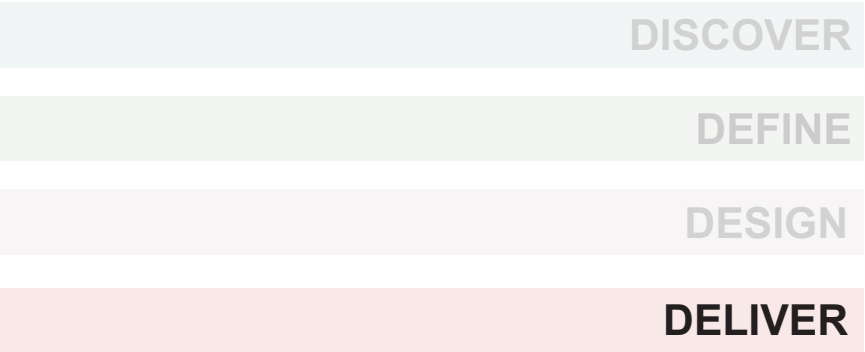


Whiteboard



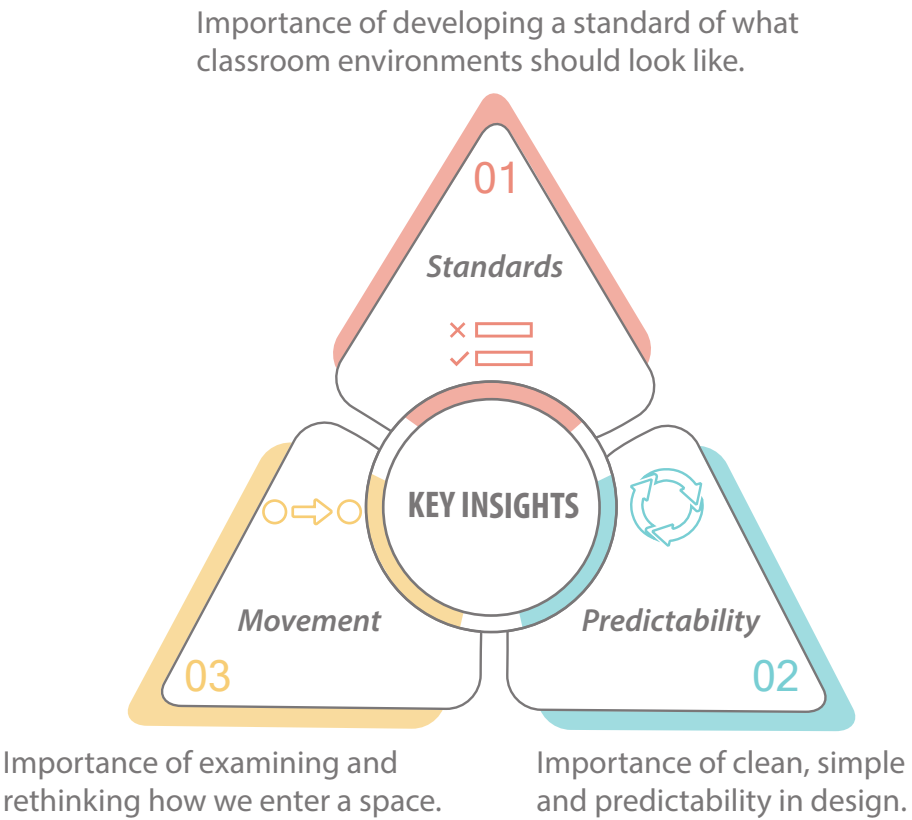
BUILD IT Being Implemented
in a Classroom

9.0 | DESIGN FEEDBACK



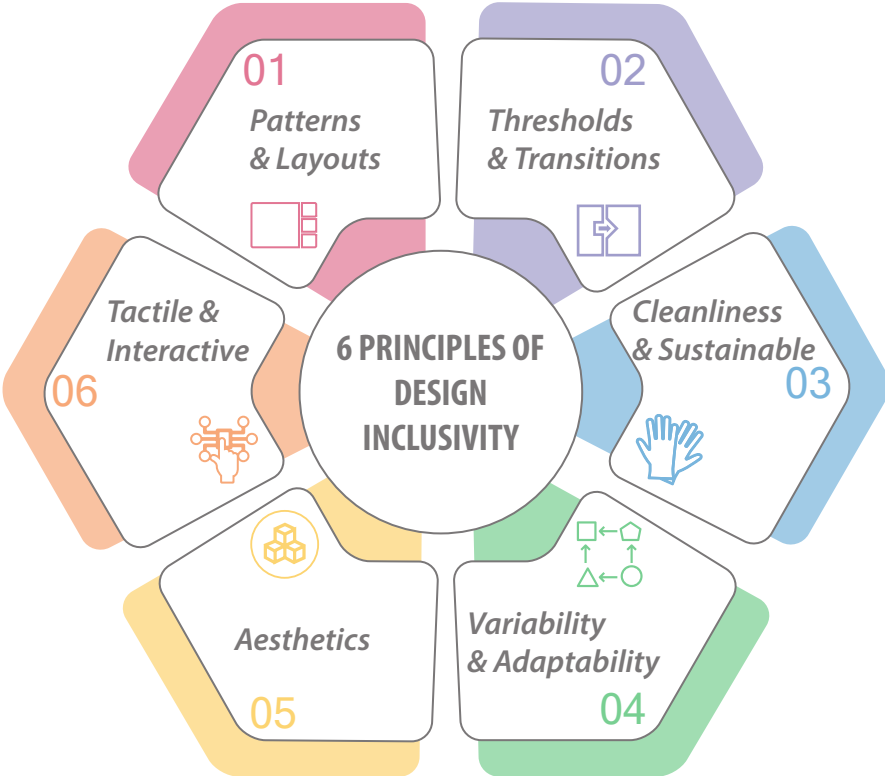
After developing both long term and short term strategies, I was curious to know what experts thought of my ideas. I again met with subject matter professionals for a round of informal discussions regarding the key insights, 6 Principles of Design Inclusivity and design approaches. The conversations took place virtually through Zoom and together we went through my design proposed concepts while having discussions on desirability, feasibility and if something needed to be changed. After the discussions, I re-examined the design proposals and made note of key insights I learned during the conversations. The following pages feature some of the most recurring themes and topics discussed during the design discourse.

