Places of Curiosity

How the design of learning places support noticing, wondering and exploration

Daniel Wilson
Designing Learning Places Lab, Project Zero
Harvard Graduate School of Education

Children and caregivers explore exhibits with flashlights at the Carnegie Museum of Natural History in Pittsburgh. (Photo credit: USA Today)

Our species has thrived largely due to our ability to wonder and explore the unknown (Wilson, 2013). Over generations, we have sought to understand the unclear and find order in the unexplained, whether it involves the sun and moon's celestial paths or experimenting with tools for food production and hunting. Curiosity and exploration have been pivotal to our development.

Curiosity is about making sense of the unexpected, novel, or ambiguous. Berlyne's (1954) pioneering work described it as the "cognitive itch" that arises when we encounter the unfamiliar and which we resolve through exploration and learning. This itch originates from gaps between our current knowledge and what we desire to know, or between our expectations and experiences (Lowenstein, 1994). Our minds find coherence through curiosity. Surprising objects or events prompt us to make sense of them, leading to investigation and insights. Neuroscience studies indicate that curiosity activates dopamine reward systems, enhancing long-term memory and learning (Gruber et al., 2014). The more disorienting or surprising an experience, the more we grapple to understand it. Consequently, curiosity is crucial for developing intrinsic motivation and adapting to our uncertain and changing world (Deci, 1985; Ryan & Deci, 2000). Without it, there is no impetus to learn or change our thinking or practices, even when it is necessary.

Despite the wide call for schools to foster student curiosity (Battelle for Kids, 2019; Dillion et al., 2019; LEGO Foundation, 2017; Partnership for 21st Century Skills, 2002) , the very design of school often suppresses it. A curriculum focused on facts and answers, predictable schedules, and standardized test scores rarely encourages encounters with novelty and ambiguity (Anderson, 2025). Additionally, the physical design of school reflects a priority of order and predictability over surprise and wonder, from fixed row seating in classrooms to limited sightlines controlling learners' visual attention (Guney & Al, 2012; Tyack, 1995). While schools should offer clear structures and routines, they should not hinder the curiosity that drives our learning and development.

How can the physical design of spaces better support learners' curiosity? How are spaces designed to evoke surprise, wonder, awe, and amazement? How do they encourage noticing, inquiry, and exploration? In what ways do they

reduce feelings of boredom, mindlessness, indifference, and disregard? This paper presents key themes from literature compiled by researchers at the Designing Learning Places (DLP) Lab at Harvard Graduate School of Education's Project Zero. These themes emerged from reviewing over seventy educational, architectural, urban design, and socio-psychological research articles on how spaces support or undermine curiosity. In summary, spaces cultivate curiosity by offering **unexpected, contrasting, and multisensory experiences that capture and focus attention**.

If educators and designers aim to create learning environments, it is essential to consider how spaces, materials, and objects reflect the following qualities:

Unexpected & Contrasting

Spaces, objects, and materials that are **surprising, novel, or unexpected** trigger our curiosity and sensemaking. Gestalt psychology, a key foundation of modern visual design, posits that individuals interpret objects through the simplest and most complete perceptual solution possible (Dresp-Langley, 2015). When elements disrupt expected patterns, they create opportunities for noticing, curiosity, and exploration. For instance, rather than just install the drab metal bars on required in Indian schools, Kabir Vajpeyi and his Building as Learning Aid (BaLA) group created colorful play areas that draw student's curiosity (Schiff, 2014). Places with novel or contrasting elements can encourage behaviors and relationships that support various learning practices.

Students in an India public school explore the surprising designs using mandatory metal bars as toys designed by Kabir Vajpeyi (Schiff, 2014).

