Indiana State Board of Education
April 12, 2023

Defining Healthy School Facilities

Dr. Erika Eitland | Co-Director Human Experience Lab

Perkins&Will

Agenda

The Power of Hoosier School Buildings

Ingredients of a Healthy Building

What Gets Measured Gets Done

Every Space is a Healthy Space

→

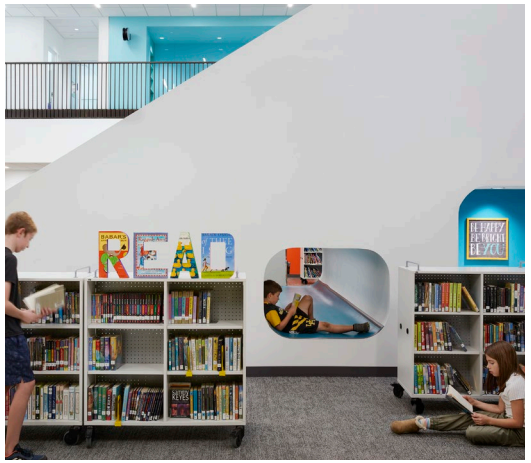
Crow Island Elementary School

1st Modern School Building U.S. in 1940

Legacy of Design
2,600+ School Projects Designed
760,000+ Students Served

Ballou High School

Washington D.C.



Windermere Elementary

Upper Arlington, OH

Morrow High School

Ellenwood, GA

Central Middle School

Columbus, IN

The Power of Hoosier School Buildings

1.2 million students

2,200 Indiana schools

21% of students are chronically absent

47 million breakfasts served AY19-20

18,252 public school children are homeless AY18-19

Children are not little adults

Physiology
Behavior
Efficacy
Growth

Perkins&Will

“The evidence is clear. No matter how good the curriculum, the teachers or administrators, we can’t achieve world-class education with crumbling school facilities.”

Mary Filardo, 2021 State of Our Schools

SCHOOLS FOR HEALTH

FOUNDATIONS FOR STUDENT SUCCESS

HOW SCHOOL BUILDINGS INFLUENCE
STUDENT HEALTH, THINKING AND PERFORMANCE

HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH
Center for Health and the Global Environment