Feedback on the Key Insights of Sensory Inclusive Environments



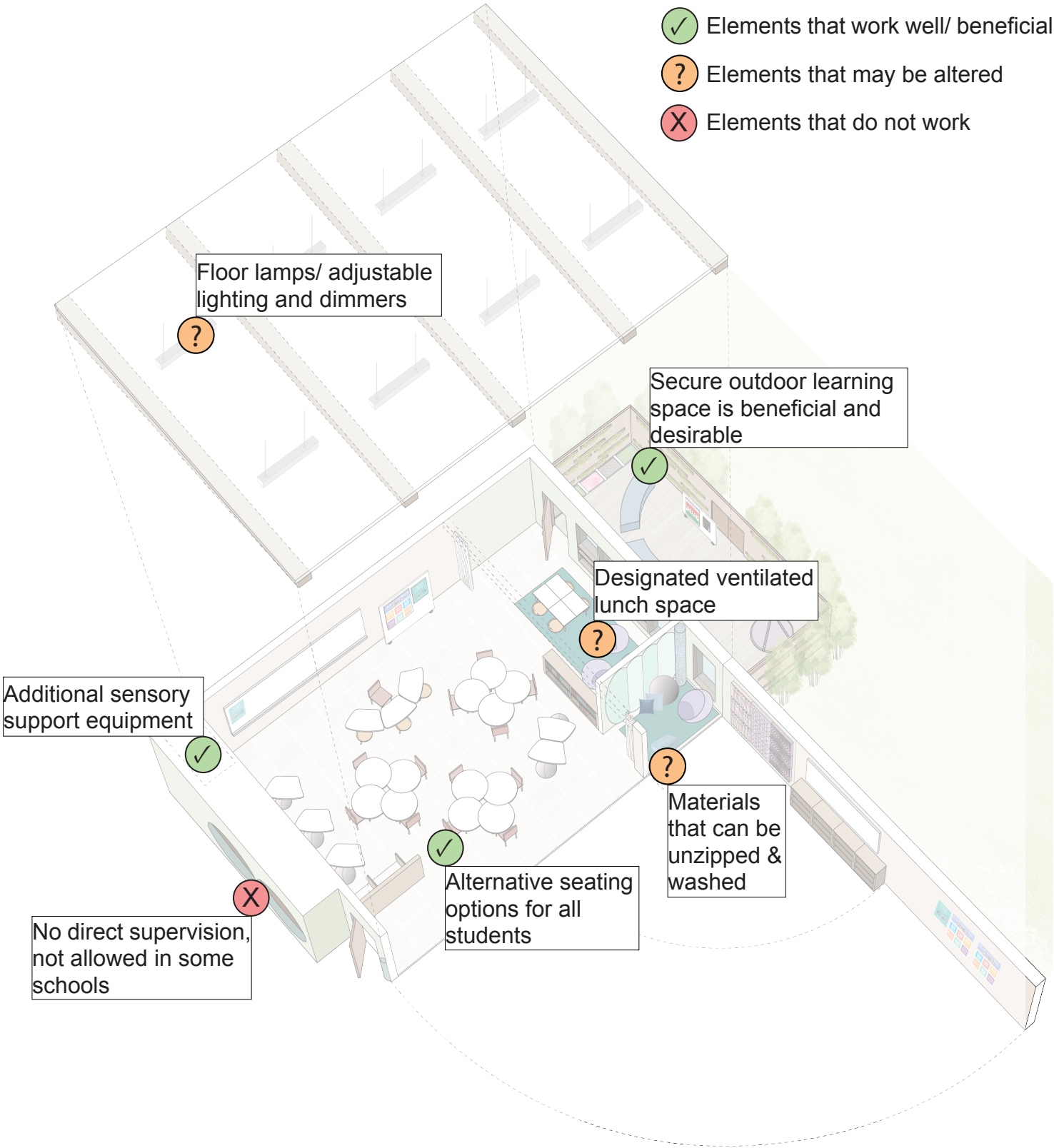
- ✓ Standards are often used during occupational therapy assessments and can help reduce anxiety inducing unpredictability produced from the external environment.
- ✓ Key insights are clear and straight forward, highlighting some of the significant sensory and environmental design areas of focus.