Rose DeSiano's Lenticular Histories exhibit attracts pedestrians to pause and explore in New York City's Prospect Park. (Photo credit: Rose DeSiano)

Elements that are **juxtaposed or incongruous** highlight differences and invite investigation. When objects appear out-of-place or surprising, they create a mismatch between expectations and reality (Paletta & Tsotsos, 2008). This incongruity triggers attention and slows movement and perception. Temporary installations in community spaces, such as those observed by Schlickman and Domlesky (2019), can increase usage, lingering, and interactions among community members. Researchers placed temporary mirror installations in urban plazas and noted that people lingered, taking pictures of themselves and the cityscape. Similarly, Nikolopoulou et al. (2016) found that mirrors as environmental interventions hold attention and heighten self-awareness, with the greatest effect occurring when they are unexpected. Artist Rose DeSiano leverages this effect in her urban pop-up mirror and artwork exhibition pictured at left. An urban design study by Hamilton-Baillie and Mitchell (2020)

Figure 1The Pillow, by Dunne and Raby, presents a range of sensorial ambiguity to explore (Gaver et al, 2003).

also found that introducing new landmarks, trees, and local storefronts on extended streets slowed traffic in villages. Intentional incongruity in spaces can encourage individuals to slow down and notice their surroundings with greater awareness.

Ambiguous objects, those with unclear meanings or uses, can also stimulate curiosity and exploration. Ambiguity creates unexpectedness, eliciting awareness and attention, and invites users to speculate on the different meanings and uses of objects (Montambeau, 2018). In their work "The Pillow," design researchers Dunne and Raby explore ambiguous objects. The Pillow is an inflated, plastic brick with a digital display that responds acoustically and visually to electromagnetic waves from nearby digital devices. The disparity between the visuals and sounds requires users to cognitively complete an idea of the object's purpose, ultimately inciting curiosity and engagement (Gaver et al., 2003).

Spaces, objects, and materials that are **unfinished or open-ended** can also spark wonder and inquiry. In a study of children's interactions with recycled and discarded materials, Guerra and Zuccoli (2012) suggest that the ambiguity of unfinished materials positively affects children's sense of wonder and creativity. Such materials allow for the formation of novel connections between information, thoughts, and objects. Studies also indicate that children's interactions with "open-ended objects" (e.g., clay, Froebelian wooden blocks) can spark and sustain curiosity, exploration, and creativity as learners construct new meanings for the objects (Cortés Loyola et al., 2020; Davies et al., 2013). On a larger scale, Jelic et al. (2020) observed that designing non-standardized and open-ended play spaces presents challenges that nurture children's curiosity and sense of wonder as they explore their surroundings. Open-ended objects and spaces that are incongruent with their surroundings afford opportunities for users and learners to lead their learning by exploring personal and intimate creations of meaning and uses. In sum, learning places that support curiosity have spaces and elements that have unexpected and contrastive qualities.

Multi-sensorial

Places that stimulate curiosity provide a diverse **range of sensory experiences**, including touch, taste, smell, sound, and movement. While the built environment tends to privilege the visual, our overall experience of place is a blend of all our senses (Spence, 2020, 2022). For example, upon entering a local library, you might feel and enjoy the smoothness of the floor and the echo of your footsteps. The sunlight though the large

Students at SEK International School Alborán in Spain explore the sounds, tastes, textures, and smells of the greenhouses near their school.

windows feels cozy and you smell the aged pages of the books on the surrounding stacks. Our experience of places is shaped by the variety and intensity of stimuli we encounter. High levels of visual, auditory, tactile, and other stimuli should not overwhelm or distract learners. Conversely, insufficient stimuli can lead to disengagement or boredom. According to optimal arousal theories (Csikszentmihalyi, 1990), the pedagogical goal are realized by creating the right balance: enough stimuli to engage and enhance learners' experiences without being overwhelming (Fisher et al., 2014).

Our curiosity stems from our felt sense of places. **Variations in colors and forms** provide sensorial complexity that prompts pausing and observation (Cox, 2018; Tanner, 2008). **Different materials offer tactile sensations** that ignite curiosity and examination (Davies et al., 2013). Schlickman and Domelesky (2019) note that urban plazas with soft surfaces and sunlight create a warm atmospheres, encouraging slower movement and relaxation. Similarly, Hamilton-Baillie and Mitchell's (2020) study found that drivers tend to slow down when experiencing different physical sensations, such as vibrations or sounds from subtle bumps and pavement variations. Researchers in the Urban Thinkspaces project designed puzzles and movable parts at bus stops and parks to stimulate spatial skills and proprioception, promoting exploration and curiosity (Hassinger-Das et al., 2020). These sensory-based interventions led to increased conversations and interactions between caregivers and children.