FOR HEALTH
forhealth.org

Biophilic Design

Carbon dioxide

Radon

PCBs

Ergonomics

Glare

Humidity

Belonging

Flicker

Active Design

Temperature

Reverberation

Mold

Aircraft noise

Asbestos

Lead

Allergens

Inclusion

Mercury

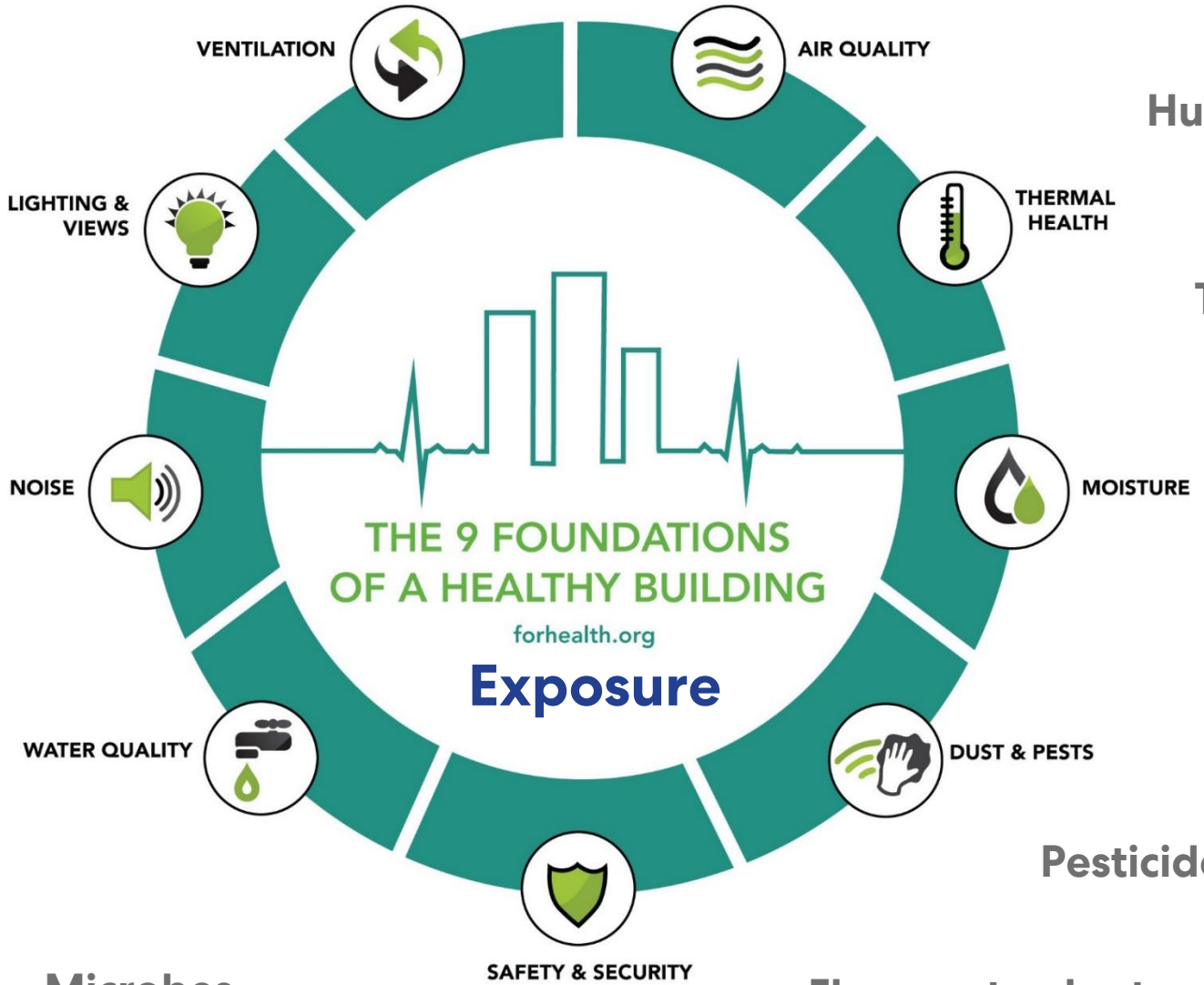
Pesticides

Accessibility

Microbes

Flame retardants

Siting

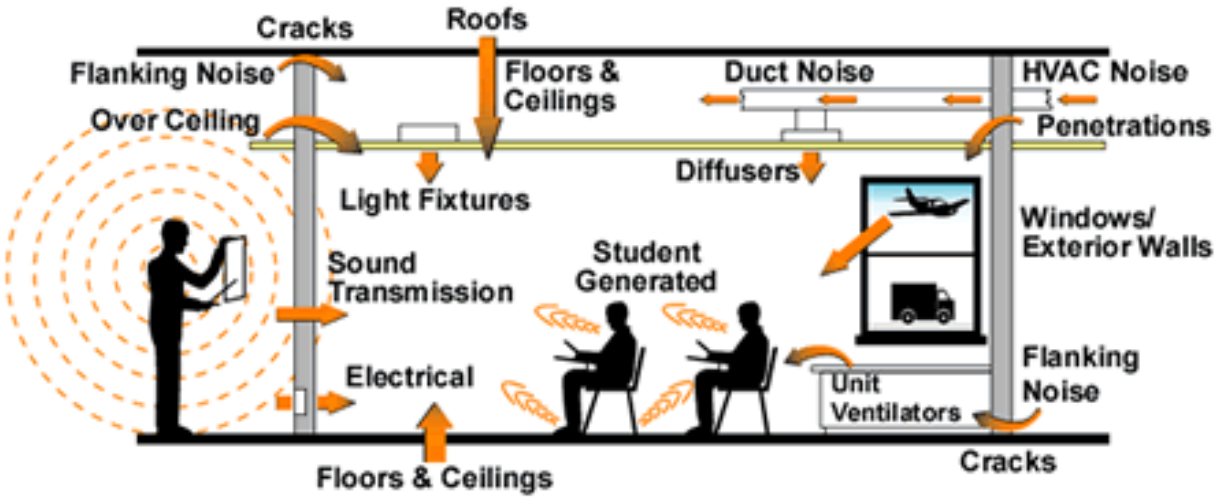


School Buildings: The Foundation for Student Health and Success

Scientific Research Provides Evidence for the Following Relationships				
9 Foundations		Student Health	Student Thinking	Student Performance
Ventilation: Low ventilation rates	was associated with…	↑ nasal patency ↑ communicable disease transmission ↑ asthma ↑ fatigue	↓ cognitive function ↓ attention span ↓ concentration ↓ focus	↓ test scores
Air Quality: High indoor carbon dioxide & volatile organic compounds		↑ allergies ↑ asthma ↑ eye, throat & nose irritation		
Thermal Health: High indoor classroom temperature		↓ respiratory health ↓ self-reported comfort	↓ memory ↓ response time ↓ concentration	
Moisture: Presence of indoor dampness and mold		↑ headache ↑ dizziness ↓ respiratory health ↑ eye, throat & nose irritation ↑ fatigue	↓ comprehension ↓ concentration	
Noise: High indoor and outdoor noise levels		↑ stress & hormone response ↑ fatigue ↓ cardiovascular health	↓ memory ↓ comprehension ↓ concentration ↓ hearing	
Safety & Security: High perceived threat to safety		↑ stress & hormone response ↓ mental health ↓ physical activity ↓ sleep	↑ self-report anxiety & stress	
Lighting & Views: Reduced glare & flicker; proper illuminance & color temperature		↑ mental health ↓ physical activity ↑ vision	↑ alertness ↑ concentration ↑ focus	↑ test scores
Dusts & Pests: Presence of cockroach allergen		↓ sleep ↓ respiratory health ↑ asthma		↓ attendance
Water Quality: Lead levels exceeding EPA standards		↑ bone growth & development ↑ risk of anemia ↑ abdominal pain ↑ cramping ↑ high blood pressure ↑ nausea	↑ irritability ↑ ADHD ↑ hearing loss ↑ behavioral problems ↓ attention span ↓ cognitive function	↓ IQ

Researchers observed a 5% decrement in “power of attention” in poorly ventilated classrooms, **roughly equivalent to the impact that a student might feel from skipping breakfast** (Coley et al., 2007).

Acoustics
Sources of Background Noise

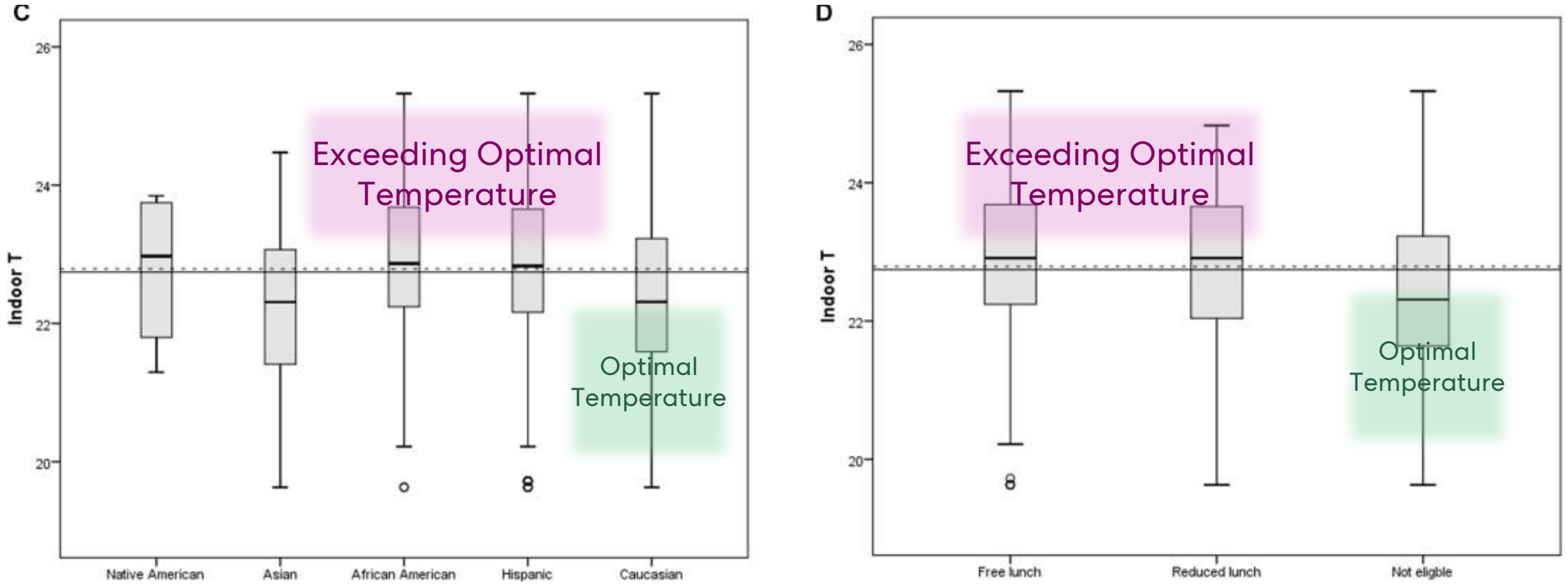


20% increase in English as a new language students in IPS (6,000 kids)

"Language justice is the "practice of ensuring people can communicate effectively, understand information, and be understood using the language in which they feel most comfortable".