Feedback on The 6 Principles of Design Inclusivity

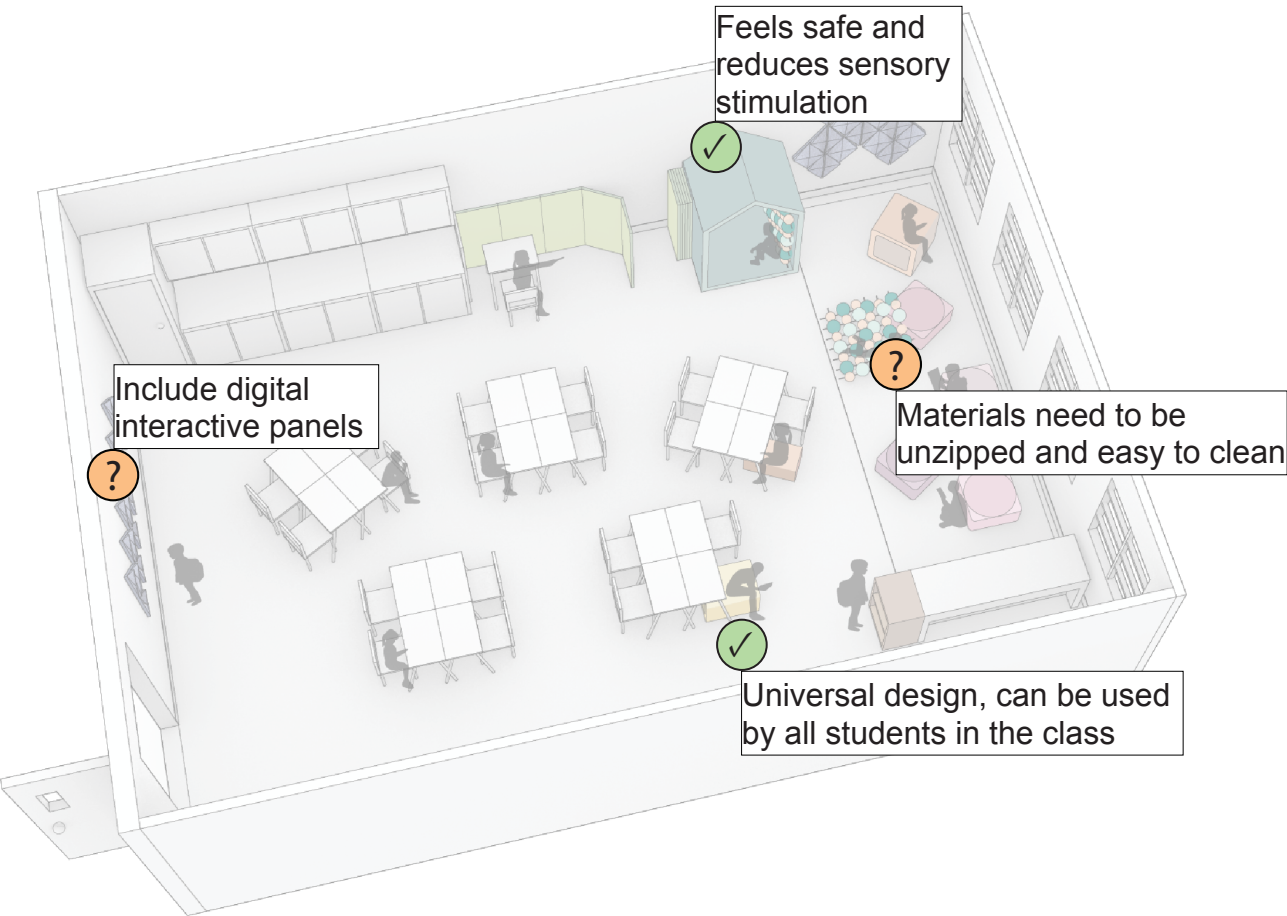


- ✓ Principles are well thought out and universal to both children and adults.
- ✓ Principles merge design and sensory practices to help to reduce limitations for occupational therapist and teachers as well as provide diverse options to support their practices in helping students cope with sensory stimulation and emotions.
- ✓ Principles help normalize the conversation of sensory needs and anxiety which go hand in hand and can be experienced by any individual regardless if they are on the spectrum or not.