Diverse and sensory-rich materials effectively stimulate attention and exploration among young learners (Penfold, 2019). Cox (2018) introduced the term "**sensescape**" to describe the range of stimuli in an environment and their role in supporting various learning tasks. In her work she illustrates that incorporating sensory variation in an environment creates various learning opportunities by sparking curiosity and

Urban Thinkspaces in Phildelphia's Belmont neighborhood create multi-sensorial experiences to explore (Hassigner-Das et al, 2020). Photo credit: Sahar Coston-Hardy.

wonder. Such environments offer ways to experience stimuli at different levels and in various ways. The sounds, textures, and other sensations in a place are not uniform. Research has shown that **sensory regulation**—the ability to change levels of environmental stimuli and one's response to them—plays a positive role in supporting observation and exploration (Barrett et al., 2015). A place might have quieter or louder areas or offer different sounds as one moves through it. Noise-canceling headphones might be provided to help learners focus by filtering out distractions. Lighting might change from brighter to darker, or color chroma might shift to be more vivid or dull. In each case individuals can adjust how and to what level they experience and can adjust the felt stimuli in their environment.

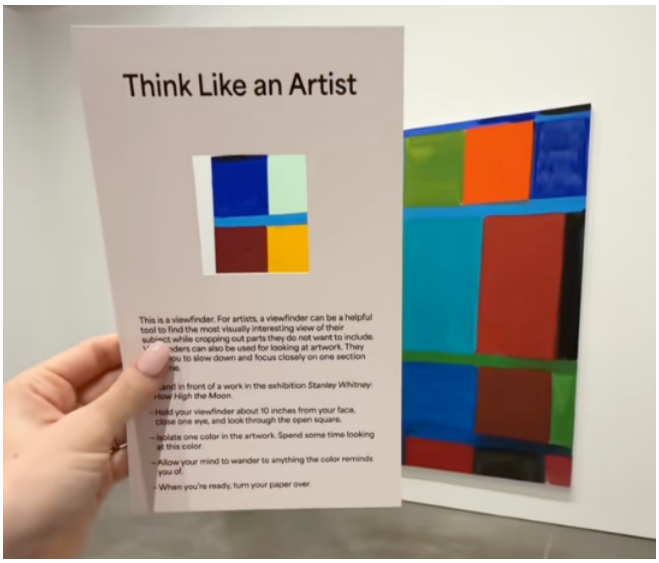
A provocative example of sensory regulation is The Edge office building in Amsterdam, which allows employees to control their personal environments via an app, adjusting the temperature, light levels, and window blinds in workstations (Bakker, 2020). Other studies suggest that classrooms with adjustable lighting, soundscapes, and tactile options improved students' on-task behavior and reduced disruptive behaviors (Barrett et al., 2019). The same study found that students showed higher levels of curiosity-driven engagement and ownership when able to self-regulate sensory input. Other research indicates

that curiosity increases when environments offer controllable sensory complexity—features often found in sensory-friendly and adaptive environments (Kidd & Hayden, 2015; Shield & Dockrell, 2008). The ability to adjust multisensory experiences becomes even more important when designing spaces for learners with special needs (Kinnealey et al., 2012; Patel et al., 2022; Unwin et al., 2022). Taken together, places support curiosity by offering rich, multisensorial experiences that learners can personalize through adjustment.

Attentional & Provocative

Noticing our environment and its components is essential for fostering curiosity. Without noticing, there can be no wonder. Environments that encourage curiosity **nudge our attention** to our surroundings through their design, such as layout and pathways. For instance, museums promote slow-paced exploration with their intentionally non-linear layouts (Tzortzi, 2014). Linear layouts, featuring a main hallway with separate branches, lead to more exhibits being visited but with less time spent exploring. In contrast, less linear designs, with multiple pathways, result in more time spent exploring across exhibits. The shape of pathways also affects our attention. Hamilton-Baillie & Mitchell (2020) found that drivers adjust their speed based on road width and curvature. Narrow or curved roads that obscure the horizon cause slower driving and increased environmental awareness. **Curved pathways** and **non-linear layouts** create attentional affordances by slowing us down, allowing us to notice more.