– IPS BYLAWS & POLICIES, Language Access/Language Justice BP2173

African American and Hispanic students, as well as free lunch eligible were exposed to higher temperatures



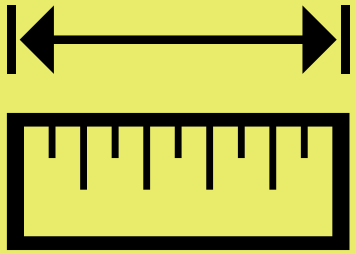
Haverinen-Shaughnessy, U., & Shaughnessy, R. J. (2015). Effects of Classroom Ventilation Rate and Temperature on Students' Test Scores. PloS one, 10(8), e0136165.

What can we do?

CHPS for healthier K-12 schools

- II C8.1 Biophilic & Responsive Design
- EQ C2.1 Pollutant & Chemical Source Control
- EQ C14.1 Electric Lighting Performance & Circadian Lighting
- EQ C15.1 Enhanced Acoustical Performance
- OM C5.1 Indoor Environmental Management

What gets measured gets done.



THE 192ND GENERAL COURT OF THE
COMMONWEALTH OF MASSACHUSETTS

Bills & Laws | Budget | Legislators | Hearings & Events | Committee

Session Laws » Acts (2022) »

CHAPTER 179

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AN ACT DRIVING CLEAN ENERGY AND OFFSHORE WIND

Whereas, The deferred operation of this act would tend to defeat its purpose, which is to authorize forthwith the advancement of offshore wind and clean energy in the commonwealth, therefore it is hereby declared to be an emergency law, necessary for the immediate preservation of the public convenience.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. Chapter 6C of the General Laws is hereby amended by adding the following section:-

Section 78. The department shall create an anonymized and aggregated database of motor vehicle types and locations. In so doing, the department shall consult with at least 1 member organization of the Massachusetts Association of Regional Planning Agencies and with the department of energy resources. The

Bill Drafted

Consortium of advocates

Engaged the willing and integrated into this bill

Published white paper to implement it

AIA Massachusetts

SECTION 83. (a) The Massachusetts School Building Authority shall conduct an assessment of elementary and secondary school buildings relative to energy efficiency, building conditions, safety, and public health. The assessment shall include cataloging the age and condition of any building systems relying on the on-site combustion of fossil fuels. The assessment shall be conducted in coordination with ongoing assessments or surveys of the authority. The authority shall determine the means of conducting the assessment which may include a representative sample of schools. In planning said assessment, the authority shall consult with the department of public health, the department of elementary and secondary education and the department of energy resources.

Following completion of the assessment, the department of public health, in consultation with the Massachusetts School Building Authority, the department of elementary and secondary education, and the department of energy resources, shall develop, and report on, methods, best practices, and standards for achieving green and healthy schools strategies to for the students of the commonwealth. Methods, best practices, and standards may involve, but shall not be limited to: (i) increasing energy efficiency, increasing electrification, and shifting to fossil-free fuels; (ii) efficiently using resources, including, but not limited to, low flow water fixtures; (iii) improving water and air quality, ventilation, and air circulation systems; (iv) maintaining thermal comfort, humidity, and temperature controls; and (v) taking other actions the department may determine.

The department of public health shall issue a report on the methods, best practices and standards and may include recommendations to prioritize schools with the greatest needs, consider the unique environmental differences of schools located in urban, industrial, rural and other areas facing site challenges, and consider the need to address historic patterns of inequity in education and schools including, but not limited to, patterns of inequity involving students in special education programs. The report shall include a projected cost estimates for implementing its recommendations in a cost-effective manner.