Feedback on the Envisioned Classroom Design

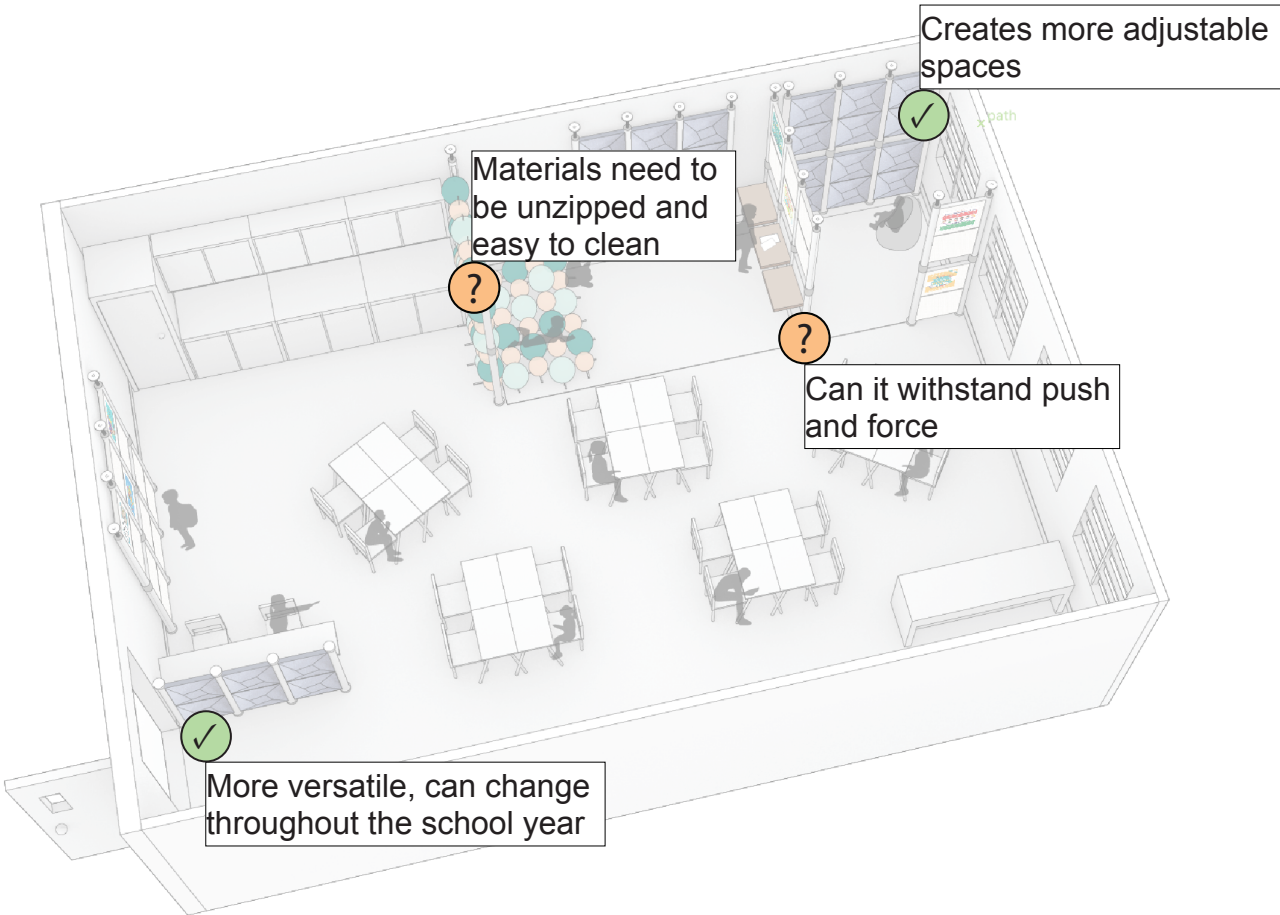


Feedback on the Kit of Parts: HOUSE



- ✔ Significance in the image of a house, a metaphor for safety, protection and retreat
- ✔ Seen as most feasible and least disruptive
- ? Can be used for younger students from JK to grade 4
- ? Can be a SEA Claim that is assigned/move with the student

Feedback on the Kit of Parts: BUILD IT



- ✔ Provides flexibility that allows each classroom to have specialized programming spaces
- ✗ Health and safety does not allow objects to be attached to the structure of some older buildings
- ? Can be used for older students and classes
- ? Can be invested by the principal and used in any classroom or space

Feedback on the Storyboard: Mrs. Patel (Teacher)







Feedback on the Storyboard: Jack (Student)







9.1 | THEMES AND RECURRING TOPICS

After investigating feedback I began to reflect on the key topics and themes that I learned during the conversations. The list below are a series of recurring ideologies that were brought up during the design discussions. In addition, I had the chance to revisit the envisioned classroom design and make a few adjustments based on what I learned as well as explore the opportunity of developing a playground concept (Fig. 9.1). The playground sketch on the following page is one of many concepts that can be created when incorporating sensory inclusive strategies and principles in design. The playground sketch is not a finalized proposal as the intentions of this thesis are focused on the process of design innovation and the classroom environment itself. It simply acts as an image to remind readers of the unique and endless indoor and outdoor possibilities that can be created when designing with inclusivity in mind.