Visual attention is also influenced by **lighting** and **openings**, pulling our gaze to specific areas (Boyce, 2003; Chun et al., 2011). Adjustable lamps or under-cabinet lighting focus light where needed, enhancing attention to tasks like reading or cooking. In environments with mixed lighting, our eyes are drawn to localized brightnesses that create spotlights for attention (Itti & Koch, 2001). A study at the Carnegie



A viewfinder card for visitors at the Institute for Contemporary Art Museum in Boston MA. (Photo credit: Lucy Corban)

Museum of Natural History found that families exploring dioramas with flashlights in dimly lit settings were more likely to engage in joint attention and educational conversations than in well-lit environments (Povis & Crowley, 2015). Openings can also create surprising perspectives that focus attention and inquiry. In updating the display of a section of the Berlin Wall in New York City's Kowsky Plaza, Aşçi (2024) designed an external shell with multiple openings, allowing people to zoom in on specific parts and explore their meanings. The use of light and forced perspectives enhances our ability to focus, notice, and explore our surroundings.

Tools and **objects** within a space can also aid attention and exploration. Flashlights provided to learners at the Carnegie Museum of Natural History served as attentional tools. Telescopes, loops, binoculars, and magnifying glasses similarly enable us to focus on surprising visual details. A stethoscope can help us notice our quiet breathing or the faint clicks of a combination lock. Such tools amplify or magnify stimuli, allowing us to better notice and investigate them.

Environments can also **explicitly provoke** attention through **visible signs, written prompts,** or **auditory messages.** At the Field Museum in Chicago, researchers found that conversational cards focusing the attention of caregivers and children often led to elaborative discussions about curious objects, nonverbal engagement with exhibits, and associative statements from caregivers between exhibits (Jant et al., 2014). Visitors at Boston's Institute for Contemporary Art can use "viewfinder cards" with prompts to notice and explore exhibits. In a more conventional setting, Hassinger-Das et al. (2018) used cleverly designed signage in local supermarkets to encourage conversations between children and caregivers in low socio-economic neighborhoods. The signs included questions like, "Where does the milk come from?" or "What's your favorite vegetable?" This intervention resulted in a notable increase in caregiver-child language interactions, with adults using more descriptive language and children asking significantly more questions. These findings demonstrate that learning environments intentionally designed to provoke attention encourage learners to notice purposeful objects and ponder curious ideas.

Conclusions

Learning flourishes when places spark noticing, wonder and exploration. Drawn from a range of disciplinary studies, this paper offers several key design qualities of spaces, objects and materials that create the psychological conditions for curiosity. It is ignited through encountering surprising and novel elements in our environments. Unexpected colors, objects, sounds or other sensations interrupt our experience, inviting us to pause and consider the unfamiliar and ambiguous. Juxtaposing and contrasting sensations further highlight differences for investigation. Unfinished objects and open-ended materials invite learners to play, create and investigate with few limits. Places that support curiosity present rich layers of multi-sensorial experiences, including touch, smell, movement, and sounds. And the environment is designed to assist learners in focusing their attention through subtle attentional nudges to explicit written provocations. In sum, these qualities of places create the conditions for curiosity to flourish.

Of course, there are many caveats as we adapt these qualities to the design of learning places. Not all places are places for curiosity. Sometimes we want learners to move efficiently between locations or not linger to examine and explore their experience. Although the logistics of schooling may require some efficiencies, an overall plan should never compromise on creating opportunities for curiosity. However, research strongly suggests a balance of sensory stimulation to ensure an appropriate to the learners and one's goals. When designing spaces, objects, and materials for learning, it is critical to first understand learners' needs and pedagogical goals. Then, with this knowledge, one can aim to design optimal levels of stimuli that support learners and their learning experiences.

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