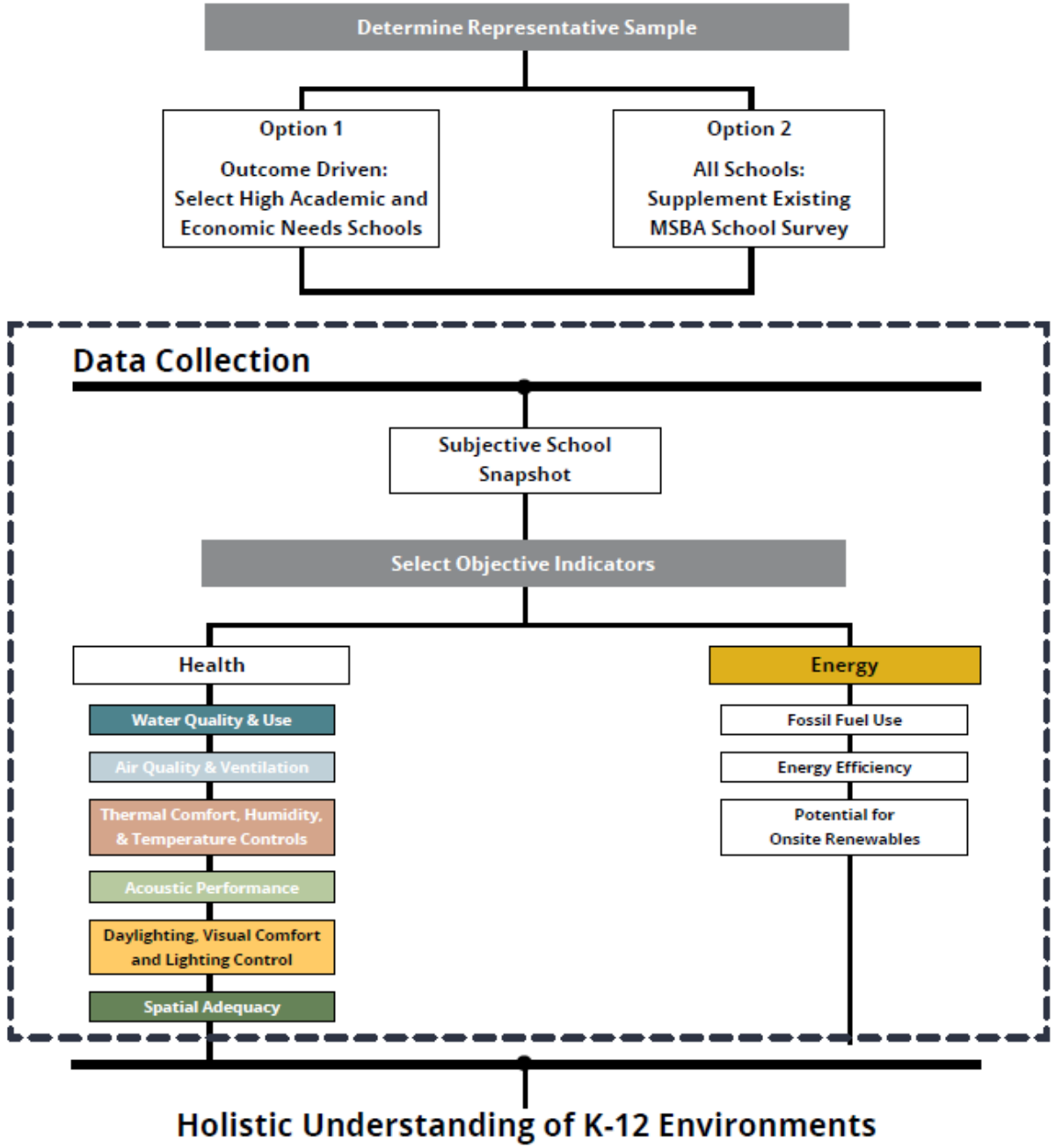
Diagnose

Coordinate Solutions

Prioritize Equity

Measuring Energy & Health in Existing Massachusetts Schools

Recommendations for Implementation of Section 83 of Chapter 179 of the Acts of 2022



Start with a walk through checklist...

	IN YOUR SCHOOL OR CLASSROOM...		INTERPRETATION
Water	**Lead/Copper in Drinking Water:** Was the plumbing system replaced after 1991?	O Yes O No	No, your plumbing system likely has elevated lead levels because it predates EPA's Lead and Copper Rule. Get water tested.
Water	**Low flow water fixtures:** Are there low flow water fixtures present throughout the building (e.g., toilets, faucets, or showers)?	O Yes O No	No, count the number of high flow fixtures to identify water conservation opportunities.
Water	**Presence of Mold or Mold Odor:** Can you see or smell mold or musty smell?	O Yes O No	Yes, even without visible signs of mold, smell can indicate hidden mold, a known trigger of asthma.
Acoustics	**Background Noise:** Do you hear clear disruption from adjacent classroom's activities? Do you see an interconnecting door or movable wall, unit ventilator, central HVAC air system, corridor plenum or duct work?	X Yes O No	If yes, there is likely increased sound transmission and opportunities to improve acoustical performance.
Acoustics	Have **acoustical finishes** have been painted?	O Yes X No	Painting and non-porous coverings reduce the acoustical effectiveness of ceiling tiles.

	IN YOUR SCHOOL OR CLASSROOM...		INTERPRETATION
g Control	**Views**: Are there views to the outdoors available to room occupants?	O Yes O No	No, views and access to nature are associated with better student satisfaction and comfort. Consider strategies to improve access to views or biophilic design.
g Control	**Pattern, Orientation & Condition:** Do you notice stark unevenness in lighting, glare, inadequate distribution, hum, flicker, or other light concerns?	O Yes O No	Yes, uneven, flickering light can lead to headaches. Consider age of lighting system and available improvements for energy efficiency and controllability.
g Control	**Visual assessment of windows:** Are they single-	O Yes	No, older windows may include legacy pollutants (e.g.
Spa	**or uneven surfaces** within the school?	O No	especially for individuals with mobility impairments. Unsafe environments may require repairs.
Energy	•Is there a lack of consistent and reliable heat in occupied spaces? •Is there a history of temperature fluctuations or uneven distribution? •Is there localized control (within a range of 8 degrees or less) of the temperature?	O Yes O No	Yes, additional energy analysis is required.

Dive deeper with objective measures...

Potential Metrics for

School Acoustic Performance

Students spend a large percentage of time focused on listening, especially early in their educational process. Children are still developing mature language skills and have poorer speech perception than young adults. Background noise can interfere with concentration, learning, comprehension, and memory. Many learners may also have undiagnosed hearing disabilities, second language learning challenges or attention deficit issues that make learning in acoustically busy spaces more difficult. Therefore, other sound considerations should include reverberation, echogenicity, and the duration or number of times loud noise levels occur. Chronic outdoor noise, such as road and aircraft noise, can also impede learning and can trigger cardiovascular health issues and vocal strain in both students and staff. Achieving modern acoustic standards (ANSI 12.60) is difficult in older buildings. The age of the building, building envelope, and HVAC system can identify common acoustic problems.

The American Speech-Language-Hearing Association (ASHA) provides resources tailored for school buildings and students.

MSBA 2016 School Survey Collected the Following Variables:

- **No metrics relevant** in 2016 School Survey

This category was not identified as a health indicator in Section 83 of Chapter 179 of the Acts of 2022. However, these environmental parameters are a part of a healthy school facility and may influence energy use or interact with other health indicators including indoor air quality and thermal comfort.