1. Predictability in design can reduce anxiety by creating a balance between sensory needs and emotional response

- Can be achieved through materiality, spatial arrangements and practicality in design

2. Providing pre-existing options in the environment can normalize the need for sensory responsive design and reduce limitations during in person occupational therapy

- Can be achieved through light dimmers, alternative seating and elements that allow spaces to be personalized for each individual

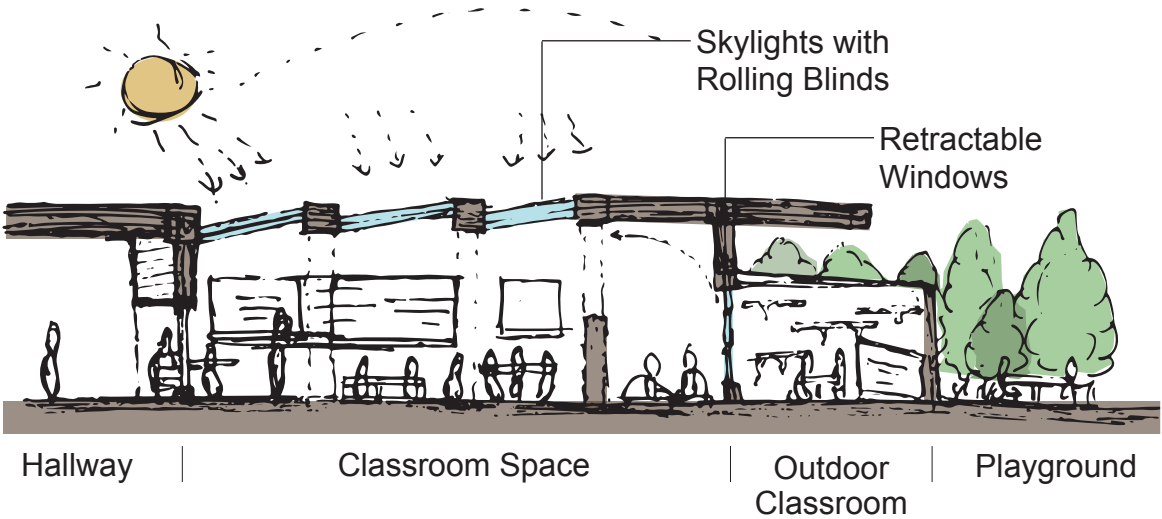
3. The current pandemic has reduced movement and sensory reduction strategies in classrooms, altering learning environments to resemble classrooms of the 70's

- To push forward we need to think about how spaces can promote movement in a safe manner such as incorporating outdoor learning environments and how to maintain the integrity of sustainable materials

9.2 | DESIGN UPDATES

Fig. 9.1 Concept sketches of updated classroom design and outdoor playground area

Updated Classroom Section



Playground Design

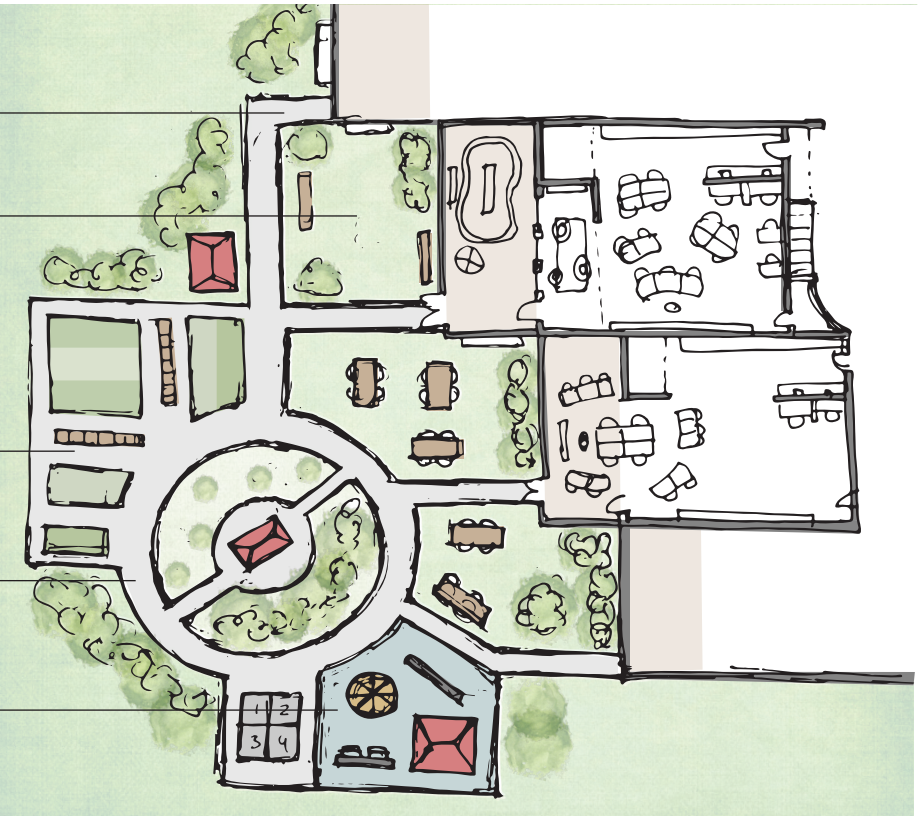
Staggered Entrance
(Reduces crowds)

Quiet Seating Space
(Features independent seating)