● Easy ▲ Medium ■ Difficult

OCCUPANCY STATUS	METRIC	RATIONALE
Occupied/ Unoccupied	**Background Noise** ▲ • Decibel measurements of an unoccupied, space where the worst-case receiver is located (e.g. by the window unit, collect 30 seconds uninterrupted).	Evening data collection allows for accurate background noise measurements because the space is unoccupied and can measure noise or sound from mechanical systems. Make sure HVAC is on or air conditioning if samples are collected during the winter.
Occupied/ Unoccupied	**Area of acoustical absorption** ● • Measure Classroom Acoustical Ceiling Tile (ACT) or Acoustical Ceiling Panel (ACP) Area relative to room area • Visual counting of acoustical finishes in percentage of surface area to total ceiling area (acoustical ceiling panel area / total ceiling surface area inclusive of lights and soffits).	This observational assessment of classroom acoustics helps to determine whether the room is reducing reverberation and activity noise build up to appropriate levels. (ANSI S12.60) While not all acoustic tiles have the same Noise Reduction Coefficient, 80% of the ceiling surface area should be made up of sound absorptive acoustical panels. Different standards apply to specialized classrooms including Language Arts, Music, and Special Education classrooms.
Unoccupied	**Sound transmission between floors, windows, and walls** ▲ • Impact sound transmission floor to floor • Impact sound transmission (metered/two-person process) • Laterally (metered/two-person process)	This indoor measurement captures sources of noise that may disrupt a student's ability to hear, especially when mastering language skills. Measuring sound transmission helps understand acoustical privacy, disruption from surrounding environments, and exposure to common daily outdoor noises (e.g., traffic, aircraft noise). Collecting the measurements during the school day can capture the lived experience. This is interior-source background noise.
Occupied/ Unoccupied	**Sound Leakage** ● • Observation of ceiling cavity and doorways for light leaks between wall, ceiling, gasketing, floor seal. Are there interconnecting doors or operable partitions? • Sound transmission at windows and doors, directly measurable with a sound level meter. • Visual assessment of windows: Are they single-paned? Well-sealed?	Sound can be transmitted between spaces in the building or from outdoors into occupied spaces. Visual observations highlight opportunities for improving the sound isolation within the building. These metrics also relate to air sealing and energy savings
N/A	**Outdoor Sources of Noise** ● • Map proximity to major roadways, highways, airports, or other high impact sources. • Measure the shortest distance between the school campus and the source.	This objective site analysis does not capture the experience inside the classroom but identifies a well-studied source of noise that impacts academic performance. This information can be collected in advance of a site visit.

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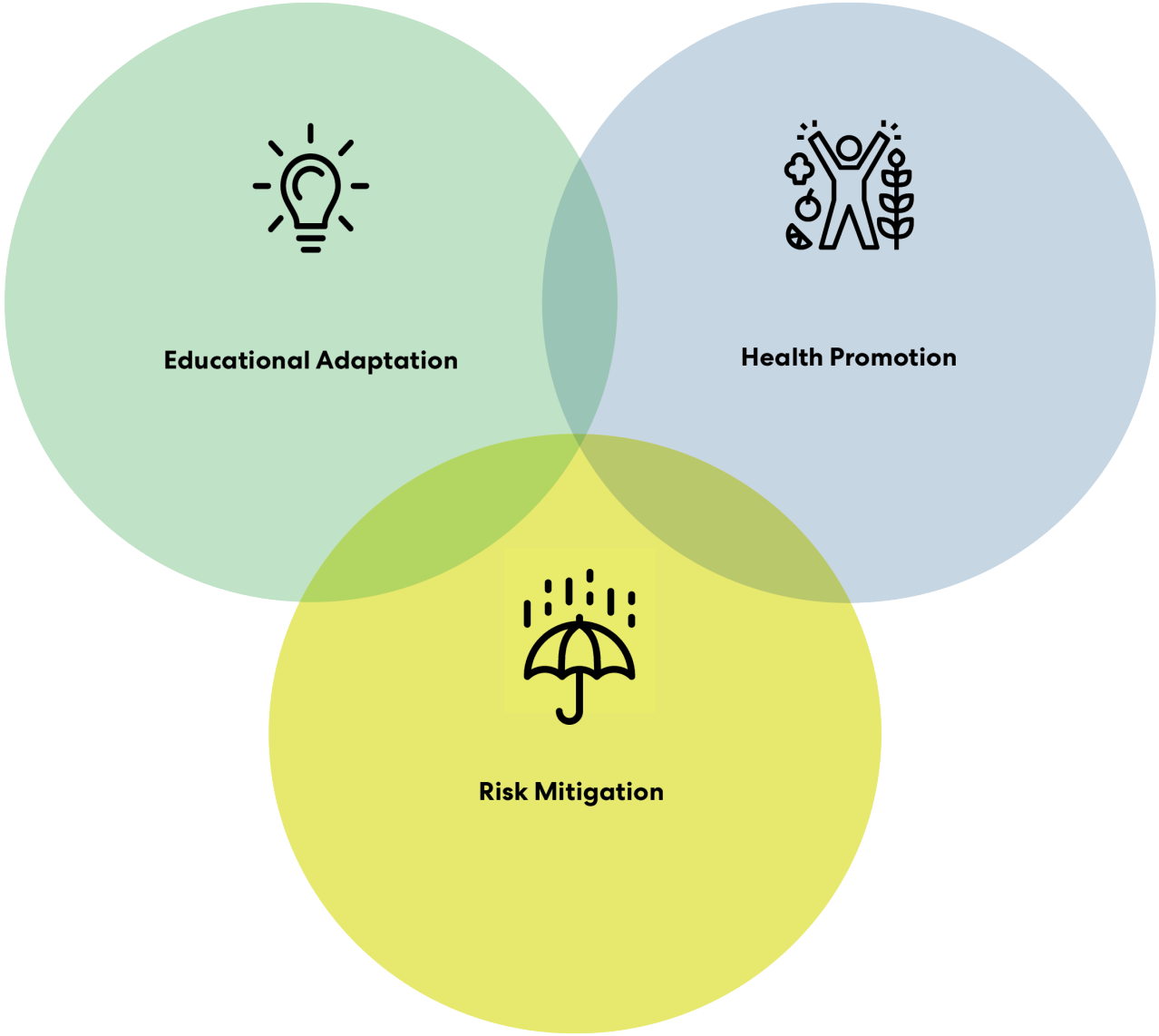
Promote well-being without compromising students' learning potential.



Navigating unprecedented change requires holistic thinking.

Educational Adaptation

Strategies that support flexibility in behavior, logistics, and technology during shifting teaching needs.