School Garden
(Soothing and calming)

Leisure Walking Path
(Soothing, calming and continuous)

Playground Structure
(Located further south in area of high stimulation)



10.0 | FINAL THOUGHTS & OVERVIEW



Throughout my graduate studies I have taken an approach in understanding the importance of process in design. As architects we often overlook the impact that the design process can have on the quality of our projects and instead spend greater attention and time on the final product. We tend to gage our understanding of the users' needs simply through our assumptions of what architecture should look like based on precedents and internet research. However, how can we assume that we are designing ideal environments without evaluating user input and our prescribed design solutions. The Double Diamond challenges the traditional method of design and focuses on the significance of process work as opposed to the final product. The importance of this method is that it allows us to spend more time understanding the significance of what we are designing. Process work encourages collaboration and the opportunity for architects to design with the users of the space. In return it can enhance the quality of our design by developing innovative and practical solutions that tackle common problems. Through my own experience of using the Double Diamond I was able to develop a greater understanding as to why seclusion spaces exist and the desire for them. I learned that it is not as simple as removing these spaces and providing a better classroom environment but thinking about integration and therapeutic functions in design. By working with subject matter professionals I learned more about therapy strategies that support complex behaviours and how they can be integrated into the environment. Taking the necessary time to understand the problem and process of

design not only allowed me to develop solutions that respond to classroom conditions but also addressed ways to improve the field of design.

Throughout my thesis I have discussed the importance of design that embraces basic human senses, as our environment has a direct impact on our emotions and perception of space. We have learned how cognitive impairments such as ASD can impact one's sensory processing abilities and lead to feelings of overstimulation and uncertainty. The repercussions of a lack of sensory inclusive environment are evident with the numerous reports of isolation abuse among students with neurosensory conditions. By approaching this problem through the lens of architecture we can work towards bringing awareness to the importance of designing inclusive spaces. The 6 Principles of Design Inclusivity have been created as a response and opportunity to apply design strategies to benefit a variety of users, even beyond those on the autism spectrum. Environments that incorporate therapeutic design strategies can build confidence and independence for its users. Designing with the core values of inclusivity can also help foster social acceptance and self soothing techniques as students become adults. The impacts of sensory inclusive design are not exclusive to those with neurocognitive conditions but are universal and have a positive and lasting effect. It is through the influence of our built spaces that we can begin to recognize and promote social diversity and the empowerment of all users.

Looking forward I imagine my work and research expanding in a variety of directions beyond simply architects designing public environments. The format of my thesis allows for certain chapters to be tailored towards addressing different user groups. Chapters 1, 4, 6, and 7 cover the preconceived “norm” in architecture and principles of design inclusivity which can be applied to studio courses and encourage students in the field of design to think about the different ways we can impact users. Chapters 2, 3, 5 and 8 references the current reality of elementary schools and provides possible solutions that can be referenced by schools, teachers and occupational therapists. The intentions of my work are not only to encourage designers but to provide tools for everyday users to create more inclusive environments and re-think the social perception of the “norm.” Architecture is an extension of societal values and principles and with this in mind it is important that we work to not only create physical spaces for inclusivity but build a society that celebrates diversity and acceptance of different human experiences.

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APPENDIX (SENSORY DESIGN DISCUSSION)

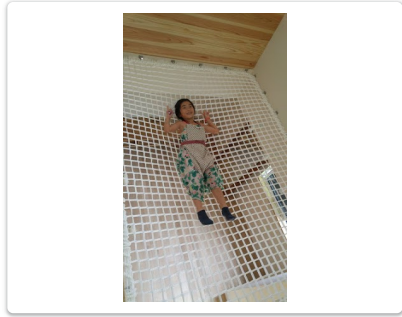


☐ Wood

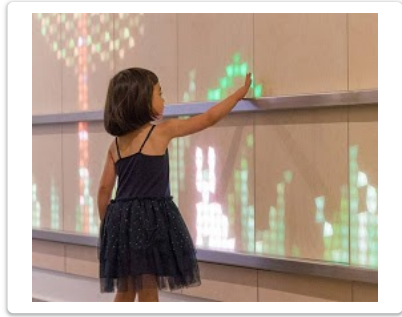


☐ Foam

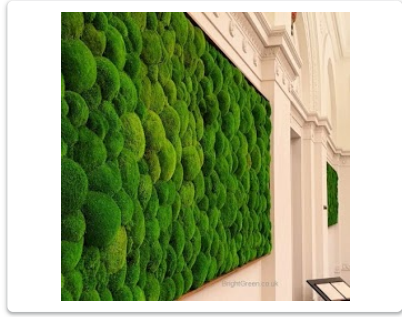
In this section we had a conversation regarding different types of materials and which were considered to be more user friendly and beneficial for a classroom. I learned that in school environments the most important determining factor was the ability for materials to be effectively cleaned. That being said, materials such as foam, digital screens and tensile fabrics that could be wiped down was considered to be better.