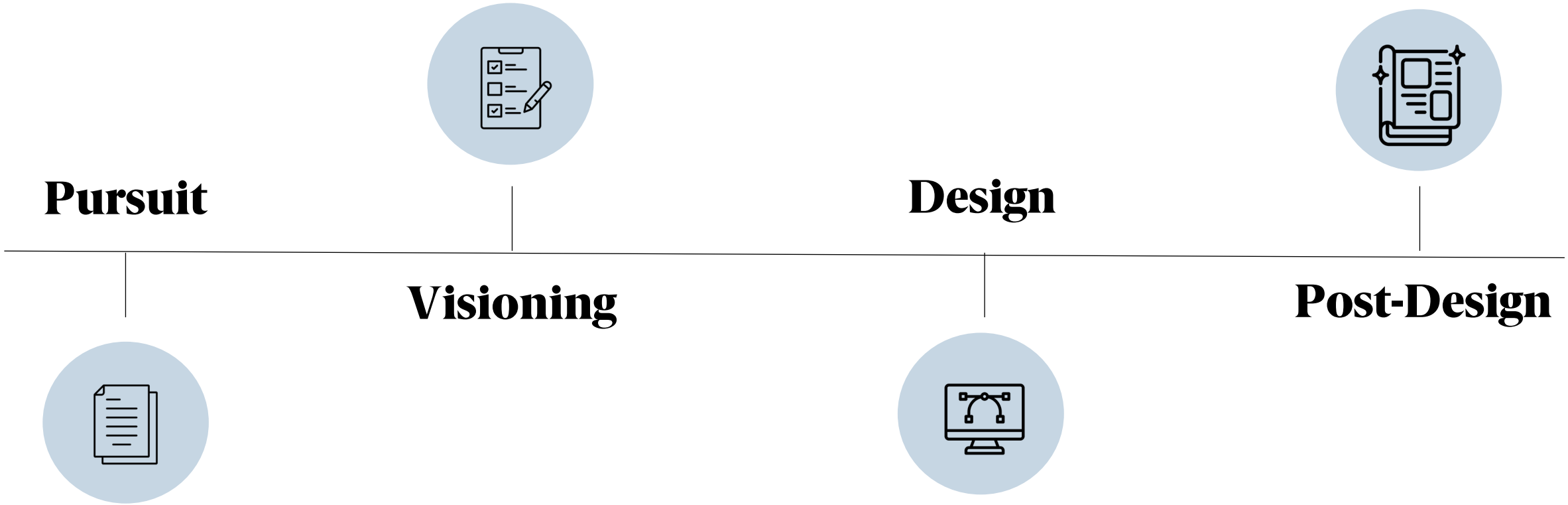
Health Promotion

Strategies that promote physical and mental health, social cohesion, and a sense of belonging and safety.

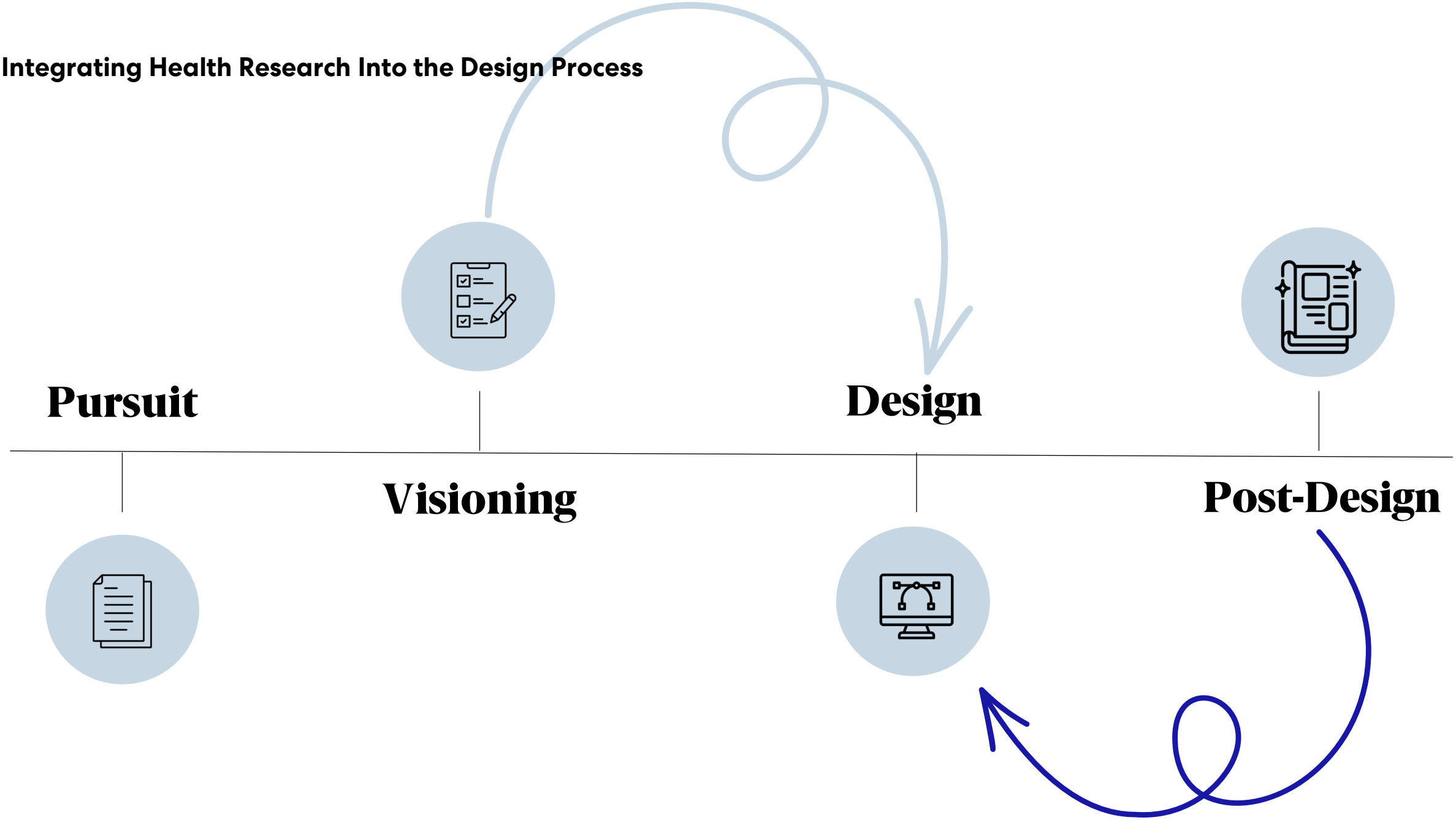
Risk Mitigation

Strategies for reducing adverse environmental exposures that influence school occupant health and performance.

Integrating Health Research Into the Design Process



Integrating Health Research Into the Design Process



Research in Action

Hi, I'm Riley.

Follow along as we make sure that the spaces I occupy every day are safe and healthy.

Circulation Space

Materials

Cafeteria

Restroom

Building Systems

Entry and Exit

Library

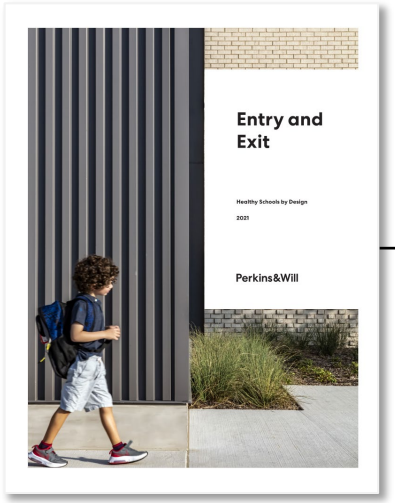
Gymnasium

Outdoor Siting

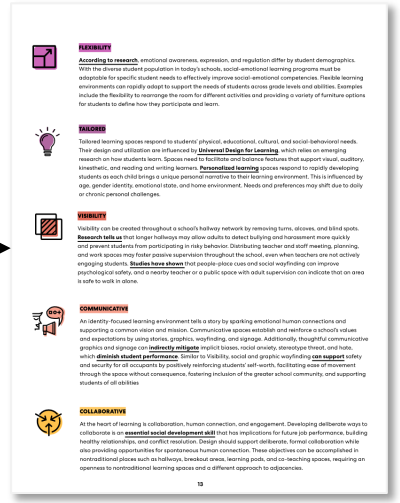
Classroom

Nurse

Document Structure

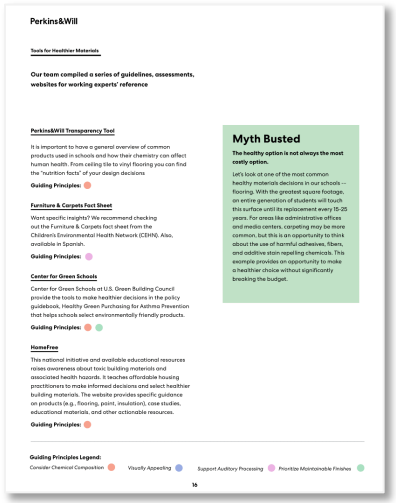


White Paper

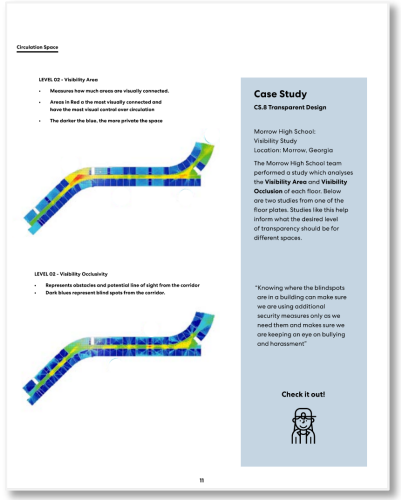


Literature Review

Strategies Checklist



Tools & Resources



Case Studies & Design Hypotheses

Schools are uniquely positioned to identify and mitigate daily mental health issues and offer support.

← Holy Innocents' Episcopal School, Upper School Humanities Building

FLEXIBILITY

According to research, emotional awareness, expression, and regulation differ by student demographics. With the diverse student population in today's schools, social-emotional learning programs must be adaptable for specific student needs to effectively improve social-emotional competencies. Flexible learning environments can rapidly adapt to support the needs of students across grade levels and abilities. Examples include the flexibility to rearrange the room for different activities and providing a variety of furniture options for students to define how they participate and learn.

TAILORED

Tailored learning spaces respond to students' physical, educational, cultural, and social-behavioral needs. Their design and utilization are influenced by Universal Design for Learning, which relies on emerging research on how students learn. Spaces need to facilitate and balance features that support visual, auditory, kinesthetic, and reading and writing learners. Personalized learning spaces respond to rapidly developing students as each child brings a unique personal narrative to their learning environment. This is influenced by age, gender identity, emotional state, and home environment. Needs and preferences may shift due to daily or chronic personal challenges.

VISIBILITY

Visibility can be created throughout a school's hallway network by removing turns, alcoves, and blind spots. Research tells us that longer hallways may allow adults to detect bullying and harassment more quickly and prevent students from participating in risky behavior. Distributing teacher and staff meeting, planning, and work spaces may foster passive supervision throughout the school, even when teachers are not actively engaging students. Studies have shown that people-place cues and social wayfinding can improve psychological safety, and a nearby teacher or a public space with adult supervision can indicate that an area is safe to walk in alone.

COMMUNICATIVE

An identity-focused learning environment tells a story by sparking emotional human connections and supporting a common vision and mission. Communicative spaces establish and reinforce a school's values and expectations by using stories, graphics, wayfinding, and signage. Additionally, thoughtful communicative graphics and signage can indirectly mitigate implicit biases, racial anxiety, stereotype threat, and hate, which diminish student performance. Similar to Visibility, social and graphic wayfinding can support safety and security for all occupants by positively reinforcing students' self-worth, facilitating ease of movement through the space without consequence, fostering inclusion of the greater school community, and supporting students of all abilities

COLLABORATIVE

At the heart of learning is collaboration, human connection, and engagement. Developing deliberate ways to collaborate is an essential social development skill that has implications for future job performance, building healthy relationships, and conflict resolution. Design should support deliberate, formal collaboration while also providing opportunities for spontaneous human connection. These objectives can be accomplished in nontraditional places such as hallways, breakout areas, learning pods, and co-teaching spaces, requiring an openness to nontraditional learning spaces and a different approach to adjacencies.