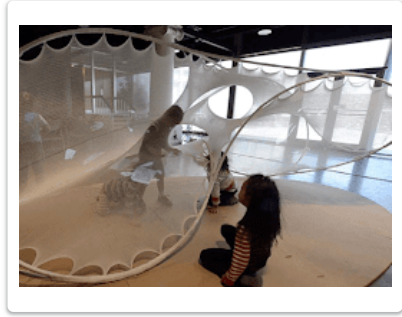
☐ Mesh



☐ Digital Screen

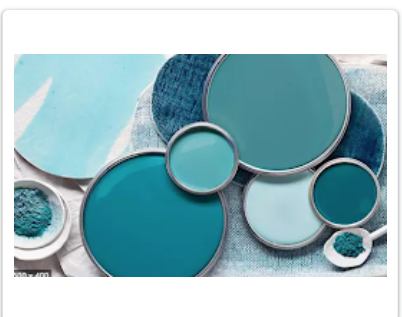


☐ Green Wall

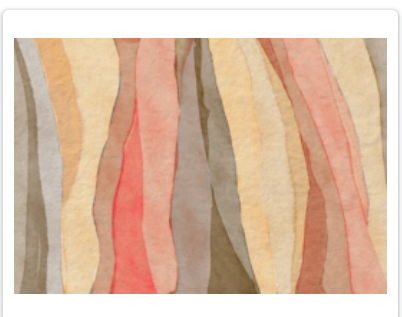


☐ Tensile

In this section we had a conversation regarding colours and how they can influence emotions. I learned that a lot of classrooms are too visually overstimulating and that softer toned colours such as pastels and earth tones can be more soothing and still make the environment an interesting place to be.



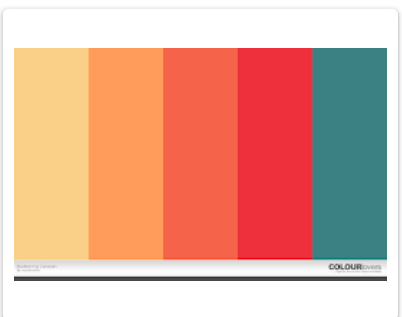
☐ Blues



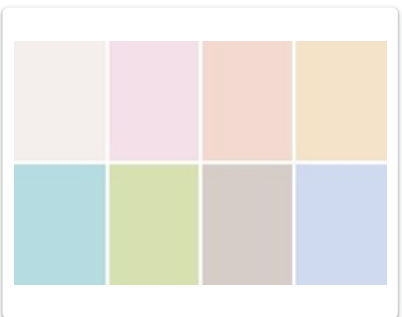
☐ Earthtones



☐ Dark Colours



☐ Bold Tones



☐ Pastels



☐ Succulent Hues



☐ Buckwheat Hulls



☐ Oat Seeds

In this section we talked about different filling types for furniture. I learned that some materials such as wool can be too rough and irritating for individuals with touch sensitivity. I have found that both buckwheat hulls and poly pellets were considered interesting and favourable options as they did not give off a strong odor.



☐ Polyester



☐ Poly Pellets



☐ Sand



☐ Wool

In this section we talked about geometry and textures. We discussed how some patterns can be considered too visually overstimulating and that certain designs such as waves can be more soothing and relaxing.