→

Classrooms

Strategies and Considerations

Strategies — Guiding Principles Legend:

Flexibility *Tailored* *Visibility* *Communicative* *Collaborative*

Natural Lighting *Thermal Comfort* *Acoustics* *Indoor Air Quality* *Nature*

	STRATEGY	CATEGORY	NEW/EXISTING	IN YOUR SCHOOL?
C.1	**Zone classrooms** to include quiet areas or zones (nooks, pods, coves, etc.) for heads-down work and larger spaces for collaboration and group learning.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.2	Include large and small **collaborative areas** adjacent to classrooms that create opportunities for interactions between classes for community building.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.3	**Increase visibility by using transparent solutions** including strategic glazing and adjacencies to optimize learning and enhance collaboration.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.4	Promote **diversity of teaching methods** by offering teachers and students flexibility by including features such as garage doors, moveable furniture, dual purpose walls (writable/projectable), and modular walls that create a variety of space types.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.5	**Provide classroom technology to increase continual learning opportunities:** 360-degree cameras, microphones, multiple fixed and portable screens, and amplified acoustical systems so students can participate in-person or remotely.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.6	**Extend technology and internet** to allow for maximum flexibility, including outdoor learning spaces.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.7	Provide **desks, storage cubbies, or lockers with charging ports or include additional outlets**, as individualized technology increases the need for power for each student.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.8	Provide **flexible, mobile, in-class storage** to reduce physical and visual clutter, increase ease of cleaning, and promote focus.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.9	Provide **alternative furniture** (such as adjustable height desks and rocking chairs/ottomans). Studies show improvements in physical activity and attention for elementary students when a variety of options are provided.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.10	**Cohesive and strategically located wayfinding graphics** and colors foster a welcoming, accessible learning environment.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable

	STRATEGY	CATEGORY	NEW/EXISTING	IN YOUR SCHOOL?
C.11	**Offer direct and indirect access to the outdoors** through windows with views of nature and access to outdoors for nature-based learning opportunities.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.12	**Optimize daylight for student alertness and to help regulate circadian rhythm.** Orient the building on an Easy-West axis to maximize sunlight while optimizing thermal and lighting needs.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.13	**Incorporate operable windows** for greater thermal control, psychological comfort, and increased natural ventilation during power outages.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.14	**Use enhanced daylighting strategies** (including light shelves, high reflective surfaces, skylights, etc.) to bring sunlight deeper into the space, while preventing increased solar radiation and glare.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.15	**Place main return and supply mechanical systems in the corridor** to serve each classroom independently to limit sound transfer from one room to another.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.16	**Design and/or provide classroom temperatures between 68F - 74°F** to support student performance and comfort.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.17	**Provide environmental control for teachers and staff** (e.g daylighting, temperature, etc.) by including dimmable lights, occupancy sensors, daylight and air quality sensors, window blinds, and classroom-specific thermostats.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.18	**Enhance acoustical performance** by increasing ceiling absorption (> .90 NRC), selecting flooring materials that dampen noise, and using sound absorption on strategic walls and at specific heights.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.19	**Educate teachers** about lighting and mechanical air filtration systems so they use the systems efficiently and effectively.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.20	**Replace dust-generating chalkboards** with whiteboards or screens to reduce damage to technology and improve indoor air quality.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable
C.21	Special attention should be paid to the classroom's **acoustics, lighting, tactility, and off-gassing odors** to support multisensory learning.	Risk Mitigation Health Promotion Educational Adaptation	New Construction Existing Building	O Yes O No O Not Applicable

Our aim is to support holistically healthy buildings, but we understand that each learning community is unique and has their own health priorities. Use these strategies as a starting point!

Strategies — Guiding Principles Legend:

Flexibility *Tailored* *Visibility* *Communicative* *Collaborative*

Natural Lighting *Thermal Comfort* *Acoustics* *Indoor Air Quality* *Nature*

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C.1	**Zone classrooms** to include quiet areas or zones (nooks, pods, coves, etc.) for heads-down work and larger spaces for collaboration and group learning.	Risk Mitigation **Health Promotion** **Educational Adaptation**	**New Construction** **Existing Building**	○ **Yes** ○ **No** ○ **Not Applicable**
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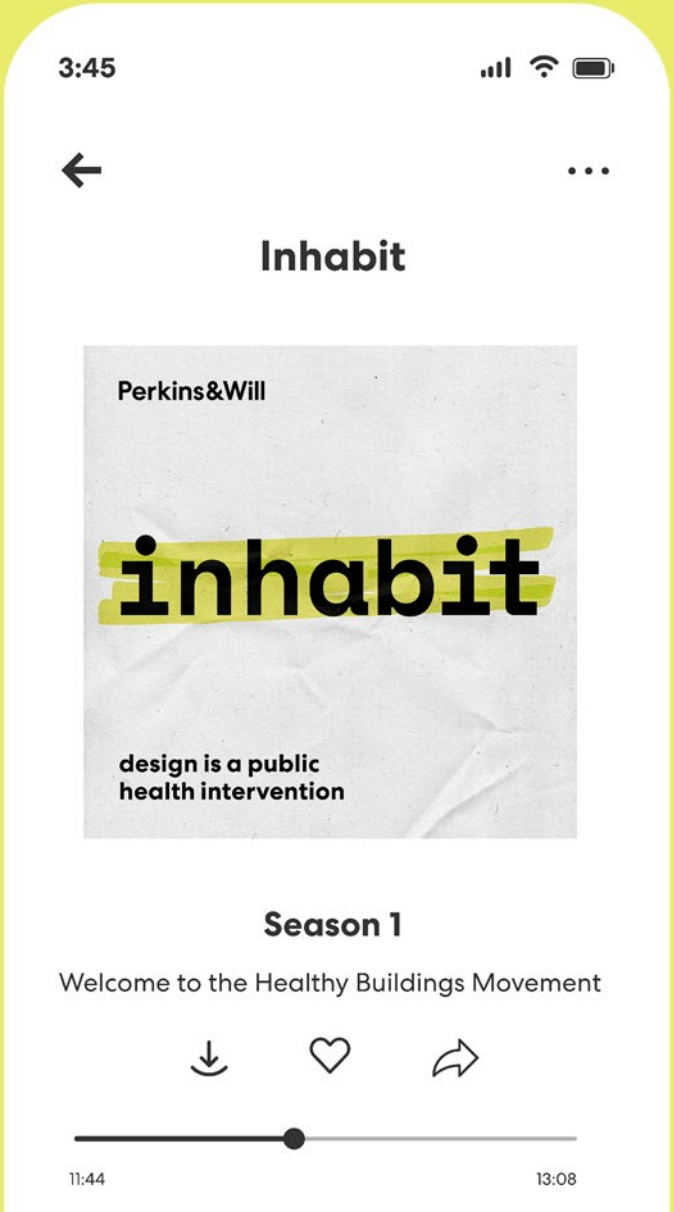
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Inhabit
Perkins&Will
inhabit
design is a public
health intervention
Season 1
Welcome to the Healthy Buildings Movement
11:44
13:08


inhabit
“What we do in our schools is magic. It should happen in temples. It should happen in palaces.”
— Tracy Washington Enger
U.S. Environmental Protection Agency

Thank you!

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