☐ Waves



☐ Caves

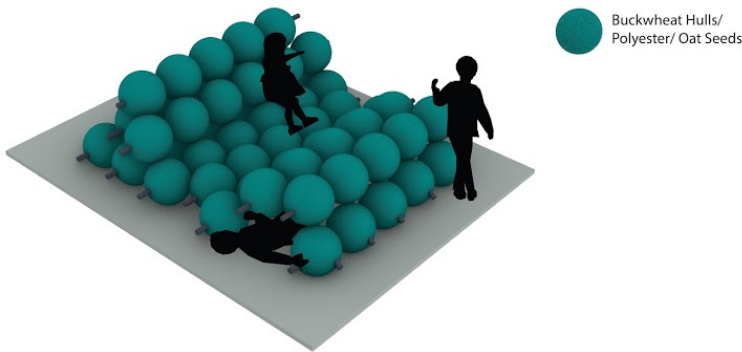


☐ Triangles

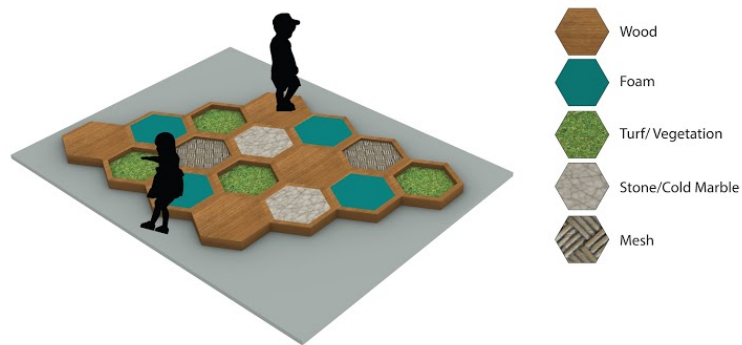


☐ Terrains

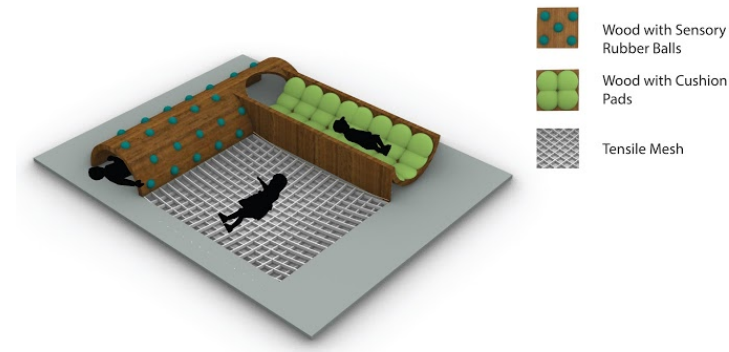
Option 1: This system is made of a series of round cushions that are attached together to form a large weighted blanket. The round cushions can be made from various materials such as polyester/feathers, buckwheat hulls and oat seeds. The blanket can be easily adjusted to form seating spaces, covered spaces, nests, etc, and allows children to be in control and modify the floor to fit their needs. The blanket can also act as a crash pad and help release built up energy.



Option 2: This system is a walking path that features various textures and materials. It helps promote balance, coordination and body awareness. The different materials provide various sensory input whether that be feeling the bounce of the mesh tiles or the squishiness of the earth beneath your feet.



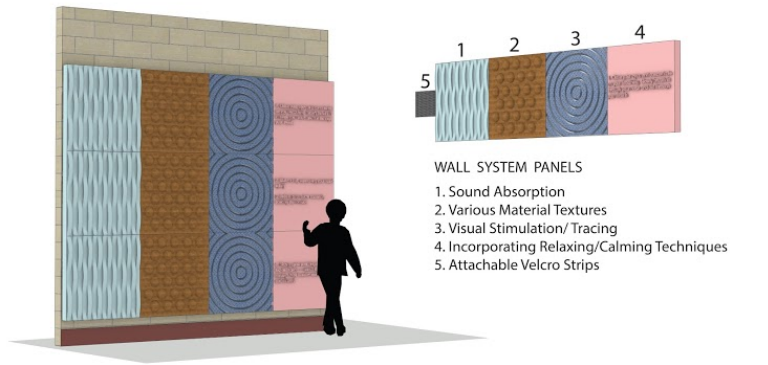
Option 3: This system is inspired by a children's treehouse. The tree trunks are tunnels that allow children to safely retreat into a private space and provide deep squeeze therapy. The mesh floor allows the child to feel cradled and can provide a rocking motion that helps calm emotions.



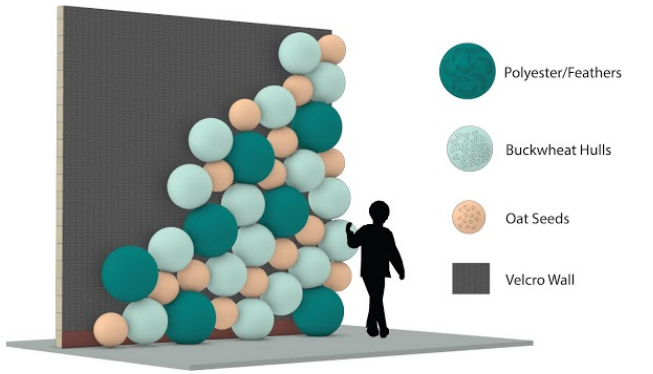
In this section I shared a few systematic floor design schemes I developed. Each option features elements derived from Occupational Therapy practices. After discussing the different designs strategies, I learned that options 1 and 2 were considered most engaging and do-able in a classroom environment.

In this section I shared a few systematic wall design schemes I developed. Each option features elements derived from Occupational Therapy practices. After discussing the different strategies, I learned that all the options were considered engaging and interesting, however it was important to think of how certain wall systems could be effectively and easily cleaned.

Option 1: This system is made of 2'x2' panels that can be attached to the existing wall using velcro strips (similar in the way gym mats are attached to walls). The panels come in a variety of designs that are carved into material blocks using Computer numerical control (CNC). Designs are visually stimulating and can encourage students to trace their fingers along patterns and textures similar to a sensory wall. The panels can also incorporate sound absorption techniques in order to minimize excess noise from a classroom.



Option 2: This system is made of a series of round cushions and a large velcro panel that can be attached to the existing wall. The round cushions are made from various materials (Polyester/feathers, Buckwheat Hulls and Oat Seeds), which allows the user to arrange and attach/detach objects to their liking. The peach cushions filled with oat seeds provides more weight in comparison to the others and can be used for deep tissue pressure therapy. The buckwheat hull cushions provide a soft rustle sound that has shown to be soothing in helping individuals sleep and feel relaxed. The wall can also be used as a way for children to safely release anger by throwing the cushions at the wall.



Option 3: This system is made of a tensile fabric stretched onto the existing wall in a way that creates a series of hills and troughs. A projector is used to project a series of interactable images onto the tensile fabric which allows children an opportunity to touch and play with the digital stimulation. The tensile fabric is soft and provides touch sensory feedback through its elasticity.

